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The Role of Predisposition to Hallucinations on Non-Clinical Paranoid vs. Socially Anxious Individuals after Hearing Negative Affective-Laden Sounds: An Experimental Investigation

Bárbara Lopes and José Pinto-Gouveia

University of Coimbra, Portugal

Background: Research suggested that negative affective-laden sounds act as environmental stressors that elicit negative affect (Bradley and Lang, 2000a). **Aims:** We tried to test for the role of an interaction between predisposition to hallucinatory experiences and exposure to negative affective laden sounds for the presence of paranoid ideation. **Method:** We used an experimental design that followed the vulnerability × stress model. We defined three groups from a sample of students: paranoia group vs. social anxiety group vs. control group. Their psychological characteristics were measured through self-reports of paranoia, anxiety, predisposition to hallucinations and depressive symptoms at Time 1 (before the experiment). Participants had to listen to either negative affective laden sounds (e.g. screaming) or positive affective laden sounds (e.g. sound of ocean waves). Their paranoid ideation and positive vs. negative emotional reactions to sounds were measured through self-reports at Time 2 (after the experiment). **Results:** Data showed that the paranoia group presented more serious psychological vulnerabilities than the social anxiety group. A MANCOVA also showed that the independent variables ("group" and "experimental sound conditions") had statistically significant main effects on general paranoia ideation at Time 2. Furthermore, there was a significant three-way interaction between group x predisposition to hallucinatory experiences × experimental condition of sounds for the presence of general paranoid ideation at Time 2. Limitations included the small sample size and the effects of parasite variables, e.g. noise. **Conclusions:** Individuals' predisposition for hallucinatory experiences increases the probability of possessing paranoid ideation. This tendency is a characteristic of paranoid non-clinical individuals.

Keywords: Paranoia, social anxiety, negative affective laden sounds, predisposition to hallucinatory experiences.

Introduction

Studies in non-clinical paranoia suggest that paranoid ideation is related to hallucinatory predisposition, such as hearing sounds and voices and a feeling that "things are not right" (Freeman, Gittins, et al., 2008). Since to our knowledge there is a lack of studies that examine

Reprint requests to Bárbara Lopes, Faculdade de Psicologia e de Ciências da Educação, Universidade de Coimbra, Rua do Colégio Novo, Apartado 6153, P-3001-0082, Coimbra, Portugal. E-mail: barbaracslopes@gmail.com

the effect of auditory stimuli in individuals from a "normal" population that present either non-clinical paranoia or social phobia, we decided to explore psychological differences between these individuals relative to hallucinatory predisposition, paranoid ideation, anxiety feelings and behaviours. We also wanted to examine whether the exposure to affective laden sounds leads to negative vs. positive emotional responses in a non-clinical sample of college students. We thus expected that negative affective laden sounds would act as environmentally and naturally occurring stressors (Bradley and Lang, 2000a).

Auditory hallucinations (hearing voices) are considered a central symptom of psychosis (Allen et al., 2005). Nevertheless, hallucinations have also been reported to occur in a substantial percentage of non-clinical individuals. Data from the USA in the early 1980s revealed a lifetime prevalence of hallucinations in 10–15% of the general population. An increasing number of investigators conceptualize hallucinatory experiences as forming a continuum with normal psychological functioning (Bentall and Slade, 1985; Claridge, 1972; Johns and van Os, 2001).

Evolutionary psychology has been suggesting that the mind has evolved a number of specialized mental mechanisms and abilities for solving challenges to survival and reproductive success (Gilbert, 1989). To function adaptively in its environment an animal must be sensitive to certain signals, have mechanisms to decode them, and respond appropriately. External signals tend to ignite certain psychobiological responses and require animals to coordinate their own behaviours to enable the enactment of specific roles, e.g. for attachment, sexual or rank-related relationships (Gilbert, 1989). Thus, for example, in attachment relationships, the individual is orientated to approach and engage, whereas in dominant-subordinate relationships the dominant may be orientated to threat and control subordinates, while subordinates are orientated to inhibit behaviour and withdraw.

Signals are important because they may indicate the presence of social threats that can be external, such as being a target for criticism or active/passive rejection, or internal, such as negative self-talk and feelings of frustration that are linked to affective memories of threatening situations (such as memories of childhood mistreatment by a parent) (Gilbert, 2001a, b).

Humans therefore evolved to decode signals of threat and to respond effectively and rapidly. The need to adapt to the strains of the environment led to the development of an automatic vigilance system that is equipped to detect potential threatening agents by processing auditory stimuli such as a scream and to respond to this either by fleeing or fighting. This system is affect laden and activates memories of threatening situations and consequent negative mood such as frustration, anger, sadness. Since this system is automatic, information is processed very quickly with none or little use of reflexive thought, as the goal is to respond as quickly as possible to the incipient threat in order to avoid harm (Gilbert, 2001a, b).

One type of stimuli that humans pay attention to and that is important to maintain healthy relationships and avoid threat in a social group is faces. Indeed, the study of facial stimuli expressing different emotions has been extensively studied in schizophrenia and paranoia (e.g. Heponiemi, Ravaja, Elovainio and Keltikangas-Järvinen, 2007). Hence, researchers such as Heponiemi et al. (2007) found that hostility and paranoia were related to unpleasant affect during a stress task and overall negative emotions and high arousal and unpleasantness were present when rating facial emotional expressions of the International Affective Picture System (IAPS).

