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Visual modulation of pleasure in subjects with physical and social anhedonia

Gwladys Rey [a,*], Kenneth Knoblauch [b], Marie Prévost [a], Odile Komano [a], Roland Jouvent [a], Stéphanie Dubal [a]

[a] CNRS - UPMC UMR 7593, Emotion Center, IFR Neurosciences, Paris, France
[b] INSERM, U846, Stem Cell and Brain Research Institute, Bron, France

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ABSTRACT

Anhedonia is a personality trait associated with a decrease in the ability to feel pleasure. We investigated the experience of pleasure in individuals with physical and social anhedonia for positive pictures with varying levels of luminance contrast. Photographs with either a sensory or a social content were modified with a contrast-gradation procedure. Participants had to report the intensity of the pleasure they experienced in response to these pictures. Twenty-six subjects with physical anhedonia, 18 with social anhedonia and 34 control subjects completed the task. In controls, high-contrast pictures elicited an intense feeling of pleasure, whereas low contrast pictures elicited little pleasure. Although they were also sensitive to the modulation of contrast, subjects with physical and social anhedonia reported less pleasure than controls, across a larger range of contrast levels for sensory and social pictures, respectively. The findings suggest that the deficit in the experience of positive emotion in anhedonia is associated with a diminished pleasure intensity, fairly selective for the sensory or the social emotion dimension. This study encourages further investigation of the interaction between perceptual encoding and emotional processing in anhedonia.

1. Introduction

Following Meehl's descriptions of the schizotype as both lacking pleasure from social interaction and having weakened feelings of joy, affection, love, pride, and self-respect (1962), Chapman et al. operationalized these clinical observations by the psychometric measure of physical and social anhedonia (Chapman et al., 1976). The Physical Anhedonia Scale (PAS) and the Social Anhedonia Scale (SAS) have been used to identify individuals putatively at risk for psychosis. These subjects have different personality profiles, with high SAS scorers having more schizophrenia spectrum symptoms than individuals with high PAS scores (Chapman et al., 1994; Kwapil, 1998).

The present work is aimed at studying the feeling of pleasure in individuals with physical or social anhedonia. Emotional processes in high PAS or high SAS subjects have been studied using emotion-eliciting stimuli. When subjects with physical anhedonia are asked to rate their feeling on an unpleasant–pleasant axis, they report less positive ratings than controls, in response to positive slides (Fitzgibbons and Simons, 1992; Ferguson and Katkin, 1996) or during imagery of positive emotional scripts (Fiorito and Simons, 1994). However, this was not found in other studies using slides (Germans and Kring, 2000) or film clips (Berenbaum et al., 1987). Researchers have used physiological measures to study state-activation elicited through perception. Although subjective ratings of state-activation in subjects with physical anhedonia are mixed (Fitzgibbons and Simons, 1992; Fiorito and Simons, 1994; Germans and Kring, 2000; Mathews and Barch, 2006), these subjects were found to display abnormal skin conductance responses (Simons, 1981; Bernstein, and Riedel, 1987; but see Fiorito and Simons, 1994), fewer changes in heart rate response when processing emotional stimuli (Simons et al., 1982; Fitzgibbons and Simons, 1992; Fiorito and Simons, 1994; Ferguson and Katkin, 1996) and abnormal affective startle eyeblink modulation (Roedema and Simons, 1994; Allen et al., 1995; but see Simons and Giardina, 1992). Furthermore, subjects with physical anhedonia did not have a larger P3 component of the event-related potential in response to cues predicting the presentation of arousing stimuli than in response to cues predicting non-arousing stimuli (Simons, 1982; Miller et al., 1984; Pierson et al., 1987). Despite some inconsistencies, subjective and physiological findings provided by direct confrontation with emotional stimuli evoke a general pattern of emotional hyporesponsiveness in subjects with high levels of physical anhedonia. There is no behavioral evidence for this in subjects with social anhedonia. Subjects with social anhedonia have not been found to differ from controls in terms of emotional modulation of the startle reflex (Gooding et al., 2002). However, these subjects reported lower scores on the Positive And Negative Affect Schedule (Gooding et al., 2002), and differential emotional processing is apparent through their atypical perceptual biases in response to emotion chimera (Luh and Gooding, 1999), as well as abnormal performances in word pronunciation (Kerns and Berenbaum, 2000) or emotion working memory tasks (Gooding and Tallent, 2003).

* Corresponding author. CNRS - UPMC UMR 7593, Centre Emotion, Pavillon Clérambault, 47 boulevard de l'hôpital, CHU Pitié-Salpêtrière, 75651 Paris cedex 13, France. Tel.: +33 173 749 567; fax: +33 153 790 770.
E-mail address: gwladys.rey@upmc.fr (G. Rey).

