anales de psicología, 2015, vol. 31, nº 1 (enero), 28-36
http://dx.doi.org/10.6018/analesps.31.1.162281

ISSN edición impresa: 0212-9728. ISSN edición web (http://revistas.um.es/analesps): 1695-2294

Differential effectiveness of two anxiety induction procedures in youth and older adult populations

Ignacio Montorio[1], Roberto Nuevo[2*], Isabel Cabrera[3], María Márquez[1], and María Izal[1]

[1] Faculty of Psychology (Autónoma University of Madrid) (Spain)
[2] School of Social and Community Medicine (University of Bristol) (UK)
[3] San Rafael-Nebrija Health Sciences Center, Universidad Antonio de Nebrija, Madrid (Spain)

Título: Eficacia diferencial de dos procedimientos de inducción de la ansiedad en poblaciones de jóvenes y adultos.
Resumen: En este estudio se comparó la eficacia en personas mayores y jóvenes de dos procedimientos habituales para inducir experimentalmente ansiedad: a) frases auto-referenciales Velten combinadas con música; b) escenas de películas. Así, este trabajo extendió hallazgos previos en este campo a la poca estudiada área de la inducción de estados de ánimo en la edad avanzada. Se asignó aleatoriamente a 57 personas mayores y 94 estudiantes universitarios a una de las dos condiciones experimentales o aun grupo control. Los resultados mostraron que ambos procedimientos eran efectivos, de acuerdo con el cambio en varios ANOVAs para diferentes autoinformes y medidas fisiológicas y conductuales. Asimismo, los tamaños del efecto más elevados se encontraron en el procedimiento Velten (g = .81 *vs.* g = .71) y los efectos fueron significativamente mayores en jóvenes que en personas mayores (g = 1.0 *vs.* g = .62 en la condición Velten; Q=4.25, $\chi^2(1)$, p = .0392). Los dos procedimientos fueron efectivos para inducir ansiedad en ambos grupos de edad, aunque especialmente en el caso del procedimiento Velten en los jóvenes. Por tanto, el uso de frases Velten combinadas con música parece un procedimiento útil para inducir ansiedad en investigaciones en situaciones controladas sobre las emociones a lo largo del ciclo vital.
Palabras clave: Emoción; cognición; inducción del estado de ánimo; experimento; envejecimiento.

Abstract: In this study, we tested in older and younger adults the efficacy of two well-known procedures to experimentally induce anxiety: a) Velten self-statements combined with music; b) film scenes. We extended the previous findings in this field to the understudied area of mood induction in older adults. Fifty-seven older adults and 94 college students were randomly assigned to one of the experimental conditions or to a control group. Results indicated that both procedures were effective, according to a series of ANOVAs for several self-report, physiological, and behavioral measures. Likewise, the highest effect sizes were observed for the Velten procedure (g = .81 vs. g = .71), and the effects were significantly higher in younger (g = 1.0 in the Velten condition) than in older adults (g = .62), Q = 4.25, $\chi^2(1)$, p = .0392. Both procedures were effective to induce inducting anxiety in both age groups, especially the Velten procedure in younger adults. Therefore, Velten self-statements combined with music may be very useful anxiety induction procedure for further research in controlled situations of emotions across the life-span.
Key words: Emotion; cognition; mood induction; experiment; aging.

Introduction

In the past two decades of psychological research, a current of renewed interest in the experimental analysis of the interaction of emotion and neurobiological processes and of emotion and cognition has become consolidated (Márquez & Delgado, 2012; Ochsne & Phelps, 2007). The main lines of research have either analyzed clinical samples or clinical analogues in laboratory or therapy situations or else they have focused on the analysis of natural emotions provoked by natural events or situations. There is an alternative experimental paradigm to both these procedures, which increases internal validity and has led to a significant advance in the research of emotions: experimental mood induction.

Through mood induction procedures (MIPs), one can to reproduce, in the laboratory and under controlled conditions, concrete transitory moods or emotional states that are supposed to be experimental analogies of the moods that occur in natural situations (García-Palacios & Baños, 2002). In most studies that employ MIPs, such moods are induced in order to study their influence, on neurobiological or cognitive processes. Currently, diverse MIPs have been described and analyzed, which have shown their capacity to induce sadness, negative affect, and depressed mood that are very similar in intensity and characteristics to those found in patients with clinical depression (Falkenberg, Kohn, Schoepker, & Habel, 2012; Gilet, 2008; Meilán et a., 2012).

The following negative induction procedures have received the most support from the empirical data: (a) Velten self-statements (Velten, 1968), a procedure in which participants read sentences in the first person that describe emotions, subjective states, or situations that represent or are congruent with a sad mood; (b) participants' exposure to sad or melancholy pieces of music; (c) participants' exposure to films or emotional images and (d) experimental situations of success/failure. The efficacy of using diverse combinations of different procedures to generate moods has also been reported (Slyker & McNally, 1991). Exhaustive reviews of the diverse MIPs, their advantages and limitations and concrete application procedures can be found in Gilet (2008).

Although there are diverse studies in which anxiety was induced (Albersnagel, 1988; Slyker & McNally, 1991), there is less empirical data available about the effectiveness of MIPs to generate this emotion in the laboratory. Orton et al. (Orton, Beiman, La Pointe, & Lankford, 1983) adapted Velten's procedure to induce anxiety, and Albersnagel (1988) confirmed the effectiveness of the Velten procedure to induce anxiety, although he found no differences between this

*** Dirección para correspondencia [Correspondence address]:**
Roberto Nuevo. School of Social & Community Medicine. University of Bristol. Oakfield House, Oakfield Grove, Clifton, Bristol BS8 2BN (UK).
E-mail: roberto.nuevo@bristol.ac.uk

method and participants' exposure to a piece of potentially anxiogenic music. Marzillier and Davey (2005) confirmed the efficacy of exposure to scenes from films with anxiogenic content for generating anxiety, and this has subsequently been confirmed in other works.

