INDIVIDUAL DIFFERENCES IN ANGER REACTION TO NOISE

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ABSTRACT

Background: A review of the literature demonstrates an association between noise and anger. It is hypothesised, however, that this association would not be the same for every subject, but depend on a large range of psychobiological differences between individuals, dependent on age, sex, and noise sensitivity of each subject. The aim of this study was to investigate these eventual individual differences in how the subjective sensitivity to noise is associated to different dimensions of anger in adolescents of different age and of both sexes. Methods: For this purpose two self-report instruments were chosen: the Sensitivity to Noise test (SENSIT) (Santisteban, 1990, 1992) and the State-Trait Anger expression Inventory (STAXI) (Spielberger, 1988). Results: showed: a) a globally significant correlationship between sensitivity to noise and the different anger aspects: feelings (in anger state), temperament (in trait anger), and internal expression (in anger expression); and b) different characteristics according to the psychobiological peculiarities of each subject (subjective sensitivity to noise, age, sex). Conclusions: in accordance to the hypothesis, the present results suggest that noise may act as a stressor causing unwanted aversive changes in an affective state, such as anger; b) that these changes are related to several psychobiological characteristics of the subject, such as age, sex, and individual sensitivity to noise; and c) that noise sensitivity, measured by SENSIT, may be used as a good predictor of anger.

INTRODUCTION

There is an increasing interest in environmental issues of noise pollution (from disturbance and other adverse effects of airports neighbourhoods or annoyance of traffic noise or to too loud rock music), given its damaging effects on health and well being. According to a recent survey of the European Environmental Agency, almost 67% of the urban population has a noise impact over the limit of tolerance (65 dB). This fact has made prominent the problem of noise-induced hearing impairment. Besides these physical damages involving inner-ear mechanisms, the exposure to either intense sudden sounds (e.g. a close jet engine, greater than 120 dB) or to chronic noise that in the least is unpleasant (noise is often defined as 'unwanted sound'), may also have detrimental psychosocial effects (Alvarado, Delgado, Santisteban & Zuluaga, 1994; Shepherd, 1974; Staples, Cornelius, & Gibbs, 1999), and even lead to psychiatric disorders (Stansfeld, 1992; Stansfeld, Clarck, Jenkins & Tarnopolsky, 1986).

Already in the last 1970's, several studies in laboratory and in naturalistic settings showed adverse facilitatory effects of high-intensity noise on anger and subsequent aggressive behavior: high-intensity noise facilitated aggression for previously angered individuals (Bell, 1980; Donnerstein & Wilson, 1976; Sherrod, Moore, & Underwood, 1979; Turner, Layton, & Simons, 1975).

A review of the literature shows that an exposure to a moderate low frequency noise load (e.g. from an air-conditioning unit, 40-60 dB) can also have subtle but significant psychological morbidity, such as tiredness, concentration difficulties (Santisteban & Santalla, 1990, 1993 a, 1993 b), a feeling of pressure on the head (Berglund, Hassmén & Soames Job, 1994), mental performance impairment (Alvarado et al., 1994; Belojevic, Öhrström & Rylander, 1992; Persson Waye, Rylander, Benton & Leventhall, 1997; Smith & Jones, 1992; Smith & Stansfeld, 1986), general annoyance (Persson Waye & Rylander, 2001), irritability (Tarnopolsky et al, 1980), anger (Miller, 1974), and enhancing stress responding (Jelinkova & Picek, 1986; Persson Waye, Bengtsson, Rylander, et al, 2002). Noise does not have to be necessarily produced by high-level sounds therefore in order to induce deleterious effects. In a West London Survey, comparing symptoms of high and low noise exposure areas, it was found that symptoms did not increase with increasing levels of noise: acute

symptoms were more common in high noise, but 20 out of 23 chronic symptoms were more common in low noise (Tarnopolsky et al, 1980). And even pleasant sounds (for instance, classical music, 75dB) showed more disturbing effects than silence on recall performance (Santisteban & Santalla, 1993 b).