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In the present article, we address the issue of the subjective intensity of pleasure felt by subjects with anhedonia when presented with positive pictures. The study was designed with the following two main purposes: (1) assessing the modulation of the intensity of pleasure in varying perceptual conditions; (2) comparing subjects with physical anhedonia with social anhedonia, whose differences in terms of emotional processing have received little study. Our paradigm is based on the modulation of a physical attribute of pictures with positive content. Affective properties of a visual scene are thought to be related to the amount of interpretable information that it contains (Biederman and Vessel, 2006) and are conveyed by physical stimulus characteristics (color, spatial frequency, local/global features) (e.g. Schupp et al., 2008). We used the attenuation of the luminance contrast of photographs as a procedure for degrading the perceptual content. In an affective judgment task, positive pictures with either a sensory or a social content were displayed at five different contrast levels. Contrast was attenuated until 20% of its initial value, a level that should not be weak enough to interfere with the identification of the content, according to recognition studies of natural scenes (Avidan et al., 2002; Mace et al., 2005). French participants, selected for their high scores for physical or social anhedonia, had to rate their emotional experience facing each picture in terms of intensity of pleasure. Given the effect of contrast on perceptibility, we anticipated that affect intensity would linearly decrease with contrast attenuation. We tested whether, compared with control subjects, subjects with anhedonia would subjectively experience different levels of pleasure intensity as a function of contrast. In addition, given the personality differences between these subjects (Rey et al., 2009), we hypothesized that subjects with physical and social anhedonia would show a different pattern of affective ratings.

2. Methods

2.1. Selection procedure

We used True–False self-completed questionnaires to screen 1400 students from the Pierre et Marie Curie University, including the revised versions of the PAS and SAS (Chapman et al., 1976) and the Magical Ideation Scale (MIS; Eckblad and Chapman, 1983). The PAS includes 61 items dealing with defects in the sensory and esthetic pleasures of eating, touching, feeling, sex, temperature, movement, smell, sight and sound. The PAS includes items such as: “The beauty of sunsets is greatly overrated” (keyed true). The SAS consists of 40 items concerning asociality and indifference to others, assessed by measuring interpersonal pleasures. The SAS includes items such as: “I sometimes become deeply attached to people I spend a lot of time with” (keyed false). Higher total scores on these scales indicate a lower capacity to feel pleasure and, thus, greater anhedonia. Details regarding the psychometric properties of the French versions of the PAS and SAS can be found elsewhere (Loas and Boyer, 1994; Kosmadakis et al., 1995). Whereas the PAS and the SAS assess the negative dimension of schizotypy, the MIS relates to the positive dimension of schizotypy, with 30 items assessing belief in implausible or invalid causality, like: “Good luck charms don't work” (keyed false).

Three groups of subjects were studied: one group of subjects with physical anhedonia (PhysAnh), one group of subjects with social anhedonia (SocAnh), and one control group. Subjects with scores falling at least 1.96 standard deviations beyond the mean for their gender on the PAS or SAS were recruited as PhysAnh and SocAnh subjects, respectively. Subjects with social anhedonia often have elevated scores on the PAS around the threshold, making the selection of subjects with an isolated social anhedonia difficult. Therefore, we subjects included in the SocAnh group also often had high PAS scores. Subjects with scores up to 0.5 S.D. above the mean for their gender on the two anhedonia scales were selected as controls. The score on the MIS was not considered in the selection procedure, but was later used to compare the groups for positive schizotypy.

2.2. Participants groups

In total, 38 subjects with physical anhedonia, 31 with social anhedonia and 37 controls participated in this study. The participants completed the PAS and the SAS again, to check for score stability. Fifteen participants with anhedonia were excluded due to variation of anhedonia score between screening and recruitment, with the second score obtained not reaching the threshold for selection or scores displaying variation by more than 1 S.D. of the mean for the subject's gender for the initial screening.

In a clinical interview, participants were administered the Mini International Neuropsychiatric Interview (M.I.N.I.; Sheehan et al., 1997) to check for any current or past Axis I psychiatric diagnoses according to DSM-IV criteria for affective disorders (American Psychiatric Association, 1994) or a history of neurological illness. One control subject with a history of substance abuse and two on antidepressants were excluded from the analyses. Subjects meeting diagnostic criteria for current major depressive disorder (3 with physical anhedonia and 6 with social anhedonia) or psychotic disorder (1 with social anhedonia) were also excluded.

Fig. 1. Examples of pictures with sensory (upper part) and social (lower part) content.