In recent years there have been a growing number of experiments using audio instead of facial stimuli as a means to study emotion, both as unisensory stimuli and as part of multisensory stimuli. Since this is a more recent trend than using a vision-only approach, there is a significant gap between the availability of well characterized audio and visual stimuli in the scientific community. Nevertheless, if we consider auditory stimuli, there is no doubt that there are quite a lot of pleasant versus unpleasant/arousing versus non-arousing sounds in everyday contexts (e.g. laughing, car wreck/scream, yawn) (Juslin and Väjfäll, 2008).

Therefore, although humans are thought to be a profoundly visual species, it is also true that sometimes a rapid response to an emotional sound may be necessary in terms of welfare and survival. So, for example, consider the ancestrally recurrent situation of being alone at night. Who has not found himself/herself extremely frightened in this particular circumstance, especially if one hears strange sounds (e.g. a scream) that signal the presence of a probable threat (Cosmides and Tooby, 1997). Thus, paying attention to strange sounds in this situation may save one's life, i.e. it is better to be safe than sorry, so when we hear a strange sound in the night we activate our escape mode and do not wait to know if it is a threat or not.

Since sounds are important sources of information, a line of systematic research has been initiated in the past decade, including experiments that employed the IADS (International Affective Digitized Sounds) (Bradley and Lang, 2000a; Stemmler, Heldmann, Pauls and Scherer, 2001).

A few auditory stimuli sets have been standardized according to the dimensional theories of emotion independent of emotional category. One of these is the International Affective Digitized Sounds (IADS). The IADS is a set of 111 standardized, emotionally evocative sounds that cover a wide range of semantic categories. This system was created with three goals in mind: better experimental control of emotional stimuli; increasing the ability of cross-study comparisons of results; and increased ability to directly replicate studies (Bradley and Lang, 1999b). To achieve these goals, the IADS were originally normalized using the Self-Assessment Manikin (SAM), a scale that assesses valence, arousal, and dominance as dimensions describing emotion (Bradley and Lang, 1994).

Research in this area has suggested that relaxing sounds, such as the sound of waves and nature sounds, induce positive emotion (Salomon, Kim, Beaulieu and Stefano, 2003), decrease subjective anxiety, systolic blood pressure, heart rate (Knight and Richard, 2001) and levels of cortisol after a stressful situation (Khalfa, Bella, Roy, Peretz and Lupien, 2003) in students. On the other hand, studies found that naturally occurring unpleasant sounds, such as screams, crying, or alarm clocks, induced larger startle reflexes, more negative emotions and larger heart rate deceleration in students than listening to pleasant sounds (Bradley and Lang, 2000a). Hence, sounds seem to be naturally occurring and powerful elicitors of emotion and because we are particularly interested in auditory hallucinations we will use auditory stimuli to induce emotional responses. That being said, why are environmental stressors such as sounds important to the understanding of the presence of hallucinations?

Authors such as Freeman, Gittins et al. (2008) and Freeman, Pugh et al. (2008) devised a cognitive model for persecutory delusions that stresses the importance of stress in the formation and persistence of persecutory hallucinations. They used the vulnerability $\times$ stress rationale to form their hypotheses. Hence, they hypothesized that individuals prone to paranoid ideation are trying to make sense of feelings of oddness caused by internal anomalies (e.g. hallucinations, perceptual anomalies, arousal). Therefore, suspicious thoughts are often preceded by stressful events e.g. difficult interpersonal relationships, bullying, and isolation

(Freeman, Gittins et al., 2008). The stresses tend to happen against a background of anxiety, worry and related interpersonal concerns. Freeman, Gittins et al. (2008) and Freeman, Pugh et al. (2008) thus argue that anxiety has an important role in the threat (mis)interpretation of the internal events. Indeed, according to these authors, individuals that are prone to paranoid ideation display vulnerability factors such as a predisposition to hallucinate, interpersonal concerns, worry and anxiety that, combined with stress, lead to the presence and maintenance of persecutory ideation (Freeman, Gittins et al., 2008)

Following this, Freeman, Pugh et al. (2008) predicted that anomalies in experience would distinguish the prediction of paranoia and social anxiety. They devised a virtual reality study that presented a scenario to participants. They then measured participants' persecutory thoughts towards virtual reality characters, i.e. avatars. Results showed that paranoia in a virtual environment was associated to a higher hallucinatory predisposition but not to social anxiety and that anxiety, depression, worry, interpersonal sensitivity and negative beliefs about the self would not distinguish the prediction of social anxiety and paranoia.

Thus, following Freeman, Gittins et al.'s (2008) rationale, we would expect to find in this study a significant difference between non-clinical paranoid individuals versus socially phobic individuals relative to the presence of hallucinatory predisposition. Indeed, it is assumed that paranoid individuals should present significantly higher levels of hallucinatory experiences than socially phobic individuals and controls. On the other hand, we expect no significant differences between non-clinical individuals that present paranoia vs. individuals that present social anxiety relative to anxiety. We argue that anxiety is assumed to be a common feature of both paranoia and social phobia and this is consistent with the rationale that claims that paranoia can be conceptualized as a type of anxious fear (Freeman and Freeman, 2008; Freeman, Gittins et al., 2008). Indeed, being in a social situation when anxious will produce anxiety, but being in a social situation when anxious and having anomalies of experience will increase the likelihood of paranoid thinking.