The most widespread and well-documented subjective response to noise is annoyance, understood as a mild form of anger, with a relationship between noise exposure level and annoyance (Cohen & Weinstein, 1981; Santisteban, 1988; Stansfield, 1992, Stansfeld, Sharp, Gallacher, Babish et al., 1994). A modest but consistent association has usually been found between noise sensitivity ('a predisposition to perceive noisy events' (Taylor, 1984)) and noise annoyance ('an attitudinal dimension indicating the extent to which noisy events are evaluated unfavourably' (Taylor, 1984)), with an overall mean correlation from 11 studies of r=0.3 (Job, 1988). Zimmer & Ellermeier (1999) have also found a relationship between noise sensibility, measured by Weinstein's scale, and trait anger, applying the STAXI). It seems evident therefore that there is a certain association between noise and anger.

This association between noise and anger, however, need not be the same for every subject. There is evidence of a large range of psychobiological differences among individuals, dependent on age, sex, and noise sensitivity of each subject (Jelinkova & Picek, 1986; Kryter, 1985; Weinstein, 1978), among other individual variables as a personality trait. Noise thus might cause morbidity within certain vulnerable groups, but not in others, according to individual subject characteristics. For instance, noise sensitivity showed a positive relationship with neuroticism and introversion, and a negative one with extraversion (Alvarado et al. 1994; Belojevic, Slepcevic & Jakovljevic 2001; Dornic & Ekehammar, 1990: Goldberg, 1972; Öhrström, Björkman, & Rylander, 1988; Stansfeld, 1992; Tarnopolsky & Morton Williams, 1980, Turrero, Zuluaga, & Santisteban, 2001).

The aim of this study was to investigate individual differences in how the subjective sensitivity to noise is associated to different dimensions of anger in adolescents of different age and of both sexes. For this purpose self-report instruments were chosen because, considering that sensitivity to noise and feelings of anger are subjective elements, they are central to a better understanding of the effects of noise in relation to anger (Stansfield, 1992), nevertheless we are aware that psycho-physiological

measurements may also be required to complement and provide external validation for the subjective measurements, and that exploratory analyses may find only weak relationships between self-report measures of noise sensitivity and objective performance decrements under noise (Zimmer & Ellermeier, 1999).

Specifically, two self-report measures were chosen: the Sensitivity to Noise test (SENSIT) (Santisteban, 1990, 1992) and the State-Trait Anger expression Inventory (STAXI-2) (Spielberger, 1988). SENSIT measures the individual sensitivity toward sounds. Its version A, for youth and adults (SENSIT-NA), was applied. The complete test is composed by two different questionnaires. The first questionnaire (QI) measures psychophysiological traits, and it is used as a control scale of the second one (QII), which measures sensitivity to noise. The STAXI-2 provides relatively brief, objectively scored measures of the experience, expression, and control of anger (Spielberger, 1988; Spielberger, & Syderman, 1994). It has proved useful in normal and abnormal individuals (Deffenbacher, 1992; Moses, 1992), and has also been used to examine relationships of anger with well-being, and stress (Schlosser, 1986), among other studies.

As the main working hypothesis, some individual differences in the relationship between noise and anger were expected: a) subjects highly sensitive to noise would report stronger anger feelings; and b) age and gender would also present some differential effects. Specifically, according to previous literature, older people were expected to have a higher sensitivity to noise (Moreira & Bryan, 1972; Weinstein, 1978; Taylor, 1984; Stansfeld, 1992); and women would also show higher noise sensitivity than men (Nivison & Endresen, 1993). Consequently, it was expected that both (older people and women) would also show stronger anger reaction to it.

MATERIAL AND METHODS

Subjects: A sample composed by 234 adolescents of both sexes (91 boys and 143 girls) between 15 and 19 years of age, from several high school colleges of Madrid, was tested.

Questionnaires:

Individual sensitivity to noise was measured by SENSIT-NA, which contains two different questionnaires: 1) QI, composed by nine items psychophysiologically oriented; it includes three factors: introversion, hyperactivity and health, and it is used as a control scale of the QII; and 2) QII, with forty seven items environmentally oriented; it is conformed by three subscales relating noise sensitivity to cognitive processes, such as ability for concentration, thinking, reading, working (factor 1); to psychophysiological reactions, such as humour changes, sleeping quality, heart beat (factor 2); and behavioural attraction toward noisy environments, such as turning on radio or TV as noisy background, attending noisy bars or, on the contrary, preference for quiet residential areas (factor 3).