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The participants completed the 13-item Beck Depression Inventory-Short Form (BDI-SF; Beck and Beamesderfer, 1974) and the 20-item State subscale of the State-Trait Anxiety Inventory (STAI; Spielberger, 1983). We used the Digit Symbol subtest of the Wechsler Adult Intelligence Scale-Revised (WAIS-R) (Wechsler, 1981) as an approximation of the Intellectual Quotient.

The final sample consisted of 26 PhysAnh subjects (16 women and 10 men), 18 SocAnh subjects (10 women and 8 men) and 34 controls (22 women and 12 men). All participants had normal or corrected-to-normal visual acuity and contrast sensitivity. Written informed consent was obtained from all participants, who were paid for taking part, and the experiment was approved by the local ethics committee.

2.3. Affective judgment task

Participants carried out an affective judgment task. Stimuli consisted of two sets of 10 black-and-white photographs of positive valence depicting landscapes, such as beaches, mountains, countryside and deserts, for the sensory pictures, and situations of interpersonal interaction with families, partners, friends or children, for the social pictures (see example in Fig. 1). Ten emotionally neutral photographs of everyday objects were also included. These pictures were selected from a photo database. The original color pictures included in the test had previously received valence and arousal ratings by 30 subjects on a four-level scale, from 1 (not at all) to 4 (high pleasure/arousal). Average ratings (valence; arousal) were as follows: for neutral pictures, 1.10 ± 1.38; 1.40 ± 0.84; for sensory pictures, 3.72 ± 0.70; 2.42 ± 1.17; and for social pictures, 3.17 ± 0.96; 2.74 ± 1.06. Valence ratings were higher for sensory than for social pictures, and both were higher than for neutral pictures. Arousal ratings for sensory and social pictures were similar and higher than for neutral pictures. Ratings of color and black-and-white versions by the same subjects were evaluated in a separate study (Dubal et al., 2004). Contrast of the 30 selected pictures was adjusted using Matlab 5.9 (The Mathworks Inc., Natick, MA), taking into account the luminance calibration of the display and its gamma-correction: each black-and-white picture was presented at each of the following five different contrast levels: 100, 80, 60, 40 and 20% of the initial contrast (Fig. 2). The 150 stimuli were randomly presented at the center of a computer screen (visual angle 20° horizontally and 13° vertically), on a gray background, for 5 s, with pictures separated by an interstimulus interval (gray screen) of between 0 and 1 s. Subjects received the instruction to rate how much they feel pleasure from on a four-level scale, from "Not at all" to "Very Much", by pressing one of four horizontally aligned keys on the computer keyboard (inverted order for half of the subjects). They were asked to respond spontaneously and were told that the picture would automatically disappear after 5 s. The test lasted 15 min.

3. Results

3.1. Clinical results

The groups did not differ in age, $F(2,75) = 1.7$, P = ns (mean age: 19.47 ± 1.49), or performance in the WAIS Digit Symbol copy task, $F(2,75) = 0.1$, P = ns. PAS and SAS scores between screening and recruitment were reliable in the selected sample ($r = 0.88$ and $r = 0.80$, respectively, Ps < 0.0001). Subsequent analyses were based on the scores obtained during testing. Table 1 provides the mean scores on each of the scales for the subject groups, as well as results of score analyses with analysis of variance (ANOVA) and planned comparisons. No effect of gender or interaction between gender and group was observed.

3.2. Affect intensity ratings

Mean ratings for the subjects with anhedonia and the controls are shown as a function of emotion condition and contrast level in Fig. 3. Gender had no effect on affective ratings, and there was no interaction between gender and group, emotion or contrast (all Ps = ns). We analyzed individual mean ratings with a 3 (group: control, PhysAnh, SocAnh) × 3 (emotion: neutral, sensory, social) × 5 (contrast: 100, 80, 60, 40, 20%) ANOVA. There was a main effect of emotion, $F(2,150) = 453$, $P < 0.0001$, with sensory and social pictures rated more pleasant than neutral pictures (both Ps < 0.0001). Sensory pictures received higher pleasure ratings than social pictures ($P < 0.0001$). The effect of contrast, $F(4,300) = 180$, $P < 0.0001$, was qualified by an emotion × contrast interaction, $F(8,600) = 71$, $P < 0.0001$. Affective ratings decreased with each 20% decrease in contrast for sensory and social pictures (all Ps < 0.0001), whereas contrast had a much smaller effect on ratings of neutral pictures, which were higher for the 80% contrast than for the 20 and 40% contrast (Ps < 0.05). The effect of group, $F(2,75) = 5.5$, $P < 0.01$, was qualified by interactions involving emotion

Fig. 2. Attenuation of the contrast of a sensory picture. From the top to bottom: 100, 80, 60, 40 and 20% of the initial contrast.