Hypotheses

1. The paranoid individuals should demonstrate statistically significantly higher levels of hallucinatory predisposition than socially anxious individuals and controls.
2. There should be a statistically significant interaction between group $\times$ predisposition to hallucinatory experiences $\times$ experimental condition for general paranoid ideation (GPS). It is expected that hallucinatory experiences would be associated with paranoid ideation.

Materials and method

Screening measures. We devised two experimental groups and one control group from a pool of 223 college students by applying standardized norms for cut-off scores on measures of non-clinical paranoia and social anxiety (Combs, Michael and Penn, 2006; Pinto-Gouveia, Cunha and Salvador, 2003).

We point out that all the instruments used in this study were translated into Portuguese by a bilingual translator and the compatibility of content was verified through stringent back-translation procedures.

General Paranoia Scale (GPS; Fenigstein and Vanable, 1992; Lopes, Pinto-Gouveia and Martins, in press). The 20-item self-report Paranoia Scale was developed to measure paranoia

in college students. The scale measures general paranoia. Each item is rated on a 5-point scale from 1 (not at all applicable) to 5 (extremely applicable). Scores can range from 20 to 100, with higher scores indicating greater paranoid ideation. It is the most widely used dimensional measure of paranoia (Freeman, Garety et al., 2005). Our study presented a Cronbach's alpha value of $\alpha = 0.90$ for $n = 223$.

Paranoia Checklist (PC; Freeman, Garety et al., 2005; Lopes et al., in press). The PC is an 18-item self-report multidimensional scale developed to measure paranoid ideation. None of the items were changed from the original version. It includes items assessing ideas of persecution (e.g. "I need to be on my guard against others") and reference (e.g. "There might be negative comments being circulated about me"). Items are each rated on 5-point Likert scales for frequency, degree of conviction, and distress and has excellent internal consistency (Cronbach's $\alpha > 0.90$) and good convergent validity. In this study Cronbach's alphas were: 0.89 (frequency), 0.95 (conviction) and 0.95 (distress).

Social Interaction and Performance Anxiety and Avoidance Scale (SIPAAS; Pinto-Gouveia et al., 2003). The SIPAAS is a self-report questionnaire that measures anxiety or fear that people show towards several types of social scenarios (e.g. public speaking) ($n = 44$). Respondents are asked to report both "the degree of fear or anxiety" the particular scenario provokes or would provoke and how "frequently" they avoid or would avoid the particular scenario. Responses are given on a 4-point Likert scale ranging from 0 (none or never) to 4 (extremely or all the time). The SIPAAS is thus composed by two subscales: "distress/anxiety" subscale and the "avoidance" subscale. The higher the scores, the more anxiety or avoidance of social situations. Pinto-Gouveia et al. (2003) have shown good internal consistency for this scale both in clinical and non-clinical populations. Cronbach's alphas for each sub-scale in this study showed that the SIPAAS was reliable: .96 (anxiety) .89 (avoidance).

Fear of Negative Evaluation (FNE; Watson and Friend, 1969; Pinto-Gouveia et al. 1986). Social anxiety has often been measured by fear of negative evaluation. The Fear of negative evaluation is a 30-item scale that assesses the fear of being negatively judged and evaluated by others (peers, superiors). Responses are given on a Likert type scale ranging from 1 (not at all) to 5 (extremely). Scores may range from 30 to 150 and the higher the scores, the more fear of negative evaluations. The Portuguese version of the FNE showed good psychometric properties with a Cronbach alpha of .87 for normal populations (Pinto-Gouveia et al., 1986). Hence in this study, we also report good internal consistency with a Cronbach alpha of .91.

Depression and Anxiety Stress Scale (DASS-42**;** Lovibond and Lovibond, 1995; Pais-Ribeiro, Honrado and Leal, 2004). This questionnaire measures the affective states of depression, anxiety and stress; 42 items correspond to a phrase that presented negative emotional symptoms. The minimum score for each sub-scale (depression, anxiety and stress) is 0 and the maximum score is 42. Higher scores indicate higher levels of emotional distress. The Portuguese version of this scale showed good internal consistency with a Cronbach alpha of 0.96 for depression (0.91 in the original version); 0.90 for anxiety (0.81 in the original version) and 0.93 for stress (0.90 in the original version).

Experimental and control groups

Paranoia Group (PG). This group consisted of 51 participants who showed high scores on the General Paranoia Scale (GPS$\geqslant$53, 1+ *SD*), a commonly used measure of subclinical paranoid ideation (Fenigstein and Vanable, 1992; Fenigstein, 1997). Normative scores on the GPS were

Table 1. Groups's characteristics and Means and *SD*s for age, school years, trait and multidimensional sub-clinical paranoia, social anxiety's behaviours and depressive symptomatology