The study of the efficacy of the diverse MIPs has been carried out predominantly with samples of young or middle-aged adults, and to a lesser degree with children, but there are scarcely any studies that contrast MIPs in older adult. Despite the relevance of the interaction between emotion and cognition in old age, and the fact that there is reason to think that some ageing-related changes in cognitive and/or emotional functioning (Orgeta, 2009) could somehow interfere with the effectiveness of the MIPs observed in younger adults, there is not enough empirical evidence to endorse the validity of the use of MIPs in this population.

Regarding anxiety induction, we only found one work (searches in *PubMed* and *PsychInfo* in August 2012) in which this emotion was experimentally induced in older people. It was the study of Fox and Knight (2005), who induced anxiety in older adults to explore attentional biases. They were requested to perform a cognitive task with time pressure and informed that their performance would be recorded on video and subsequently evaluated by expert judges. An important methodological problem in this study was that the anxiety induction method was specifically designed to older adults, and could not be an anxiety MIP valid for all ages. This is an important issue as older people and youths do not react with anxiety to the same stimuli (Montorio, Nuevo, Márquez, Izal, & Losada, 2003).

This study aimed to analyze the efficacy of two anxiety induction procedures in older adults and younger samples compared with a neutral mood induction control group. We analyzed the following MIPs: (a) a combination of anxiogenic Velten self-statements, plus listening to an anxiogenic piece of music, plus an incubation period, and (b) watching film scenes of anxiogenic content plus an incubation period. Both conditions were compared with a neutral condition that consisted of a combination of neutral Velten sentences plus listening to a neutral piece of music. Both conditions represent two different combinations of anxiety induction procedures, which maximized the efficacy in the studies analyzing them (Gilet, 2008).

Method

Ethics statement

Before the experiment, the participants read and signed an informed consent. The study was approved by the Universidad Autónoma de Madrid Ethics Committee (Madrid, Spain).

Sample

A total of 151 people agreed to participate voluntarily in the study. Of the total sample, 57 people were individuals over 60 years of age who attended a day center for older adult. Seven older adults were eliminated because they presented a possible cognitive impairment. The final sample of older adults had a mean age of 69.3 years (*SD*=6.8; range: 60-86). Of this sample, 74% were women. The young sample was comprised by 94 undergraduate students, mean age of 21.8 years (*SD*=1.2; range: 20-27). Of the sample, 84% were women.

Instruments

Dependent variables. To assess the efficacy of the two anxiety induction procedures, we measured cognitive, motor, and psychophysiological aspects before and after induction.

Level of state anxiety was assessed by means of the Tension subscale of the Profile of Mood Scale (POMS). This subscale has 9 items with a 5-point Likert-type response format, ranging from 0 (*not at all*) to 4 (*very much*), with scores ranging from 0 to 36. We also administered two visual analogue scales (VAS). The first assessed mood by asking how the person felt at the present moment (scale range: 0 = *very bad* to 100 = *very good*), and the second question concerned the level of tension or nervousness felt at that moment (scale range: 0 = *not at all nervous* to 100 = *extremely nervous*).

The behavioral level was assessed by asking the participants to count out loud from 1 to 10 at any desired speed. In previous studies, it has been confirmed that this test is efficient because rapid speech rate is associated with a higher level of anxiety (Dimberg & Thunberg, 2007). While people counted, their voice was recorded with the Sony Sound Forge 4.5 program. Finally, we measured two psychophysiological variables: skin conductance and heart rate. For this purpose, we used the psychophysiological recording apparatus BioFeedback 2000. The recording procedure was adjusted to the indications of the manual of the device, including a 5-minute habituation period.

Induction Procedures

Anxiety induction procedure with Velten sentences plus music (hereafter V+M)

This procedure consisted of reading 40 self-statements (Velten, 1968), listening to a piece of music, and mood incubation. Half of the anxiety inducing sentences were the same for both groups and were taken fo those proposed by Sinclair, Soldat, and Ryan (1997), and were referred to psychophysiological sensations of anxiety or to general worries (e.g., "I'm so afraid- my whole life makes me feel tense and worried. I feel like I have no control "). They were selected because of their high arousal capacity as reported in a previous study (Sinclair et al., 1997). The other 20 sentences were

selected from the Worry Domains Questionnaire (WDQ; Tallis, Eysenck, & Mathews, 1992) for the sample of youths and, for the older adults, from the Scale of Older People's Worries according to the topics that cause the most concern to each group (Montorio et al., 2003). The sentences were read at the speed of one every 12 seconds. Subsequently, the participants listened to a fragment of Ligeti's *Requiem.* This piece of music was selected after a pilot study (N = 20) in which the anxiety generated by this piece of music was compared to that caused by Schoenberg's *Erwartung,* used in previous studies to induce anxiety (Mennin, McLaughlin, & Flanagan, 2009). We also included a short 2-minute incubation period, because it has been confirmed that this intensifies the induced mood and it makes it last longer (Sinclair, Mark, Enzle, Borkovec, & Cumbleton, 1994).