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Table 1
Psychometric scores

Scale	Control (C) ($n=34$)	PhysAnh (PA) ($n=26$)	SocAnh (SA) ($n=18$)	*F*-value	Post-hoc
PAS	9.15 (4.43)	29.31 (5.07)	23.28 (9.00)	90****	C<SA<PA
SAS	4.18 (2.81)	8.31 (4.25)	20.44 (3.85)	123****	C<PA<SA
MIS	7.68 (4.78)	8.00 (5.07)	8.83 (5.12)	0.3	–
BDI-SF	1.65 (1.76)	4.15 (3.11)	6.22 (4.91)	13****	C<PA<SA
STAI	29.59 (5.82)	33.65 (8.68)	39.94 (12.92)	8****	C<SA, PA<SA

Mean (standard deviation) scores of each group on the Physical Anhedonia Scale (PAS) and the Social Anhedonia Scale (SAS) on the day of testing, Magical Ideation Scale (MIS) score at screening, Beck Depression Inventory-Short Form (BDI-SF) and the State subscale of the State-Trait Anxiety Inventory (STAI). *F*-value and post-hoc results of the group comparisons using ANOVAs and planned comparisons are shown; ****$P<0.0001$.

Table 2
Between-group comparisons for sensory and social pictures at each level of contrast

Emotion	Contrast	PhysAnh vs. C	SocAnh vs. C	PhysAnh vs. SocAnh
Sensory		10.6**	0.6	4.2*
	100%	15.9***	4.6*	1.8
	80%	17****	2.6	3.9 (0.053)
	60%	11**	0.3	5.6*
	40%	4.8*	0.3	1.8
	20%	2.1	0.6	3.8 (0.054)
Social		2.7	12.1***	3.7 (0.059)
	100%	9.3**	25.2****	4.8*
	80%	5*	20.4****	5.8*
	60%	3.7 (0.057)	12.4***	2.9
	40%	0.6	5.7*	2.6
	20%	0.01	2	1.5

*$P<0.05$; **$P<0.01$; ***$P<0.001$; ****$P<0.0001$.

and contrast: group×emotion interaction, $F(4,150)=6.1$, $P<0.001$, group×contrast interaction, $F(8,300)=5$, $P<0.0001$, and group×emotion×contrast interaction, $F(16,600)=2.5$, $P<0.01$.

Post-hoc analyses were conducted using planned comparisons (see Table 2). For combined conditions, both PhysAnh and SocAnh subjects reported feeling less pleasure than did controls ($Ps<0.01$). On average, subjects with physical anhedonia rated sensory pictures less pleasant than did controls and subjects with social anhedonia, whereas subjects with social anhedonia rated social pictures less pleasant than did controls and subjects with physical anhedonia. The comparisons at each level of contrast showed that subjects with physical anhedonia reported less pleasure than controls for sensory pictures at all but the lowest level of contrast and for social pictures at high contrast levels. In contrast, subjects with social anhedonia reported less pleasure than controls for social pictures at all but the lowest level of contrast and for sensory pictures at the highest level of contrast.

4. Discussion

In this study, both subjects with physical and social anhedonia reported experiencing less intense pleasure than controls viewing positive pictures. However, they were differentially sensitive to the emotion condition and contrast variation of the picture content. Whereas subjects with physical anhedonia displayed a deficit mainly in the sensory dimension of pleasure, subjects with social anhedonia displayed a deficit mainly in the social dimension of pleasure.

4.1. Physical vs. social anhedonia and emotion dimension

In previous studies, self-report psychometric tests and direct confrontations with emotional stimuli provided some evidence for a deficit of subjects with anhedonia in the experience of positive affect (Fitzgibbons and Simons, 1992; Fiorito and Simons, 1994; Ferguson and Katkin, 1996; but see Berenbaum et al., 1987), but the specificity of this deficit in terms of the emotional condition is not documented by behavioral or physiological data. A single study addressed the effect of picture content on affective processing in subjects with social anhedonia (Gooding et al., 2002) and found no differences in terms of affective modulation of startle blink, regardless of whether or not pictures contained social–interpersonal content.