	Paranoia Group (PG)		Social Anxiety Group (SAG)		Control Group (CG)	
	M = 7 *M*	F = 44 *SD*	M = 5 *M*	F = 46 *SD*	M = 44 *M*	F = 7 *SD*
Age	20.43	4.665	19.60	3.572	19.50	1.759
School years	13.19	1.844	12.82	1.506	12.96	.958
GPS - total	57.52	8.874	43.00	7.290	31.72	5.087
PC - frequency	37.21	11.621	29.66	7.0786	22.21	6.986
PC - conviction	43.84	13.970	37.03	13.009	27.76	15.067
PC - distress	32.19	15.353	26.74	14.148	12.11	14.465
SIPAAS - Anxiety	104.00	22.862	116.49	16.851	80.74	15.873
SIPAAS – Avoidance	92.83	21.339	107.49	17.427	69.41	13.235
FNE - total	100.09	16.272	108.35	13.705	84.29	11.689
DASS - depression	11.94	9.602	7.62	7.321	1.50	2.290
DASS - anxiety	8.94	7.330	6.19	4.812	1.64	1.874
DASS - stress	15.78	7.658	13.11	6.810	5.84	4.605

Notes: GPS - Total (total score on general paranoia); PC (Paranoia Checklist: scores on the frequency, conviction and distress of paranoid thoughts); SIPAAS (Social Interaction Perfomance Anxiety Avoidance Scale: scores on anxiety and avoidance); FNE (total score of fear of negative evaluations); DASS (Depression Anxiety Stress Scales: scores on symptoms of depression, anxiety and stress)

used to determine cut-off scores for classifying this group (Combs, Penn and Fenigstein, 2002; Combs et al., 2006). We used this cut-off score because individuals who score at or above this level on the GPS show cognitive, social, and behavioural biases similar to those observed in persons with persecutory delusions (Combs and Penn, 2004). All participants had to also acknowledge an experience of paranoia in the PEPS (Ellet, Lopes and Chadwick, 2003).

The paranoia group was composed of 44 women (86.3%) and 7 men (13.7%). The mean age for this group was $M = 20.43$, $SD = 4.665$ and the mean of years at school was $M = 13.19$, $SD = 1.844$, which is equivalent to a secondary school diploma and presently attending the first year of college education. The Paranoia Group's general paranoia ideation score, depressive symptomatology scores and social anxiety and fear of negative evaluation scores can be seen in Table 1. As expected this group scored high on paranoid ideation and moderately on depressive symptomatology, although within the normal range (Pais-Ribeiro et al., 2004).

Social Anxiety Group (SAG). This group was composed of 51 individuals that showed both high scores on the "distress/anxiety subscale" of the SIPAAS (SIPAAS "Distress/Anxiety" >115) and on the "avoidance subscale" of the SIPAAS (SIPAAS "Avoidance" >105), and > 110 on the Fear of Negative Evaluation Scale (FNE). In order to differentiate this group from the paranoid group, all 51 individuals had also to score lower than the general sample's paranoia score's mean (cut-off score of <44). The same as the paranoia group, this group was mainly composed of females $n = 46$ (90.2%) with only 5 males (9.8%). Also, the

mean age for this group was $M = 19.60$, $SD = 3.572$ and the mean of years spent at school was $M = 12.82$, $SD = 1.560$, which is equivalent to a secondary school diploma.

The SAG's scores on general paranoia, social anxiety and fear of negative evaluation and depressive symptomatology are presented in Table 1. As expected the SAG's score on social anxiety was slightly higher than in the other groups.

Control Group (CG). This group consisted of 51 individuals. The mean age for this group was M = 19.50, $SD = 1.759$ and the mean of years of education was $M = 12.96$, $SD = .958$. This group like the ones before was composed mainly of females $n = 44$ (86.3%) than males $n = 7$ (13.7%). As expected the control group presented the lowest scores for general paranoid ideation and social anxiety and fear of negative evaluation and depressive symptomatology (see Table 1).

Group differences

There were no statistically significant differences between the three groups concerning age ($F(2,152) = 1.042$, $p = .355$) and on the years spent at school ($F(2,152) = .852$, $p = .44$) and on the female:male ratio χ^2 (1, 152) = .421, $p = .810$. In all three groups there were more females than males. Also, all three groups included more single than married individuals χ^2 (1, 152) = 137.41, $p < .001$.

Experimental design and procedure

Instruments. Participants of the three groups had to fill in a battery of questionnaires at Time 1 (before the experimental sessions) and at Time 2, including the General Paranoia Scale, the DASS-42 and the following measures:

State-Trait Anxiety Inventory (Spielberger, Gorsuch, Lushene, Vagg and Jacobs, 1983; Ponciano, 2003). This Inventory addresses state anxiety that is measured by 20 items that evaluate current level of anxiety (e.g. "I feel nervous"). Each item is rated on a 4-point scale (1 = not at all, 5 = very much so). Higher scores indicate higher levels of anxiety. Trait anxiety was measured using the Trait anxiety subscale (20 items) of this inventory. STAI scores range from 20 (almost never anxious) to 80 (almost always anxious). This questionnaire is widely used in the literature to control for anxiety induced by the experimental situation and a general tendency to be anxious (Freeman and Freeman, 2008; Freeman, Gittins et al, 2008; Startup, Freeman and Garety, 2007).

Launay Slade Revised Hallucination Scale (LSHRS; Launay and Slade, 1981; Morrison, Wells and Nothard, 2000; Lopes and Pinto-Gouveia, in press). This 12-item LSHS is designed to measure hallucinatory predisposition by assessing clinical and sub-clinical hallucinatory phenomena. A 4-point scale to measure frequency was used (1 = never, 2 = sometimes, 3 = often, 4 = almost always; see Morrison et al., 2000) with a minimum value of 12 and maximum of 48. Higher scores indicate a greater frequency of hallucinatory experiences. This scale presented good internal consistency with an $\alpha = .91$ for $n = 153$.