The different dimensions of anger were measured by the STAXI-2, consisting of forty four items, which form five primary scales: State (15 elements), Trait (10 elements), Anger-In, Anger-Out, and Control (these last three, composed by 19 items, were the anger expression scale).

Design and statistical treatment

This descriptive study employed a correlational design that looked for the presence or absence of relationships among the various constructs using the Pearson product moment correlation with an alpha level of .05. Additionally, analysis of variance was used to determine if there were any differences in the constructs (anger and sensitivity to noise) and subject variables (sex and age). Sensitivity to noise was grouped in three according to their intensity (high, medium and low) taking the 25% of the higher and lower puntuations in the scale QII as groups of high and low sensitivity respectively.

RESULTS

I) Before analysing the data obtained applying the mentioned questionnaires, the characteristics of both tests, SENSIT-NA and STAXI-2 were tested on our sample. The reliability, means, standard deviations and ranges for the subscales of SENSIT-NA and STAXI-2 are presented in Table 1. A high reliability (Cronbach´α coefficient) was found for all scales of both tests

INSERT TABLE 1

II) The correlations between the SENSIT-NA and STAXI-2 subscales are presented in Table 2:

INSERT TABLE 2

a) Correlationship between SENSIT-NA and STAXI-2 Anger State was significant ($p < 0.01$) only for the feeling components ($r = 0.26$ for QI, and $r = 0.18$ for Q II), but not for the anger expression.

b) Correlationship between SENSIT-NA and STAXI-2 Anger Trait were statistically significant ($p<0.01$) for both components of trait anger: anger temperament ($r=0.31$and $r=0.21$ for QI y QII respectively); and for anger reaction ($r=0.20$ and $r=0.21$ for QI y QII respectively).

c) Correlationship between SENSIT-NA and STAXI-2 Anger Expression Index were statistically significant ($p<0.01$) with the expression components, and specially to the Internal Expression ($r = 0.27$ for QI, and $r = 0.20$ with Q II), but not to the control ones.

d) The higher correlation values were obtained between trait anger and trait state ($r>=0,43$) and between the trait anger and AEI ($r>0,42$)

III) A multivariate analysis of variance (MANOVA) was conducted to detect the influence of gender, age and individual sensitivity to noise differences on the measures of state anger and trait anger. Following significant effects were found:

a) Individual sensitivity to noise showed a main effect of $F_{2,221}=7,55$ ($p<0.01$). It seems to be due to the scores on anger state as well as anger trait increased concomitantly with sensitivity to noise scores. State anger mean for low sensitivity to noise group is 17,78, being 19,29 for medium level and 21,01 for the high sensitivity level group. The trait anger means were 19.35, 20.33 and 22.65 for high, medium and low sensitivity groups levels. A post hoc Bonferroni test showed statistically significant differences in anger between the high sensitivity to noise group and the

médium level group p=0.019) and also with the low sensitivity group (p<0.001).

b) Age showed a main effect of $F_{1,221}$=4,45 (p=0.036). Young obtained higher scores than adolescents in anger. The anger state means were 18.56 for youngs and 20.17 for adolescents. Less differences were observed between means 20.23 versus 21.31 in Age (adolescents-14/16 years- and young –17/20 years-)

c) Interaction sex x anger showed a main effect of $F_{1,221}$=5,292 (p=0.022). Whereas anger trait level was similar in both sexes, anger state was lower in women than in men (fig. 1).

INSERT FIGURE 1

IV) A second ANOVA was performed to analyze the influence of sex and age on some of the four components of Anger Expression Index (internal control, external control, internal expression, external expression). A significant interaction was found between Anger Expression Index and sex: men obtained higher scores than women in external control [$F_{3,663}$= 3,014 (p=0.029)] (fig. 2).