In our study, PhysAnh and SocAnh subjects showed decreased pleasure across a larger range of contrast levels for sensory and social pictures, respectively. These response patterns suggest that the measured pleasure deficit is related to the subject's a priori anhedonia type. Such an interpretation is based on the examination of the main differences between the picture sets. Sensory pictures depict landscapes with no humans or animals or any suggestion of their presence. The pleasure elicited by these pictures is thought to include a large sensory dimension and may be described as a visual or esthetic pleasure. On the other hand, social pictures show at least two individuals, of different ages and relationships (e.g. familial, friendly, loving). The individuals depicted generally express positive emotions, and are always interacting, mostly looking at each other, or with their attention focused on the

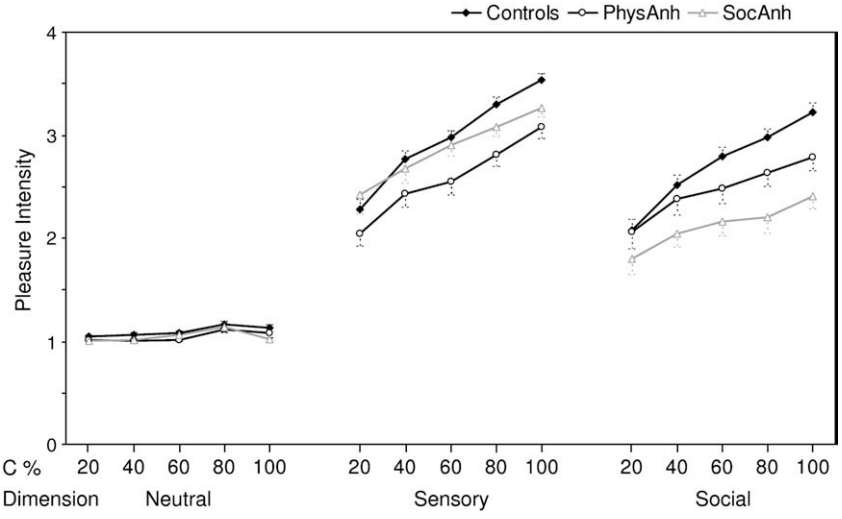

Fig. 3. Mean pleasure rating for neutral, sensory, and social pictures as a function of contrast level in subjects with anhedonia and control subjects. Rating level 1 corresponds to the minimal rating ('not at all'); rating level 4 corresponds to the maximal rating ('very much').

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same situation or carrying out the same activity. We previously found that color suppression affects the ratings of pictures with sensory but not with social content (Dubal et al., 2004). Thus, affective appraisal of sensory pictures is thought to be largely based on visual components, whereas appraisal of social pictures depends on the social component and, in a lower extent, on visual components.

Subjects with physical anhedonia displayed a larger deficit of pleasure for sensory than for social pictures, suggesting that they are mostly deficient in the visual and esthetic components of pleasure. According to their lower scores for social pictures at high contrast in comparison with controls, they would still have a weak deficit in the social component of pleasure. This may be accounted for by a lower capacity to derive pleasure from interpersonal sources, as evoked by descriptions of a social withdrawal in these subjects (Chapman et al., 1980). As for SocAnh subjects, we observed a strong reduction of social pleasure scores: the social pictures with the highest contrast elicited a feeling of pleasure of similar intensity to the sensory pictures with the lowest contrast. This may reflect that subjects with social anhedonia derive generally little satisfaction from interpersonal interactions, as suggested by self-reported or global clinical interview measures in high SAS subjects (Mishlove and Chapman, 1985; Kwapil, 1998).

The two anhedonia groups had a second highest anhedonia score (PAS in subjects with social anhedonia and SAS in subjects with physical anhedonia) relatively elevated in comparison with controls. This is congruent with the positive correlation between the two scales (e.g. Kwapil et al., 2008), and indeed an elevated score on one scale is rarely associated with a low score on the other scale. The affective rating patterns fit with these anhedonia profiles, in that intermediate anhedonia scores are associated with intermediate ratings at 100% contrast. In our view, these findings support that physical anhedonia manifests itself essentially in the sensory dimension of pleasure, whereas social anhedonia manifests itself essentially in the social dimension of pleasure. Accordingly, the selection of stimuli for the type of emotional content may be useful to explore emotion processing deficits associated with anhedonia.

4.2. Intensity and modulation of pleasure in anhedonia

As expected, attenuation of the contrast of the positive pictures led to a decrease in the intensity of the feeling of pleasure in all participants. Individuals with anhedonia reported a modulation of affective intensity by the contrast attenuation. However, both subjects with physical and social anhedonia reported a feeling of pleasure of lower intensity than controls at normal contrast, and this difference persisted when the contrast was lowered, except at the lowest contrast. At 20% contrast, the pictures may convey insufficient affective information for significant differences to be detected between subjects with anhedonia and controls.

Psychometric scales have been used in individuals with high anhedonia to assess the degree to which individuals experience discrete emotions. Scores obtained by populations with anhedonia on the Positive And Negative Affect Schedule (PANAS) and the Emotional Intensity Scale (EIS) suggest that physical anhedonia and social anhedonia are associated with a diminution of the subjective intensity in the experience of positive emotions (Germans and Kring, 2000; Gooding et al., 2002; Gooding and Tallent, 2003). Accordingly, and consistent with our results, subjects with anhedonia may report their positive emotions as being pleasant in a lower extent than controls do. This difference may refer to a lowered affect intensity, defined as the characteristic intensity or strength with which an individual reports his pleasant and unpleasant affective experience over time (e.g., Larsen and Diener, 1987).