Experimental design and procedure

We used a standard experimental setting (Redondo, Fraga, Padrón and Piñeiro, 2008; Stevenson and James, 2008). This study was a quasi-experiment that tried to mimic real life situations by using naturally occurring sounds from the IADS (International Affective

Digitalized Sounds**:** Bradley and Lang, 1999a, b; Bradley and Lang, 2000a, b). First of all we randomly selected from Redondo and colleagues' (2008) standard blocks of 37 sounds, 8 sounds for 4 separate blocks (making a total of 32 sounds) labelled as negative sounds: anger/irritation vs. fear/threat vs. sadness/distress, and positive sounds: happy/calm. Two independent raters heard each sound and labelled it according their positive versus negative valence. The inter-rater reliability was high: kappa .98. Experimental sessions were programmed in Superlab-Pro software in order to automate the assessment process. This software controlled the instructions and the practice sounds at the computer display as well as the presentation of sounds via headphones. The duration of each sound was lengthier than in the original study (6 seconds) (Bradley and Lang, 1999a, b). All sounds had a duration of 60 sec and were presented at full volume. Sounds were presented in a random order for each participant.

During the rating session, 15 participants were seated facing a computer screen and were asked to read the instructions and then practice hearing three sounds. After reading the instructions, the experimenter asked if there were any questions and then the session would begin. Participants had to rate in a pre-experiment visual analogue scale the extent to which they felt anxious (0–10) and how much they felt other people were intentionally trying to harm and put them down (0–10) before the experiment began. Following the presentation of a random block of 8 sounds, participants had to fill in measures that evaluated the emotional impact of sounds and the presence of anxious and paranoid feelings. Hence participants were asked to rate: a) 40 bipolar adjectives (20 positive versus 20 negative emotions) in a 0–3 scale of intensity (0 = nothing, 1 = a little, 2 = a lot, 3 = extremely) with a minimum value of 0 and maximum of 60 (Bradley and Lang, 2000a, b; Stemmler et al., 2001); b) 6 adjectives measuring the activation of the autonomic sympathetic nervous system ($n = 3$) versus deactivation ($n = 3$) in a 0–3 scale of arousal (0 = nothing, 1 = a little, 2 = a lot, 3 = extremely); and c) 11 symptoms of anxiety (e.g. sweating, hands shaking and headaches) versus 2 indicators of relaxation (e.g. relaxed muscles) in a dichotomist scale "yes" versus "no" that answered the question whether participants had felt them or not during the presentation of sounds. Each experimental session lasted approximately 45 minutes.

After doing the ratings participants were asked to fill in post-experiment visual analogue scales measuring the extent they felt anxious and paranoid. Finally, they were asked to fill in a post-experiment battery of questionnaires (Time 2) composed by the GPS (general paranoia score), the STAI (state trait anxiety) and the DASS-42 (depressive, anxious and stress symptoms).

After filling in the questionnaires participants were debriefed about the experiment and any questions they had were answered.

Results

Mean scores according to group membership are presented in Table 2. All measures showed acceptable levels of Kurtosis and Skewness (i.e values between +/-1) prior to statistical analysis.

Group differences on psychological vulnerabilities

As to be expected there were statistically significant differences between the Paranoia Group and the Social Anxiety and Control Groups for the GPS total score at Time 1 (pre-experiment)

(F (2,152) = 162.196, $p < .001$). Post – Hoc Tukey HSD tests revealed that the PG showed statistically significantly higher scores on the GPS at Time 1 (pre-experiment) than both the SAG ($t = 14.490$, $p < .001$) and the control group ($t = 25.803$, $p < .001$). Also the Post-Hoc Tukey HSD test revealed that the SAG presented statistically significantly higher scores on GPS at Time 1 than controls ($t = 11.314$, $p < .001$ at Time 1).

Consistent with these results, one-way ANOVAS showed that there were statistically significant differences between the groups for the three dimensions of the PC: "frequency" of paranoid thoughts ($F(2,152) = 36.784$, $p < .001$); "conviction" of paranoid thoughts (F (2,152) = 16.851, $p < .001$) and "distress" of paranoid thoughts (F (2,152) = 25.554, $p < .001$). Hence, as expected, the PG showed statistically significantly higher scores on the dimension of "frequency" of paranoid thoughts of the PC than the SAG ($t = 7.549$, $p < .001$) and the control group ($t = 15.00$, $p < .001$). The PG scored statistically significantly higher as well on the dimension of "conviction" of paranoid thoughts of the PC than the SAG ($t = 6.804$, $p < .050$) and the control group ($t = 16.078$, $p < .001$) and finally the PG also showed statistically significantly higher scores on the dimension of "distress" of paranoid thoughts of the PC than the control group ($t = 20.078$, $p < .001$). However, the PG did not show statistically significant higher scores on the distress of paranoid thoughts than the SAG ($t = 5.450$, $p = .149$). Furthermore, the SAG showed higher scores than the control group on the three dimensions of the PC: frequency ($t = 7.450$, $p < .001$); conviction ($t = 9.275$, $p < .005$) and distress ($t = 14.627$, $p < .001$).

Hence, the PG consistently showed higher levels of trait paranoia on the GPS as well as higher frequency, conviction and distress of paranoid thoughts on the PC followed by the SAG. On the other hand, as expected, the controls consistently showed the lowest levels of trait paranoia as well as the lowest frequency, conviction and distress of paranoid thoughts.