Anxiety induction procedure by watching scenes from films (hereafter F)

This procedure consisted of watching a video made up of seven scenes of anxiogenic content from three different films, plus mood incubation. To select the scenes, in addition to carrying out a review of the literature of the films used in other studies, we performed a filmographic review of different films that could generate anxiety, with the collaboration of a cinema expert. Scenes were taken from "What lies beneath" (2000), "Damien: Omen II" (1978), and "Pi" (1998). After watching the video, a 2-minutes mood incubation was carried out. Both anxiety procedures had the same duration, taking approximately 13 minutes.

Control procedure (hereafter C)

This procedure consisted of reading 40 neutral sentences from the original work from Velten (1968) and listening to a piece of music. The sentences were read at the speed of one every 12 seconds. After reading the sentences, the participants listened to Fauré's *Ballad for piano and orchestra,* which has been used in other studies to induce neutral mood (Albersnagel, 1988), and then mood incubation was carried out. The total duration of the neutral procedure was approximately 13 minutes.

Procedure

All the participants were scheduled individually and randomly assigned to one of the two experimental conditions or to the control group. According to Sinclair and collaborators (1994), the introduction of a demand for honesty can be useful to counteract the demand effect of mood induction procedures, so we requested the participants to be sincere in their responses because the study in which they were collaborating could help other people in the future. After completing the questionnaires and mood assessment prior to anxiety induction, we explained to the V+M and F groups that the goal of the study was to determine the extent to which they could change their mood and, specifically, they should try to get nervous. Next, they were informed that both the sentences and the music, as well as the film scenes were selected to help them get nervous. The people in the control group were only requested to read some sentences and to listen to a piece of music.

In addition, the V+M participants were instructed to first read each sentence out loud and then silently, and to concentrate on the sentence content and to think that it evoked a real situation and with real meaning for them. Before playing the music, the participants were requested to give in to their feelings, and they were encouraged to use memories, images, or any other thing that would help them get nervous. The people from the control group were asked to first read each sentence out loud and then silently, to concentrate on the sentence content and to think of how it could be related to them, and while they listened to the music, they were asked to go along with their feelings. Incubation was carried out at the end of the procedure in the two experimental groups by the experimenter's suggestion that they concentrate on their feelings of nervousness, whereas the control group was asked to think about what the sentences and the music had suggested to them.

For the older group, to prevent the interference of possible age-related motor difficulties when turning pages to change to the next sentence, we presented the sentences by computer (Toshiba M40, 15.4-inch LCD screen, font size 28) and used an automatic switch every 12 seconds. For the group of youths, all the sentences were printed on 21 x 14.8-cm pages, in Verdana font, size 22, and in a booklet bound with rings. Every 12 seconds, the experimenter asked the participant to turn to the next page. In the older group, we also increased the decibels of the two pieces of music as of high frequencies (2000 Hz) to counteract the effects of presbycusis that are common in this age group according to the normative data (Allen & Eddins, 2010).

Results

Firstly, we carried out an ANOVA to confirm that there were no differences among the participants of the three conditions prior to anxiety induction. The results showed that the groups were equivalent. These same analyses were performed on the age groups separately, finding the same results.

In order to compare the effectiveness of the two types of anxiety induction, we performed a series of univariate ANOVAs with two independent between-subject variables (age with two levels: older adults vs. youths; and the induction anxiety procedure with three levels: V+M, F, and C) and various dependent variables: the change produced between the pre- and posttest scores in the following: VAS mood, VAS Nervousness, the Tension subscale of the POMS, the behavioral task, heart rate, and skin conductance. Table 1 shows the mean, standard deviation, statistics with associated probability and the post-hoc analyses of the main effect of the anxiety induction procedure of these uni-

variate comparisons. The results indicate that, for the variable VAS mood, there was a significant effect of the anxiety induction procedure, $F(2, 145)= 23.8$, $p < .001$. Pairwise comparisons revealed statistically significant differences among the V+M and C conditions and the C and F conditions, ($p < .001$), but not between the V+M and F conditions ($p = .362$). Thus, participants in the V+M and the F conditions worsened their mood more than those in the C condition. The levels of mood before and after anxiety induction for each one of the conditions are presented in Figure 1.

Table 1. Univariate Comparisons of the Conditions for the Total Sample with the Pre-post Difference as Dependent Variable.

Measures	Velten & Music		Film		Control Group		*F*	*p*	Post-hoc
	Mean	*SD*	Mean	*SD*	Mean	*SD*			
VAS Mood	23.0	27.0	17.0	21.9	-5.8	13.7	23.8	< .001	A & B > C
VAS Nervousness	18.5	28.6	16.7	21.2	-13.8	20.2	29.9	< .001	A & B > C
Tension (POMS)	6.3	6.8	4.9	6.1	-2.4	3.1	31.7	< .001	A & B > C
Behavioral task	0.5	1.9	-0.4	1.6	-1.0	1.5	7.7	< .001	A > B & A > C
Heart rate	-1.6	8.5	-.4	9.4	-1.7	6.3	0.2	.790	-----
Conductance	0.05	0.98	0.03	0.7	0.2	1.8	0.2	.849	-----

A = Velten sentences plus music condition. B = Film condition. C = Control group.