INSERT FIGURE 2

DISCUSSION

The purpose of this study was to compare the subjective feelings of anger and its expression with the sensitivity to noise. The main conclusions were that noise may act as a stressor causing unwanted aversive changes in an affective state, such as anger; and that these changes are related to several psychobiological characteristics of the subject, such as age, sex, and individual sensitivity to noise.

While average population measures of noise annoyance agree fairly strongly with noise exposure, being associated in a dose-response relationship (Schultz, 1978; Tarnopolsky & Morton Williams, 1980), at any particular noise exposure level there is a wide individual variation in the degree of annoyance and anger felt. Individual

factors such as noise sensitivity and attitudes to noise sources account for more variance than plain noise exposure (Job, 1988). Noise sensitivity determines the level of anger. Higher sensitive people may attend and react more readily to noises, perceive increased threat from noises exposure and may have a slower adaptation to noises and pre-existing negative affectivity than people who are less sensitive (Stansfeld, 1992). This observation, as well as another recent one focused to low frequency noise, noting that high-sensitive subjects generally rated a higher value on stress than low-sensitive subjects (Person Waye et al, 2002), support the 'vulnerability hypothesis' (Tarnopolsky et al., 1980), according to which noise sorts individuals into annoyance categories according to their vulnerability to stress: at any noise level there may be some individuals who take little notice of it and some who are extremely annoyed by it.

Anger assessment shows individual differences too. The higher individual sensibility to noise, the higher levels of anger in all the three measured aspects. For instance, years ago Rosenzweig (1976, 1978) differentiated between 'impunitive' persons who do not experience anger in anger provoking situations, and 'intrapunitive' persons who turn anger in. Some people seem to be chronically angry and hostile but experience little dysfunction because of that anger, whereas others experience high levels of anger, dysfunction, and display problematic behaviors (Reid, 2000). It is further suggested that individuals with a higher trait anger (those who experience anger more frequently) are more likely to express anger than to suppress it, and may feel a higher sensibility to noise just because of their higher tendency to be annoyed, irrespective of the real meaning of the noise. For disturbing noises, the noise-sensitive people may show greater variability in anger under different conditions of noise exposure than less sensitive people, but will remain consistently highly annoyed over long periods of time.

The finding of a higher correlationship between noise sensitivity and anger in the older group (17-20 years) than in the younger ones (14-16 years) matches quite well with previous findings of Miedema and Vos, (1999), collecting data on transportation noise in Europe, North America, and Australia, who also found that age had an effect on annoyance, being this effect on annoyance dependent on the noise level. It may be explained because of their higher degree of maturation: the older ones

may be more self-aware of the presence of noise and the need of its avoidance (see also Ramirez, Bonnioc, & Cabanac, in press). And a similar effect was already observed by our group in speech intelligibility tests applied to subjects of the same range of age as in the present study (from 14 to 18 years of age): estimating sensitivity to noise, related to sex, age, and personality traits such as neuroticism, extraversion, and attention, and its effects on the performance, older subjects were more sensible to environmental noise (Turrero et al.,2001).

Men and women experience and express anger in different ways, as the old nursery rhyme claims that little girls are made of "sugar and spice and everything nice," and little boys are made of "slugs and snails and puppy dog tails". Evaluating gender differences in the different anger aspects measured by STAXI, we found that anger state was higher in boys than in girls, whereas on trait and on expression the scores were similar in both sexes. Spielberger et al. (1983), while investigating the validity of the Anger Expression Scale, found that girls reported higher anger expression than boys. Later, however, using the same instrument, Spielberger, Reheiser, & Sydeman (1995), got opposite results: males scored significantly higher than females on trait and on expression of anger, whereas no gender differences were found in state, or control measures. Other studies have reported differences in anger expression (Faber & Burns, 1996), with a higher frequency and intensity of anger in females (Brebner, 2003; Brody et al, 1985), and differences in anger management training needs of police officers (Abernethy & Cox, 1994). And finally many authors failed to find any gender difference in anger expression, using both child (Brody, 1985; Brody, Lovas, & Hay, 1995; Buntain & Costenbader, 1997; Zenman & Shipman, 1996) and adult samples (Averil, 1983; Koper, 1993; Koper & Epperson, 1991, 1996). According to Thomas (1989, 1993) women were more likely to discuss their anger than men, and their trait anger was strongly related to perceived stress.