Results showed that the groups statistically significantly differ on levels of "depression" (F (2,152) = 27.826, $p < .001$); "anxiety" (F (2,152) = 25.824, $p < .001$) and on "stress" at Time 1(F (2,152) = 32.085, $p < .001$) . Post-Hoc Tukey HSD tests showed that the PG presented statistically significantly higher levels of "depression" and "anxiety" (DASS-42) at Time 1 than the SAG ($t = 4.313$, $p < .005$ for "depression" and $t = 2.745$, $p < .030$ for "anxiety") and than the control group ($t = 10.431$, $p < .001$ for "depression" and $t = 7.294$, $p < .001$ for "anxiety"). The PG also showed higher levels of "stress" (DASS-42) at Time 1 than the SAG, although this difference was not statistically significant ($t = 2.666$, $p = .098$). On the other hand, the PG scored statistically significantly higher on "stress" at Time 1 than controls ($t = 7.274$, $p < .001$). As to be expected, the SAG scored statistically significantly higher on symptoms of "depression", "anxiety" and "stress" (DASS-42) at Time 1 than controls ($t = 6.117$, $p < .001$ for "depression"; $t = 4.540$, $p < .001$ for "anxiety" and $t = 7.274$, $p < .001$ for "stress" respectively).

Thus, the PG demonstrated higher levels of psychopathology such as depression, and anxiety than the SAG. On the other hand and as expected, controls showed the lowest levels of symptoms of depression, anxiety and stress.

Results also showed statistically significant differences between the groups for state (STAI) (F (2,152) = 18.510, $p < .001$) and trait anxieties (STAI) at Time 1 (F (2,152) = 37.842, $p < .001$). Post-Hoc Tukey HSD tests revealed that the PG showed statistically significant higher scores on both state and trait anxiety (STAI) at Time 1 than controls ($t = 9.529$, $p < .001$ for state anxiety and $t = 10.980$, $p < .001$ for trait anxiety respectively). On the other hand, as expected there were not statistically significant differences between the PG and the SAG for

Table 2. Psychological vulnerabilities and post experiment's scores of general paranoia and negative vs. positive emotional reactions for the non-clinical paranoia vs. social anxiety's vs. control groups

	Paranoia Group		Social Anxiety Group		Control Group	
	$N = 51$		$N = 51$		$N = 51$	
Measures	*M*	*SD*	*M*	*SD*	*M*	*SD*
STAI: state anxiety – T1	38.19	10.457	35.64	7.493	28.66	5.972
STAI: trait anxiety – T1	47.27	8.311	45.84	6.771	36.29	5.397
GPS: paranoia – T1	57.52	8.875	43.03	7.290	31.72	5.087
GPS: paranoia - T2	68.86	15.764	54.94	12.406	26.35	5.820
LSHRS: hallucinatory - total	29.03	5.392	14.54	1.540	15.78	1.803
Positive emotions	18.87	24.278	15.35	19.414	30.96	19.479
Negative emotions	28.35	18.551	26.11	17.299	17.50	12.007

Notes: STAI (state and trait anxiety scores at Time 1); LSHRS (Launay Slade Revised Hallucinatory total score); GPS (general paranoia score at Times 1 and 2) Positive emotions (bipolar adjectives) at Time 2; Negative emotions (bipolar adjectives at Time 2)

state and trait anxieties (STAI) at Time 1 ($t = 2.549$, $p = .261$ for state anxiety and $t = 1.431$, $p = .551$ for trait anxiety respectively). Nevertheless, the SAG scored statistically significantly higher on state and trait anxiety (STAI) at Time 1 than controls ($t = 6.980$, $p < .001$ for state anxiety and $t = 9.549$, $p < .001$ for trait anxiety respectively). Hence results suggested that both the PG and the SAG presented the highest scores on state and trait anxieties, while the controls presented the lowest scores. This meant that both the Paranoia Group and the Social Anxiety group presented not only a tendency to be anxious but also anxiety at the present moment.

Finally, results showed that there was a statistically significant difference between groups for the total score on hallucinatory predisposition (LSHRS) (F (2,152) = 284.501, $p < .001$). Post-Hoc Tukey HSD tests revealed that the PG demonstrated a statistically significantly higher total score on hallucinatory predisposition (LSHRS) than both the SAG ($t = 14.490$, $p < .001$) and the control group ($t = 13.254$, $p < .001$). There was not a statistically significant difference between the SAG and the control group for the hallucinatory predisposition score (LSHRS) ($t = -1.235$, $p = .162$). This meant that the paranoia group presented a tendency to experience hallucinations that is not characteristic of both socially anxious individuals and controls.

Impact of negative affective laden sounds vs. positive affective laden sounds

We performed a multivariate MANCOVA in order to examine main effects and potential interactions for the prediction of the presence of general paranoid ideation (GPS), post-experimental anxiety feelings versus paranoid feelings (visual analogue vignettes), and negative versus positive emotional intensity reactions to the experimental conditions.