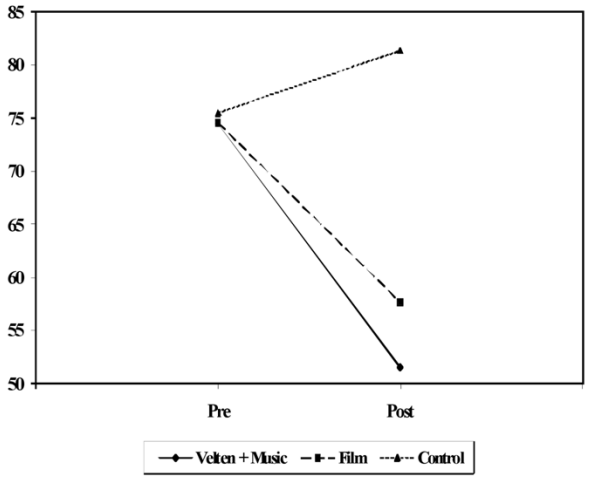

Figure 1. Levels of the variable VAS mood before and after anxiety induction for the total sample.

For the dependent variable VAS nervousness, there was a significant effect of type of induction, $F(2, 144)=25.9$, $p < .001$, again, differences were found between the V+M and C conditions and between the F and C conditions ($p < .001$), but not between the two anxiety induction procedures. Thus, participants from the two experimental conditions increased their nervousness significantly in comparison to the control group.

With regard to the Tension subscale of the POMS, there was a significant main effect of age, $F(1, 140)=9.9$, $p = .002$, with a higher increase after induction in the group of youths ($p < .001$). There was also a significant main effect of type of anxiety induction procedure, $F(2, 140)= 31.7$, $p < .001$. Pairwise comparisons revealed that participants in the V+M and F conditions significantly increased their level of tension in comparison with group C ($p < .001$) but again, there were no differences between the two experimental conditions ($p = .375$). Lastly, we found a significant Age x Anxiety induction procedure, $F(2, 140)= 3.2$, $p = .042$, the results of which are shown in Figure 2. We compared the simple effects to analyze the interaction, following the procedure proposed by Pardo and collaborators (Pardo, Ruiz, & San Martín, 2007), finding that, in comparison to condition C, the group of youths increased their level of tension more than the group of older adults, both in the V+M procedure, $t(72)= -2.5$, $p = .014$, and in the F procedure, $t(66)= -2.6$, $p = .011$.

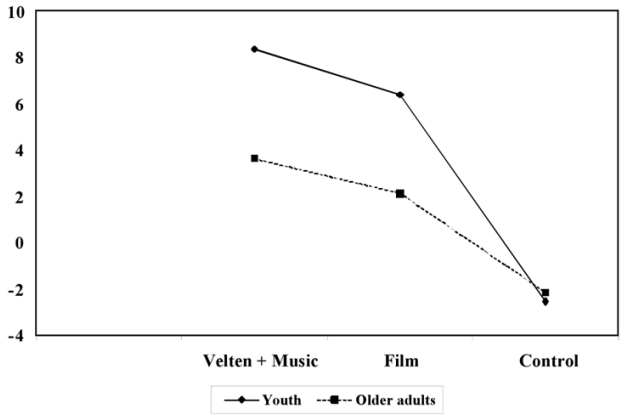

Figure 2. Effect of the interaction among the variables age and induction procedure in the pre-post change in the Tension subscale of the POMS.

In the behavioral variable, there was a significant main effect of age, as the group of older adults took less time to count from 1 to 10 in comparison to the group of youths, $F(1, 127)= 6.5$, $p = .012$. There was also a significant main effect of type of induction, $F(2, 127)=.7$, $p < .001$. Pairwise comparisons indicated that participants in the V+M condition decreased the time needed to count from 1 to 10 in comparison to the F and C conditions ($p = .027$ and $p < .001$, respectively).

With regard to the two psychophysiological variables, heart rate and skin conductance, no differences were found between the age groups or the types of anxiety induction.

Another goal of the study was to determine the efficacy of the anxiety induction procedures in each age group separately. For this purpose, we compared the three conditions by means of unifactorial ANOVAs, taking as dependent var-

iable the pre-post differences in each dependent variable. Tables 2 and 3 show the mean, standard deviation, statistics with associated probability and the post-hoc analyses of these ANOVAs. In the group of youths, the pattern of results was similar to that of the analysis conducted on the two age groups conjointly; that is, statistically significant differences were observed in the two experimental conditions in the variables VAS mood, VAS nervousness, and the Tension subscale of the POMS, in comparison to the control group. In the behavioral variable, there were no differences between the F and C conditions, but differences were found between the V+M and the C conditions ($p < .001$). The results found in the two age groups taken conjointly were maintained in the group of older adults for the variables VAS nervousness and the Tension subscale of the POMS, but the effects of the variable VAS mood was only maintained in the V+M condition ($p = .003$) but not in the F condition, and no differences were found between the experimental conditions and the control group in the behavioral variable. Figure 3 presents the time needed to carry out the behavioral task in the group of youths and of older adults in each condition before and after anxiety induction.

Table 2. Univariate Comparisons of the Conditions for the Sample of Youths with the Pre-post Difference as Dependent Variable

Measures	Velten & Music		Film		Control Group		*F*	*p*	Post-hoc
	Mean	*SD*	Mean	*SD*	Mean	*SD*			
VAS Mood	25.1	21.0	19.8	16.7	-3.1	10.6	25.1	< .001	A & B > C
VAS Nervousness	23.0	21.2	18.3	22.0	-13.1	17.4	29.2	< .001	A & B > C
Tension (POMS)	8.3	6.6	6.4	6.9	-2.6	2.6	31.2	< .001	A & B > C
Behavioral task	0.9	1.9	-0.02	1.5	-1.0	1.4	9.8	< .001	A > C
Heart rate	-1.9	8.4	-0.6	10.4	-2.5	6.0	0.4	.657	-----
Conductance	0.06	1.0	0.1	0.7	0.3	1.5	0.4	.653	-----

A = Velten sentences plus music condition. B = Film condition. C = Control group.