Although the reasons for these mixed results are unclear, a possible explanation lies in the specific characteristics of the sample population and how these characteristics influence the measurement used (Suter et al. 2002). Some insight is provided through research using clinical populations, where sex differences have been reported. For example, Funabiki Bologna, Pepping, and FitzGerald (1980) found sex differences in the verbal hostility displayed by depressed patients, while Novaco

(1994, cited in O'Neill, 1995 b) found sex differences while collecting normative data for the Novaco Anger Scale, with females scoring higher than males. Sex differences have also been found in the behavioural manifestations of anger. Kelsall, Dolan, and Bailey (1995) reported that females accounted for almost half of the violent incidents reported at an adolescent forensic unit, despite constituting only a third of the population under study. While these results appear counter-intuitive, Kelsall et al. (1995) included self-harm in their measures of violent behaviour, which may be relevant to the gender imbalance of reported violent incidents. Such a finding is supported by a study in which females scores higher on the *indirect expression of anger* (Swaffer & Epps, 1999). These authors hypothesised a link between such scores and self-harming behaviour.

Previous research of our group (Ramirez, Fujihara, van Goozen & Santisteban, 2001; Ramirez, Santisteban, Fujihara & van Goozen, 2002; Van Goozen, Cohen-Kettenis, Sancho, Fujihara, & Ramirez, 1996), administering the Anger Situation Questionnaire (ASQ) (van Goozen et al. 1994) to European and Japanese people, found that even if the feelings of anger experience were higher than the readiness to action in everybody, men seem to have a stronger disposition than females to express their angry feelings in an aggressive way.

How to explain these gender differences in anger, and probably in its relationship to noise sensitivity too? Explanations range from social to biological perspectives. Richardson and Green (1999), for instance, argued that women would be more socially inhibited than men, perhaps, because the likelihood of social sanctions for such behaviour might be higher for females. Gur and Gur (2002), on the contrary, based on the evidence that males have greater brain size than females (even after adjusting for body size) prefer to argue that women's brains are better at handling anger because the part of the brain that modulates aggression is smaller in men than it is in women. Both sexes would have about the same ability to produce emotions, but when it comes to keeping those emotions in check, men have been short-changed. But, if evolution stumbled on a way of making women's brains especially compact, we could wonder why doesn't it make men's brains more compact too? Why on earth would such an advantageous biological innovation be sex-specific?

And, according to the present study, males and females may also be different in their sensitivity to noise: whereas in girls there was a positive correlationship between all the different anger aspects and noise sensitivity, in boys this correlationship was only found between the trait anger and sensitivity to noise. Nivison and Endresen (1993): studying 82 adults (aged 19-78 yrs) who lived beside a street with different levels of traffic, observed a relationship between poor sleep quality and sensitivity only in women, with a stronger relationship among noise sensitivity, health complaints, and poor sleep quality for women than for men. On the contrary, Alvarado et al. (1994), studying the performance of 209 students (aged 14-18 yrs) in very noisy environments, observed that girls were better than boys in attention tasks. A possible evolutionary explanation of the higher sensitivity to noise in women might be considering female sensitivity to noise stemming from the fact that being the child bearer and in charge of 'attending her offspring', she needs to be able to hear whenever it would be required. This biological reason for being more sensitive to sound might lead to conclude, even if only at a speculative level, that any other sound not related to biological needs would be irritating to her, as she cannot turn off her extra sensitivity.

Finally, even if the SENSIT questionnaire has probed useful as a predictor of anger, it would be of interest to further complement the subjective interactions of anger and noise sensitivity presented in this study, providing external validation and assessing other psychological correlates of anger, such as aggression or impulsiveness, in a setting of meaningful noise with due attention to contextual factors in terms of socio-economical, cultural, and other environmental situations, such as our group has in project to carry. Other psycho-physiological measurements may also be required. For instance, given the association between both noise and anger with cortisol (Persson Waye et al, 2002; Ramirez, in press), it would also be convenient to analyze cortisol levels, as well as the habituation for the effects studied here.