The most direct way to measure the contents of a mental representation of emotion is to examine people's verbal behavior regarding their own mental state, in the form of self-reports (Barrett et al., 2007). Pleasure ratings reported by subjects with anhedonia reflect the pleasure they subjectively experienced, but do not represent all aspects of their experience. However, at least in subjects with physical anhedonia, there are supportive findings for an attenuated emotional experience both in its physiological and subjective aspects. This includes lower pleasantness, arousal or interest ratings of positive stimuli (Fitzgibbons and Simons, 1992; Simons et al., 1993; Fiorito and Simons, 1994) and lower arousal-related physiological responses (Simons, 1981, 1982; Miller et al., 1984; Bernstein and Riedel, 1987; Pierson et al., 1987; Roedema and Simons, 1994; Allen et al., 1995). In contrast, there is no physiological argument for a decreased emotional experience in subjects with social anhedonia (Gooding et al., 2002). Actually, these and other studies have not always provided consistent findings (see also Germans and Kring, 2000; Mathews and Barch, 2006). Homogeneity of stimulus content might account for these discrepancies. For instance, whereas most studies have used a broad range of negative and positive stimuli, Ferguson and Katkin (1996) used humorous positive pictures and disgust-inducing negative pictures and showed significant differences in valence and interest ratings in subjects with anhedonia. Moreover, affect intensity is differentially related to physiological responses as a function of the thematic content of the stimuli (Bernat et al., 2006). We did not use highly arousing pictures, such as erotic or adventure scenes, but instead we included situations that one may more commonly encounter in daily life, probably closer to the highly pleasant-relaxing pictures from the International Affective Picture System depicting landscapes, flowers or babies (Ribeiro et al., 2007). With such pictures, the decrease of pleasurableness through manipulation of perceptibility appears as an efficient way to study the modulation of affect intensity and the subtle deficits in subjects with anhedonia. In other respects, bipolar rating scales may be criticized, because unpleasantness and pleasantness may not be reciprocal and antagonistic, such that some stimuli could engage both hedonic and aversive motivational systems. We avoided this problem by using a unipolar, hedonic rating scale. On the other hand, without a separate unpleasant rating scale, we have no way of assessing whether the decrease of pleasure is accounted for by increased levels of aversiveness. For example, schizophrenia patients may experience strong aversive emotions in response to positive stimuli (for a review, see Cohen and Minor, 2010). However, since subjects with anhedonia have been shown to report similar unpleasantness, indeed lower arousal ratings than controls for negative stimuli (Simons et al., 1993; Fiorito and Simons, 1994; Ferguson and Katkin, 1996), it is unlikely, in our view, that subjects with anhedonia experienced higher aversiveness for positive stimuli.

Our findings support that physical and social anhedonia are associated with attenuated positive affects, to a larger extent in the sensory and the social emotional dimension, respectively. Subjects with anhedonia were able to modulate their affective responses as a function of the stimulus perceptual intensity. If the early stages of the visual perceptual processes are thought to be spared in individuals with anhedonia (e.g. Silverstein et al., 1992), the deficits observed in some visual tasks rather suggest impairments at higher levels of the visual processing, such those associated with attentional function (e.g. Gooding and Braun, 2004). Indeed, attentional dysfunctioning has been repeatedly shown in subjects with physical anhedonia (e.g. Yee and Miller, 1994; Dubal et al., 2000; Dubal and Jouvent, 2004). Given that attentional and emotional processes both interact with perceptual processes (Vuilleumier and Driver, 2007), notably with contrast sensitivity (Phelps et al., 2006), further psychophysical or neuroimaging studies are required to explore perceptual processes of emotional information in subjects with anhedonia.

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References

Allen, N.B., Trinder, J., Rae, H., Brennan, C., 1995. Affective modulation of the startle reflex in anhedonia and clinical depression. Poster presented at the annual conference of the Society for Psychophysiological Research. Psychophysiology 32, S16.

American Psychiatric Association, 1994. Diagnostic and Statistical Manual of Mental Disorders, 4th ed. Author, Washington, DC.

Avidan, G., Harel, M., Hendler, T., Ben-Bashat, D., Zohary, E., Malach, R., 2002. Contrast sensitivity in human visual areas and its relationship to object recognition. Journal of Neurophysiology 87, 3102–3116.

Barrett, L.F., Mesquita, B., Ochsner, K.N., Gross, J.J., 2007. The experience of emotion. Annual Review of Psychology 58, 373–403.