Table 3. Univariate Comparisons of the Conditions for the Sample of Older Adults with the Pre-post Difference as Dependent Variable

Measures	Velten & Music		Film		Control Group		*F*	*p*	Post-hoc
	Mean	*SD*	Mean	*SD*	Mean	*SD*			
VAS Mood	20.1	33.9	11.4	29.4	-10.6	17.1	6.1	< .004	A > C
VAS Nervousness	12.1	36.0	13.8	20.2	-14.9	24.9	5.7	< .006	A & B > C
Tension (POMS)	3.6	6.2	2.1	2.9	-2.2	3.8	7.8	< .001	A & B > C
Behavioral task	0.2	1.7	-1.3	1.7	-1.1	1.8	1.8	.175	-----
Heart rate	-0.9	8.8	0.3	6.7	0.1	7.0	0.1	.895	-----
Conductance	0.04	1.0	-0.2	0.6	0.01	2.5	0.07	.931	-----

A = Velten sentences plus Music condition. B = Film condition. C = Control group.

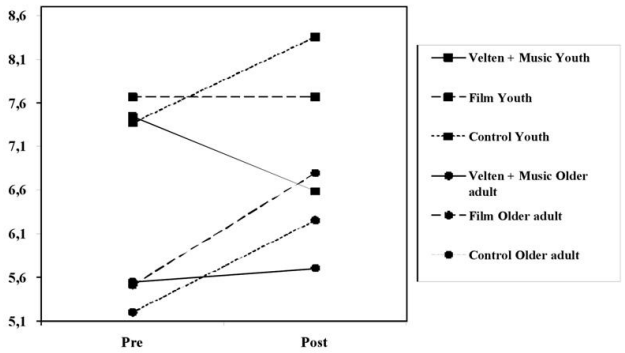

Figure 3. Time needed to carry out the behavioral task before and after anxiety induction for each age group.

Lastly, we calculated the effect size (Hedges' *g*) for each anxiety induction condition, with the entire sample on the on hand and, on the other, the age groups separately. We also determined whether there were any differences in the effect sizes among conditions by means of homogeneity tests. The effect size was calculated globally for the variables that had shown significant effects: VAS mood, VAS nervousness, and the Tension subscale of the POMS. The weighted average effect size for the three dependent variables for the total sample was slightly higher (M_{ES} = .812, 95% *CI:* .995/.629) for the V+M condition than for the F condition (M_{ES}=.714, 95% *CI:* .961/.467). The heterogeneity test indicated differences not explained in the V+M condition, Q = 15.51, distributed as $\chi^2(7)$, p = .0299, whereas homogeneity could be assumed for the F condition, Q=6.83, distributed as $\chi^2(7)$, p= .4467. The average effect size of the V+M condition in the sample of older adults was .624 (95% *CI:* .880/.368) and that of the F condition was .553 (95% *CI:* .931/.175). In the sample of younger adults, the effect sizes of the V+M and F conditions were 1.010 (95% *CI:* 1.263/.739) and .834 (95% *CI:* 1.160/.508), respectively. The test for differences between younger and older adults in the V+M condition revealed that the younger adults had significantly higher effect sizes, Q_B = 4.25, $\chi^2(1)$, p = .0392.

Discussion

This study examined the utility and validity of two anxiety induction procedures for adults of any age, including people of advanced age. This is a current research requirement because of the great interest in the experimental analysis of the interaction of emotion and neurobiological processes and of

emotion and cognition. This can be explored through the analysis of the effects of emotions and moods on cognitive processes (Ochsne & Phelps, 2007). These studies should not exclude a relevant part of the adult population such as older adults. This is justified because the findings of gerontological research reveal differences between younger and older adults in cognitive, affective, and neurobiological functioning, which should be taken into account by any experimental analysis of emotion that includes samples of older adults (Phillips, Smith, & Gilhooly; 2002).

Specifically, the present study compares the efficacy of two anxiety induction procedures in young and older adults: on the one hand, a combination of anxiogenic Velten self-statements plus listening to a piece of anxiogenic music and, on the other, watching various film scenes of anxiogenic content. These two procedures were compared to a neutral condition that included neutral Velten phrases plus listening to a piece of neutral music. The selection of these procedures was guided by the review of the literature, which concluded that the two procedures represented two different combinations of anxiety induction, which maximized the efficacy of the anxiety induction procedures in the studies that analyzed it (Gilet, 2008).

The results of the study show that both procedures are effective to induce anxiety. The participants report higher tension, more nervousness, and they feel worse after undergoing the anxiety induction procedures. Likewise, the participants in the V+M condition show an increase in speech rate in comparison to the other conditions. No consistent changes in the psychophysiological parameters we analyzed were observed.

A key issue of this investigation was to determine the efficacy of the two induction methods in each age group, and whether either of them is more effective with samples that include diverse adult age ranges. The results reveal that the sample of young adults behaved like the conjoint sample of the two experimental induction conditions, that is, they felt worse, were more tense, more nervous, and their speech rate increased –only in the V+M condition– when compared to the control group. Among the older adults, some of these effects were observed V+M condition, but not in the F condition. However, the mean changes were systematically higher in the V+M condition (see Table 1) than in the F condition either in the total sample (Table 1) or in the sample of younger and older adults separately (Tables 2 and 3, respectively). When the degree of change according to the analysis of the effect sizes is included, this is corroborated and it can therefore be concluded that the V+M procedure is globally superior to the F procedure (effect size .81 vs. .71), as well as that it is more effective in the youths (g = 1.0 in V+M, .83 for F) than in the older adults (.62 and .55, respectively).