Group membership (Paranoia Group-PG; Social Anxiety Group-SAG and Control Group-CG) and Experimental conditions (negative sound condition: fear/threat versus negative sound condition: sadness/distress versus negative sound condition: anger/irritation versus positive

sound condition: happy/calm) served as the between group independent variables, whereas the total general paranoid ideation score (GPS), negative versus positive emotional intensity scores at Time 2 were the dependent variables. Owing to differences between groups on the total general hallucination predisposition score (LSHRS), state and trait anxiety (STAI) and the three dimensions of psychopathology at Time 2 ("depression", "anxiety" and "stress"), were entered as potential covariates. There was only one covariate in the model that presented main effects on the general paranoia ideation total scores (GPS) at Time 2 and this was the total hallucinatory predisposition score (LSHRS). Results showed that the hallucinatory predisposition had a statistically significant main effect (F (1,153) = 4.154, $p = .044$) on the general paranoia ideation (GPS). Overall, there was a significant multivariate effect for Group Wilk's Lambda = 786.139, $p < .001$, $\eta^2{}_\rho = .001$, for experimental sound conditions Wilk's Lambda = 246.962, $p = < .001$, $\eta^2{}_\rho = .001$. Results thus suggested that the independent variables of "group membership" had main effects on general paranoid ideation as well as the experimental manipulations of being subjected to several types of negative affective laden sounds. In other words, negative affective laden sounds led to a significant increase in paranoia, especially for the group of non-clinical paranoid individuals (F (1,47) = 558.538, $p < .001$).

The role of hallucinatory predisposition

Results showed a statistically significant three-way interaction between group × hallucinatory predisposition (LSHRS) × experimental sound condition for the prediction of general paranoia ideation (GPS) scores at Time 2 (F (9,153) = 2.836, $p = .005$). This meant that the more predisposition to hallucinatory experiences the more paranoia at Time 2 ($r = .65$, $p < .001$) (see Figure 1). Indeed, a linear regression showed that the predisposition to hallucinatory experiences' score statistically significantly predicted the variance of general paranoia at Time 2 ($t = 10.562$, $p < .001$). Furthermore, the predisposition to hallucinatory experiences appeared to be a major predictor of general paranoia, accounting for 65% of the variance.

Discussion

One main goal of this study was to analyze the psychological vulnerabilities of a group of non-clinical paranoid individuals versus a group of socially anxious individuals. We expected that paranoid individuals would show a predisposition to hallucinatory experiences (Freeman and Freeman, 2008; Freeman, Gittins et al., 2008; Freeman, Pugh et al., 2008).

We performed one-way ANOVAS to test our hypotheses about differences between the paranoia group vs. the social anxiety group concerning their psychological vulnerabilities. We expected that the paranoia group (PG) would show a more disruptive and dysfunctional psychological profile than the social anxiety group (SAG). Results suggested, not surprisingly, that the paranoia group showed significantly higher frequency, conviction and distress of paranoid thoughts; more psychopathological symptoms of depression and anxiety, and significantly more predisposition to hallucinatory experiences than the social anxiety group (SAG) and controls. This meant that the paranoia group not only presented signs of psychopathology such as depression and stress but also had a predisposition to hallucinations (auditory and visual) that was not observed in the case of socially anxious individuals and controls. On the other hand, the social anxiety group showed more feelings of anxiety than

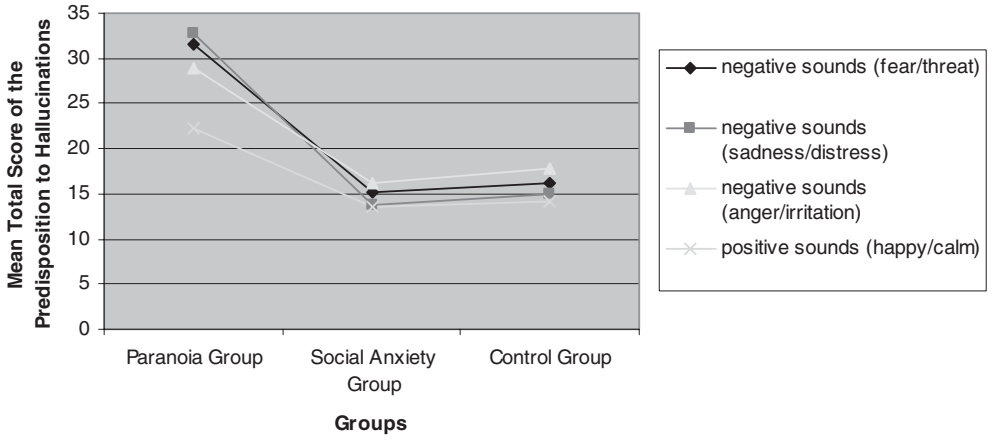

Figure 1. Means of the total scores of predisposition to hallucinatory experiences for the three groups under negative affective laden sounds's conditions vs. positive affective laden sounds's condition

the paranoia group, although it did not differ from this group concerning trait anxiety. Results thus supported the argument that anxiety is the bridge between sub-clinical paranoia and social anxiety (Freeman, 2007; Freeman and Garety, 1999, 2000, 2003; Freeman, Garety and Kuipers, 2001). Hence, anxiety is assumed to be an emotional factor present in paranoia and also accounts for paranoid ideation in non-clinical populations (Freeman and Garety, 2003; Lincoln, Peter, Schäfer and Moritz, 2008; Valmaggia et al., 2007). Thus, our results support the notion that anxiety provides fertile soil for paranoid thoughts and, in accordance with basic research, demonstrate that anxiety tends to narrow attention to the emotionally relevant cues (Lincoln, Lange, Burau, Exner and Moritz, 2010). Moreover, our finding that people that show higher baseline symptomatology of depression and anxiety are more likely to present paranoia is consistent with the vulnerability notion for psychosis (Lincoln et al., 2010).