Beck, A.T., Beamesderfer, A., 1974. Assessment of depression: the Depression Inventory. Modern Problems of Pharmacopsychiatry 7, 151–159.

Berenbaum, H., Snowhite, R., Oltmanns, T.F., 1987. Anhedonia and emotional responses to affect evoking stimuli. Psychological Medicine 17, 677–684.

Bernat, E., Patrick, C.J., Benning, S.D., Tellegen, A., 2006. Effects of picture content and intensity on affective physiological response. Psychophysiology 43, 93–103.

Bernstein, A.S., Riedel, J.A., 1987. Psychophysiological response patterns in college students with high physical anhedonia: scores appear to reflect schizotypy rather than depression. Biological Psychiatry 22, 829–847.

Biederman, I., Vessel, E.A., 2006. Perceptual pleasure and the brain. American Scientist 94, 247–253.

Chapman, L.J., Chapman, J.P., Raulin, M.L., 1976. Scales for physical and social anhedonia. Journal of Abnormal Psychology 85, 374–382.

Chapman, L.J., Edell, W.S., Chapman, J.P., 1980. Physical anhedonia, perceptual aberration, and psychosis proneness. Schizophrenia Bulletin 6, 639–653.

Chapman, L.J., Chapman, J.P., Kwapil, T.R., Eckblad, M., Zinser, M.C., 1994. Putatively psychosis-prone participants 10 years later. Journal of Abnormal Psychology 103, 171–183.

Cohen, A.S., Minor, K.S., 2010. Emotional experience in patients with schizophrenia revisited: meta-analysis of laboratory studies. Schizophrenia Bulletin 36, 143–150.

Dubal, S., Jouvent, R., 2004. Time-on-task effect in trait anhedonia. European Psychiatry 19, 285–291.

Dubal, S., Pierson, A., Jouvent, R., 2000. Focused attention in anhedonia: a P3 study. Psychophysiology 37, 711–714.

Dubal, S., Rey, G., Knoblauch, K., Jouvent, R., 2004. The effect of contrast on affective ratings in normal and anhedonic subjects. Perception 33, 132.

Eckblad, M.L., Chapman, L.J., 1983. Magical ideation as an indicator of schizotypy. Journal of Consulting and Clinical Psychology 51, 215–225.

Ferguson, M.L., Katkin, E.S., 1996. Visceral perception, anhedonia, and emotion. Biological Psychology 42, 131–145.

Fiorito, E.R., Simons, R.F., 1994. Emotional imagery and physical anhedonia. Psychophysiology 31, 513–521.

Fitzgibbons, L., Simons, R.F., 1992. Affective response to color-slide stimuli in subjects with physical anhedonia: a three systems analysis. Psychophysiology 29, 613–620.

Germans, M.K., Kring, A.M., 2000. Hedonic deficit in anhedonia: support for the role of approach motivation. Personality and Individual Differences 28, 659–672.

Gooding, D.C., Tallent, K.A., 2003. Spatial, object, and affective working memory in social anhedonia: an exploratory study. Schizophrenia Research 63, 247–260.

Gooding, D.C., Braun, J.G., 2004. Visuoconstructive performance, implicit hemispatial inattention, and schizotypy. Schizophrenia Research 68, 261–269.

Gooding, D.C., Davidson, R.J., Putnam, K.M., Tallent, K.A., 2002. Normative emotion-modulated startle response in individuals at risk for schizophrenia-spectrum disorders. Schizophrenia Research 57, 109–120.

Kerns, J.G., Berenbaum, H., 2000. Aberrant semantic and affective processing in people at risk for psychosis. Journal of Abnormal Psychology 109, 728–732.

Kosmadakis, C.S., Bungener, C., Pierson, A., Jouvent, R., Widlocher, D. 1995. [Translation and validation of the Revised Social Anhedonia Scale (SAS Social Anhedonia Scale, M.L. Eckblad, L.J. Chapman et al., 1982)]. Study of the internal and concurrent validity in 126 normal subjects.] Encephale 21, 437–443.

Kwapil, T.R., 1998. Social anhedonia as a predictor of the development of schizophrenia-spectrum disorders. Journal of Abnormal Psychology 107, 558–565.

Kwapil, T.R., Barrantes-Vidal, N., Silvia, P.J., 2008. The dimensional structure of the Wisconsin schizotypy scales: factor identification and construct validity. Schizophrenia Bulletin 34, 444–457.

Larsen, R.J., Diener, E., 1987. Affect intensity as an individual difference characteristic: a review. Journal of Research in Personality 21, 1–39.

Loas, G., Boyer, P., 1994. [Evaluation of anhedonia in psychopathology: second study of the validation of the French version of the Chapman and Chapman physical anhedonia scale. Study of 356 persons]. Annales Medico-psychologiques (Paris) 152, 256–259.