With regard to other experimental induction works, this investigation introduces some noteworthy methodological variants. Firstly, many studies have based the success of the induction on participants' self-rating of their mood, comparing a negative mood induction with a positive one without including a control condition. This could generate interpretation difficulties due to the metric limitations involved; for example, happiness and sadness are not necessarily symmetrical measures of the same mood (Richell & Anderson, 2004). In this study, we have attempted to overcome this limitation by including the comparison to a true control condition, with participants in whom we induced a neutral mood. Secondly, the success criterion of induction was expanded from the traditional self-rating of mood to a broad group of subjective, behavioral, and psychophysiological responses. Thirdly, the procedures were partially adjusted to the diverse experiential, physical, and sensory characteristics of the younger and older participants. For this purpose, half of the Velten phrases selected were specific for each age group, reflecting their essential concerns. The sensory characteristics of the induction stimuli were also adapted taking into account age-related differences

Regarding the sensitivity of the diverse measures employed and their comparison with previous results, all the prior literature has indicated that the greatest effect of the change in mood has been found in self-reports (Sandvik, Diener, & Seidlitz, 2009). Likewise, the different rates of change found among the three self-report procedures used should be interpreted in the sense that they all measure different subjective emotional aspects (Shapiro, MacInnis, & Park, 2002). Regarding the behavioral measure based on speech rate, it is difficult to establish solid conclusions. In the case of the youths, the V+M procedure led to a significant increase in speech rate, an effect that did not occur in the F condition. In the case of the older adults, there was some parallelism with the youths, because in the V+M condition, there was also higher speech rate. Although behavioral measures may be a reliable way to assess mood changes after mood induction, other works, as in this study, have not been consistently capable of showing changes in measures such as psychomotor speed (Richell & Anderson, 2004). The same can be said with regard to the use of traditional psychophysiological measures (Etzel, Johnsen, Dickerson, Tranel, & Adolphs, 2006). Psychophysiological measures have been used less frequently, they have produced inconsistent results and, as in this study, the lack of change after mood induction has been inconsistently documented (Larsen, Berntson, Poehlmann, Ito, & Cacioppo, 2008). Etzel et al. (2006) could not find out differences in traditional measures of cardiovascular reactivity after listening musical pieces, whereas strong changes in the emotional experience were reported. A possible explanation for that difference between objective and subjective measures is that participants could exaggerate their emotional experience using the mood they perceive that music is expressing, but there is not empirical evidence supporting this idea. Interestingly, the authors suggest that given the sample of the study, mainly older adults (50-74 years old), cardiovascular responses could have muted due to age, and propose make studies comparing younger and older adults. The present work goes pre-

cisely in this line, and that explanation do not fit to our results, as there were not physiological changes in any group of age, despite of the lower psychophysiological reactivity that is typical of old age (Labouvie-Vief, Lumley, Jain, & Heinze, 2003) although a recent meta-analysis (Uchino, Birmingham, & Berg, 2010), also indicates that older adults present higher systolic blood pressure reactivity during emotionally evocative tasks.

It should be noted that younger and older adults are surely differing in their audiovisual learning, A limitation inherent to cross-sectional studies comparing older and young persons is associated with the idea that comparisons do not only involve differences in age, but different socio-cultural trajectories, what is known as cohort effect. According to that effect results could be partially explained by these different trajectories. In that sense, it should be highlighted that the main utility of the present study is proposing a common and valid procedure for inducting anxiety, invariant across age for the experimental analysis of emotion, not only because of the cohort effect, also for cognitive and affective changes associated with aging, which could make more or less valid any procedure depending on the age of the persons participating in the induction. In that sense, the main goal of the study has been fulfilled, as a common valid procedure of induction can be proposed despite of those two known limitations outlined above. On the other hand, several steps were taken for avoiding cohort effects and trying to guarantee that induction procedures were adequate regardless age: Velten statements were selected separately for each group choosing those topics that have proved to cause the higher concern to this group in previous research; musical excerpts and film scenes were selected in agreement with experts specifically asked to guide their selection for the adequacy to any group of age; a pilot study was developed for music and films in order to test that were producing changes in the emotional state, and in the expected direction; and, finally, in the selection of the film scenes, an explicit effort was made for avoiding the inclusion of images of terror, violence, or scenes excessively explicit, potentially closer to the audiovisual language of younger adults. In fact, scenes selected were contemporary, but similar to thrillers of the fifties or the sixties. This approach of specific adaptations in the induction of emotions has been recently supported in a study of Ellard, Farchione, and Barlow (2012). Nevertheless, differences in musical and audiovisual languages between groups of ages, probably remain, and despite of the efforts to avoid biases in the selection of the material included in the induction procedures, some arbitrary is necessarily included.

Likewise, aging in this work is considered as a continuum in the life span development, focusing on manifest changes or transformations that occur in human behavior related to length of life. Much of the literature on aging of different competence in adulthood has been concerned with the comparison of performance levels between different age groups (Schaie, 1994). However, there have also been extensive discussions of the internal validity of such comparisons. These discussions have explicated the theoretical assumptions that should be met in order to demonstrate that the relationship between the measures used to mark the latent theoretical constructs of interest remain invariant across age. For the researcher in aging, these issues are of central concern for age-comparative cross-sectional studies. These concerns are both methodological and substantive. In this sense, as indicated before, the main utility of the present study is proposing a common and valid procedure for inducting anxiety, invariant across age for the experimental analysis of emotion. As well, it analyzes the effects of such manipulation on neurobiological or cognitive processes in the frame of cognitive and affective neuroscience and the experimental psychopathology. To induce emotions elicits changes in cognition (e.g., attentional bias), judgment (e.g., the risk perceived), experience (e.g., the recognition that one is anxious), behaviour (e.g., a tendency to avoidance), and physiology (e.g., increased respiration) that are adapted to facilitate a response to the types of environmental changes that elicit that emotion.