Thus our results give support to data from Martin and Penn's (2001) study that observed that non-clinical paranoid individuals show symptoms of depression and anxiety, which suggested that paranoia is associated with psychological disturbances and a more dysfunctional psychological profile than social anxiety (Freeman, 2007). Furthermore, our results support the argument suggesting that paranoia is associated with a predisposition to hallucinatory experiences, i.e. a feeling that things do not seem right (Freeman, Gittins et al., 2008; Freeman, Pugh et al., 2008).

Indeed, our main goal was to test the role of the predisposition to hallucinatory experiences for the presence of paranoid ideation after being exposed to stress inducing conditions, which in this case was the audition of negative affective laden sounds such as screams (fear/threat), sobbing (sadness/distress condition) and alarm clocks (anger/irritation condition). We used the experimental design extensively studied in the literature of emotions (Bradley and Lang, 1999a, b, 2000a, b; Redondo et al., 2008; Stevenson and James, 2008) to evaluate the interaction between the predisposition to hallucinatory experiences with the impact on the three groups of individuals (non-clinical paranoids, socially anxious, and controls), of negative affective-laden sounds as factors of environmental stress. Results showed the importance of the predisposition to hallucinatory experiences

in paranoia. Indeed, there was a significant three-way interaction between group × predisposition to hallucinatory explanations × experimental sounds conditions for the general paranoia scores at Time 2. Thus data suggested that possessing a tendency to experience hallucinations interacts with belonging to a certain group and with hearing certain types of sounds for an increase of paranoid ideation. Once again data support Freeman, Gittins et al.'s (2008) results. Freeman, Gittins, et al. (2008) suggested that paranoid individuals from a non-clinical population show abnormal perception of stimuli. It seems that paranoid individuals have a tendency to hear voices and to daydream. Our results allowed us to infer that paranoid individuals present this tendency to hallucinate and that, when faced with negative affective laden sounds, they increase their paranoid ideation. Hence there is an interaction between their vulnerabilities, such as the predisposition for hallucinatory experiences, with the presence of negative and stressful stimuli such as screams for the presence of paranoid ideation. Thus, it may well be the case that on a day to day basis when individuals possess such a predisposition if they hear negative sounds such as a scream or a woman sobbing they tend to perceive them in a paranoid way, that is they attribute threatening and malevolent meaning to them and this installs a vicious circle of vigilance and paranoid defences that help to maintain the paranoid schemata (Gilbert, Boxall, Cheung and Irons, 2005).

Under the light of an evolutionary perspective, (Gilbert, 2001 a,b, Gilbert, 2002, Gilbert et al., 2005) the perception of threat in a hallucinatory way leads to reasoning errors and to paranoid explanations that are automatically activated whenever faced with negative affective laden sounds. This being the case, an individual that has a tendency to hear voices, on hearing a woman screaming, he/she immediately perceives this as a threat and attributes paranoid meaning, e.g. someone is trying to hurt me and I should watch out.

Limitations

This study presented several limitations. The sample was small and was composed mainly of females so it makes it harder to generalize. However, in spite of this, the literature does suggest that there are no significant differences between males and females of a non-clinical sample on the frequency of paranoid thoughts (Freeman, Garety et al., 2005). Therefore, we can argue that in spite of our gender ratio being skewed, results do suggest that a higher frequency of paranoid thoughts may well be associated to a predisposition to hallucinate. We suggest that further studies would use another method to test for this (e.g. physiological reactions to sounds), rather than self-report that leads to demand characteristics and other samples with a less skewed distribution. There were as well some methodological problems, such as the influence of external variables, e.g. negative life events and "noise" that may have had an impact on symptoms of depression and paranoid reactions. We also suggest the use of another measure to examine paranoid ideation in order to grant validity to the study. We used a uni-dimensional measure for paranoia so we didn't measure the different dimensions of this phenomenon.

Clinical implications

Clinical aspects of research suggest that therapy should address how individuals deal with negative sounds and how they induce paranoia. Our study suggests that sounds can elicit emotion and that negative emotional sounds are associated not only with negative emotion

such as anxiety but also to paranoia. It seems therefore that the inability to regulate emotions and abnormalities in perception are key vulnerability factors in psychopathology. Thus our study gave support to interventions such as mindfulness that encourage a string acceptance of negative affect. Our findings also gave support to positive psychology that encourages the development of positive emotions. Positive psychology has been claiming that positive emotions such as joy lead to psychological well-being. In addition, there is also established agreement in the literature that certain sounds are effective in reducing stress in students (Bradley and Lang, 2000a, b). Moreover, music is thought to be a powerful instrument for mood control, to change emotions, to release emotions, and to match current emotion, and people have been using music to change emotions, to enjoy or comfort themselves, and to relieve stress (Juslin and Västjfäll, 2008). Hence, positive affective laden sounds could be used to reduce stress in patients and can serve as instruments of emotion control. Preventive measures could address the tendency to hallucinate and its relationship to paranoia and could also try to help the individual to process stimuli in a non-hallucinatory way, by helping him/her to find other meanings for abnormal stimuli (Freeman, Gittins et al., 2008; Freeman, Pugh et al., 2008).

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