Luh, K.E., Gooding, D.C., 1999. Perceptual biases in psychosisprone individuals. Journal of Abnormal Psychology 108, 283–289.

Mace, M.J., Thorpe, S.J., Fabre-Thorpe, M., 2005. Rapid categorization of achromatic natural scenes: how robust at very low contrasts? European Journal of Neurosciences 21, 2007–2018.

Mathews, J.R., Barch, D.M., 2006. Episodic memory for emotional and non-emotional words in individuals with anhedonia. Psychiatry Research 143, 121–133.

Meehl, P.E., 1962. Schizotaxia, schizotypy, schizophrenia. American Psychologist 17, 827–838.

Miller, G.A., Simons, R.F., Lang, P.J., 1984. Electrocortical measures of information processing deficits in anhedonia. Annals of the New York Academy of Sciences 425, 599–602.

Mishlove, M., Chapman, L.J., 1985. Social anhedonia in the prediction of psychosis proneness. Journal of Abnormal Psychology 94, 394–396.

Phelps, E.A., Ling, S., Carrasco, M., 2006. Emotion facilitates perception and potentiates the perceptual benefit of attention. Psychological Science 17, 292–299.

Pierson, A., Ragot, R., Ripoche, A., Lesevre, N., 1987. Electrophysiological changes elicited by auditory stimuli given a positive or negative value: a study comparing anhedonic with nonanhedonic subjects. International Journal of Psychophysiology 5, 107–123.

Rey, G., Jouvent, R., Dubal, S., 2009. Schizotypy, depression and anxiety in physical and social anhedonia. Journal of Clinical Psychology 65, 695–708.

Ribeiro, R.L., Teixeira-Silva, F., Pompéia, S., Bueno, O.F., 2007. IAPS includes photographs that elicit low-arousal physiological responses in healthy volunteers. Physiology and Behavior 91, 671–675.

Roedema, T., Simons, R.F., 1994. Imagery and emotion in anhedonia: blink-reflex modulation. Poster presented at the annual conference of the Society for Psychophysiological Research. Psychophysiology 31, S82.

Schupp, H.T., Stockburger, J., Schmälzle, R., Bublatzky, F., Weike, A.I., Hamm, A.O., 2008. Visual noise effects on emotion perception: brain potentials and stimulus identification. NeuroReport 19, 167–171.

Sheehan, D.V., Lecrubier, Y., Harnett-Sheehan, K., Janavs, J., Weiller, E., Bonora, L.I., Keskiner, A., Schinka, J., Knapp, E., Sheehan, M.F., Dunbar, G.C., 1997. Reliability and Validity of the MINI International Neuropsychiatric Interview (M.I.N.I.): according to the SCID-P. European Psychiatry 12, 232–241.

Silverstein, S.M., Raulin, M.L., Pristach, E.A., Pomerantz, J.R., 1992. Perceptual organization and schizotypy. Journal of Abnormal Psychology 101, 265–270.

Simons, R.F., 1981. Electrodermal and cardiac orienting in psychometrically defined high-risk subjects. Psychiatry Research 4, 347–356.

Simons, R.F., 1982. Physical Anhedonia and future psychopathology: an electrocortical continuity? Psychophysiology 19, 433–441.

Simons, R.F., Giardina, B.D., 1992. Reflex modification in psychosis-prone young adults. Psychophysiology 29, 8–16.

Simons, R.F., MacMillan, F.W., Ireland, F.B., 1982. Anticipatory pleasure deficit in subjects reporting physical anhedonia: slow cortical evidence. Biological Psychology 14, 297–310.

Simons, R.F., Fitzgibbons, L., Fiorito, E., 1993. Emotion-processing in anhedonia. In: Birbaumer, N., Ohman, A. (Eds.), The Organization of Emotion. Cognitive, clinical and psychophysiological perspectives. Hogrefe-Huber, Toronto, pp. 288–306.

Spielberger, C.D., 1983. Manual for the State-Trait Anxiety Inventory (Form Y) ("Self-evaluation questionnaire"). Consulting Psychologists Press, Palo Alto, CA.

Yee, C.M., Miller, G.A., 1994. A dual-task analysis of resource allocation in dysthymia and anhedonia. Journal of Abnormal Psychology 103, 625–636.

Vuilleumier, P., Driver, J., 2007. Modulation of visual processing by attention and emotion: windows on causal interactions between human brain regions. Philosophical transactions of the Royal Society of London. Series B. Biological Sciences 362, 837–855.

Wechsler, D., 1981. WAIS-R: Manual: Wechsler Adult Intelligence Scale—Revised. The Psychological Corporation, San Antonio, TX.

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