Additionally, it is interesting to analyze the results of this study from an information processing perspective, and the effects of aging in this processing. On one hand, memory processes are involved, as memory mediates retaining of information needed for an effective induction procedure. There is a known loss of memory with aging, but recent findings suggest that memory is relatively well preserved in advanced age for emotional material, visual or verbal, although is better for positive than for negative information (Mikels, Larkin, Reuter-Lorenz, & Carstensen, 2005), whereas for not emotional material memory loss with aging is higher. These results suggest that aged people would not be affected by memory loss as induction implies only the exposition to emotional information. On the other hand, it is possible that even when both V+M and F procedures are valid and effective regardless age, differences in favour of V+M could be explained for differences associated with age in verbal and visual processing. Taking together previous research in this topic, there is evidence indicating that differential deficits observed on speeded and unspeeded tasks strongly suggest that visual processing is generally more affected by aging than verbal cognition (Jenkins, Myerson, Joerding, & Hale, 2000). This difference could partially explain the more intense effects in the V+M procedure.

One of the main implications of results this work is in its application to the study of clinical anxiety. The study of cognitive processes associated with anxiety has usually involved comparisons between a clinical group with a control group. Persons with an anxiety disorder present high levels of anxiety making difficult discerning if between-groups differences are attributable to emotional states or to stable characteristics of personality, such as trait-anxiety level (Mathews & MacLeod, 1994). Validated procedures of anxiety induction can be helpful in clarifying and disentangling in the laboratory the contribution to emotional states and per-

sonality traits in the patterns of cognitive processing associated to anxiety.

Before carrying out a final appraisal, some limitations of the study should be mentioned. First, the reduced size of the groups limits the statistic power to detect subtle changes and, particularly, the capacity to examine the interaction of the effects of the experimental conditions and the two age groups. Although it is typical of induction studies and it also affects this study, another problem is related to individual efficacy after mood manipulation. Though the procedures are effective as a whole, the results reveal substantive variability in mood modification and, therefore, some people may be expected to respond only minimally to mood manipulation. Finally, although efforts were made in order to choose sentences, music, and film scenes optimizing the anxiougenous load, using as possible quantifiable and expert criteria, some arbitrary necessarily remains.

The two MIPs tested are potentially useful for experimental mood manipulation and to analyze the effects of such manipulation on neurobiological or cognitive processes. We also consider them to have apparent validity to fulfill the research goal. In any event, an anxiety induction procedure that consists of reading Velten self-statements plus listening to anxiogenic music followed by a short incubation period seems to be a valid procedure for most adults, independently of their age. This procedure would be a successful combination and would imply a first induction that occupies foreground attention and a second one that contributes to a congruent background atmosphere (Jallais & Gilet, 2010). There are some general problems inherent to the use of experimental mood induction procedures. However, MIPs, particularly the Velten method, seem to be an useful procedure for the experimental study of the effects of emotions on cognitive and brain activity (Gadea, Espert, Salvador, & Martí-Bonmatí, 2011).

Acknowledgments.- Supported by the Spanish Ministry of Science and Innovation (Ministerio de Ciencia e Innovación): research grant PSI2008-02338. The sponsor played no role in study design or conduct of the study, the collection, management, analysis, or interpretation of data, the preparation, review, and approval of the manuscript, or the decision to submit the manuscript for publication.

All authors declare that they have no financial or competing interests in the manuscript.

References

Albersnagel, F. A. (1988). Velten and musical mood induction procedures: A comparison with accessibility of thought associations. *Behaviour Research and Therapy, 26*, 79-96.

Allen, P., & Eddins, D. A. (2010) Presbycusis phenotypes form a heterogeneous continuum when ordered by degree and configuration of hearing loss. *Hearing Research, 264,* 10-20.

Dimberg, U., & Thunberg, M. (2007). Speech anxiety and rapid emotional reactions to angry and happy facial expressions. *Scandinavian Journal of Psychology*, *48*, 321–328.

Ellard, K-K., Farchione, T. J., & Barlow, D.H. (2012). Relative effectiveness of emotion induction procedures and the role of personal relevance in a clinical sample: a comparison of film, images, and music. *Journal of Psychopathology and Behavioral Assessment, 34,* 232-243.

Etzel, J., Johnsen, E., Dickerson, J., Tranel, D., & Adolphs, R. (2006). Cardiovascular and respiratory responses during musical mood induction. *International Journal of Psychophysiology, 61*, 57-69.

Falkenberg, I., Kohn, N., Schoepker, R., & Habel, U. (2012) Mood Induction in Depressive Patients: A Comparative Multidimensional Approach. *PLoS ONE 7*(1): e30016.

Fox, L. S., & Knight, B. G. (2005) The effects of anxiety on attentional processes in older adults. *Aging & Mental Health 9,* 585-593.

Gadea, M., Espert, R., Salvador, A., & Martí-Bonmatí, L. (2011). The sad, the angry, and the asymmetrical brain: Dichotic Listening studies of negative affect and depression. *Brain and Cognition, 76*, 294-299.

García-Palacios, A., & Baños, R. (1999). Eficacia de dos procedimientos de inducción del estado de ánimo e influencia de variables moduladoras. *Revista de Psicopatología y Psicología Clínica, 1*, 15-26.