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Table 1. The reliability (Cronbach's α), Means, Standard Deviations and Ranges of SENSIT-NA and STAXI-2.

	α	Mean	SD	Range
SENSIT-NA				
QI	0.7029	19.1116	4.2594	11-33
QII	0.8973	107.9115	17.0686	65-154
STAXI-2				
State anger	0.9055	19.2414	6.0904	15-45
Trait anger	0.7739	20.6696	4.6497	12-36
AEI				
Expression	0.6469	22.8899	4.6735	12-42
Control	0.7994	30.9474	6.3445	12-48

Note. Anger Expression Index (AEI) = 36 + (Expression – Control).

Table 2. Interrelations Among SENSIT-NA subscales (QI and QII) and STAXI-2 subscales (State anger, Trait anger and Anger Expression Index)

	QI	**QII**	**State anger**	**Trait anger**	**AEI**
QI	---				
QII	0.6067**	---			
State anger	0.2045**	0.1541*	---		
Trait anger	0.3001**	0.2536**	0.4327**	---	
AEI	0.1913**	0.1400*	0.2849**	0.4228**	---

Note. All tests were two-tailed.

*p<0.05; **p<0.01

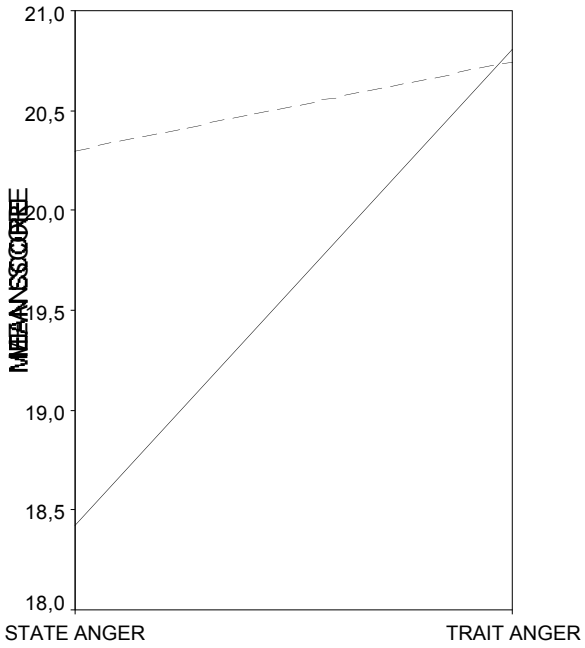

Figure 1. Mean score in anger state and anger trait for male (dash line) and female (solid line).

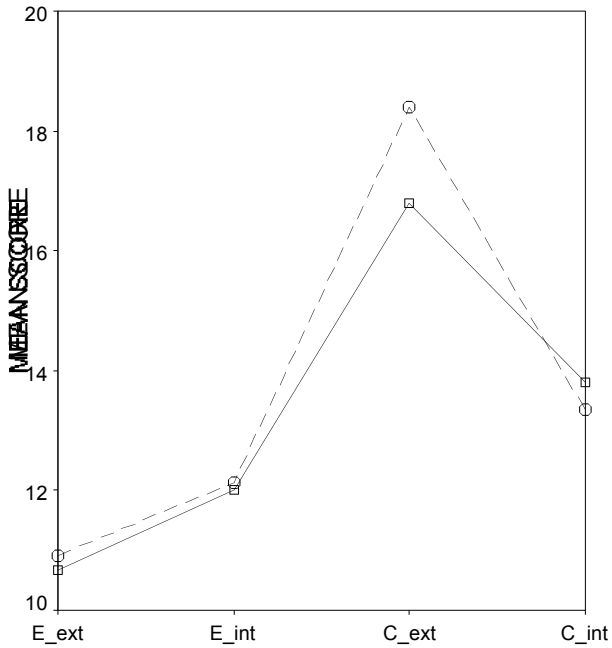

Figure 2. Mean score in external expression, internal expression, external control and internal control for male (dash line) and female (solid line).