Gilet, A. (2008). Mood induction procedures: A critical review. *Encephale, 34*, 233-239.

Jallais, C., & Gilet, A. L. (2010). Inducing changes in arousal and valence: comparison in two mood induction procedures. *Behavior Research Methods, 42,* 318-325.

Jenkins, L., Myerson, J., Joerding, J. A., & Hale, S. (2000). Converging evidence that visuospatial cognition is more age-sensitive than verbal cognition. *Psychology and Aging, 15*, 157-175.

Labouvie-Vief, G., Lumley, M.A., Jain, E., & Heinze, H. (2003). Age and gender differences in cardiac reactivity and subjective emotion responses to emotional autobiographical memories. *Emotion, 3,* 115-126.

Larsen, J. T., Berntson, G. G., Poehlmann, K. M., Ito, T., & Cacioppo, J. (2008). The psychophysiology of emotion. In M. Lewis and J. M. Haviland-Jones (Eds.), *Handbook of emotions* (pp. 173-191). New York: Guilford.

Márquez, M.G., & Delgado, A.R. (2012). Revisión de las medidas de reconocimiento y expresión de emociones. *Anales de Psicología, 28,* 978-985.

Marzillier, S. J., & Davey, G. C. L. (2005) Anxiety and disgust: Evidence for a unidirectional relationship. *Cognition and Emotion 19,* 729-750.

Mathews, A., & McLeod, C. (1994). Cognitive approaches to emotion and emotional disorders. *Annual Review of Psychology, 45,* 25-50.

Meilán, J. J. G., Carro, J., Guerrero, C., Carpi, A., Gómez, C., & Palmero, F. (2012). El efecto de memoria congruente con el estado afectivo: reconocimiento diferencial de palabras de tristeza y alegría. *Anales de Psicología, 28,* 266-273.

Mennin, D. S., McLaughlin, K., & Flanagan, T. (2009) Emotion regulation deficits in generalized anxiety disorder, social anxiety disorder, and their co-occurrence. *Journal of Anxiety Disorders, 23,* 866-871.

Mikels, J. A, Larkin, G-R, Reuter-Lorenz, P.A., & Carstensen, L. L. (2005). Divergent trajectories in the aging mind: Changes in working memory for affective versus visual information with age. *Psychology and Aging, 20,* 542-553.

Montorio, I., Nuevo, R., Márquez, M., Izal, M., & Losada, A. (2003). Characterization of worry according to severity of anxiety in elderly living in the community. *Aging & Mental Health, 7*, 334-341.

Ochsne, K., & Phelps, E. (2007) Emerging perspectives on emotion–cognition interactions. *TRENDS in Cognitive Sciences, 11*, 317-318.

Orgeta, V. (2009) Specificity of age differences in motion regulation. *Aging & Mental Health, 13*, 818-826.

Orton, I. K., Beiman, I., La Pointe, K., & Lankford, A. (1983). Induced states of anxiety and depression: Effects on self-reported affect and tonic psychophysiological response. *Cognitive Therapy and Research, 7*, 233-244.

Pardo, A., Ruiz, M. A., & San Martín, R. (2007) How to fit and interpret multilevel models using SPSS. *Psicothema, 19*, 308-321.

Phillips, L. H., Smith, L., & Gilhooly, K.J. (2002). The effects of adult aging and induced positive and negative mood on planning. *Emotion, 2*, 263-272.

Richell, R. A., & Anderson, M. (2004). Reproductibility of negative mood induction: A self-referent plus musical mood induction procedure and a controllable/uncontrollable stress paradigm. *Journal of Psychopharmacology, 18*, 94-101.

Sandvik, E., Diener, E., & Seidlitz, L. (2009). Subjective Well-Being: The Convergence and Stability of Self-Report and Non-Self-Report Measures. *Social Indicators Research*, 39, 119-138.

Schaie, K. W. (1994). The course of adult intellectual development. *American Psychologist, 49*, 304-313.

Shapiro, S., MacInnis, D. J., & Park, C. W. (2002). Understanding program-induced mood effects: Decoupling arousal from valence. *Journal of Advertising, 31*, 15-26.

Sinclair, R. C., Mark, M. M., Enzle, M. E., Borkovec T. D, & Cumbleton, A. G. (1994). Toward a multiple-method view of mood induction: The appropriateness of a modified Velten mood induction technique and the problems of procedures with group assignment to conditions. *Basic and Applied Social Psychology, 15*, 398-408.

Sinclair, R. C., Soldat A.S., & Ryan, C. A. (1997). Development and validation of Velten-like image-oriented anxiety and serenity mood inductions. *Basic and Applied Social Psychology, 19*, 163-182.

Slyker, J. P., & McNally, R. J. (1991). Experimental induction of anxious and depressed moods: Are Velten and musical procedures necessary? *Cognitive Therapy and Research, 15*, 33-45.

Tallis, F., Eysenck, M., & Mathews, A. (1992). A questionnaire for the measurement of nonpathological worry. *Personality and Individual Differences, 13*, 161-168.

Uchino, B. N., Birmingham, W., & Berg, C. A. (2010). Are older adults less or more physiologically reactive? A meta-analysis of age-related differences in cardiovascular reactivity to laboratory tasks. *Journals of Gerontology, Series B, Psychological Sciences and Social Sciences, 65B,* 154-162.

Velten, E. (1968). A laboratory task for induction of mood states. *Behaviour Research and Therapy, 6*, 473-482.

(Article received: 4-11-2012; revision received: 10-12-2013; accepted: 14-2-2014)