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Inducing changes in arousal and valence: Comparison of two mood induction procedures

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This research examined the relative effectiveness of two mood induction procedures (MIPs) for inducing four specific moods varying along the dimensions of both valence and arousal. Participants were randomly assigned either to an autobiographical recall or to a music and guided imagery MIP and underwent a happiness, serenity, anger, or sadness mood induction. The findings confirmed the effectiveness of the two MIPs in producing changes on both the valence and arousal dimensions of mood. The results also revealed an unexpected greater efficiency of the autobiographical recall than of the combined procedure.

In many studies, the influence of mood on various cognitive tasks has been investigated by inducing different emotional states. Mood induction procedures (MIPs) can be defined as strategies whose aim is to momentarily change the participant's mood in an artificial and controlled way; the moods then elicited are supposed to be equivalent to naturally occurring moods. Since the pioneering study of Schachter and Singer (1962), a variety of experimental techniques have been developed to induce mood states in participants (for reviews, see Gerrards-Hesse, Spies, & Hesse, 1994; Gilet, 2008; Martin, 1990; Westermann, Spies, Stahl, & Hesse, 1996).

MPIs can be classified into two main categories: simple (use of only one mood induction technique) and combined (two or more techniques at once) methods. Among the simple MIPs, autobiographical recall is one of the most commonly used methods in research. It is considered one of the most effective MIPs (Baker & Gutterfreund, 1993) and as the best technique for inducing positive mood (Strack, Schwarz, & Gschneidinger, 1985). This technique has been successfully used in several studies to induce (positive and negative) mood states in participants tested individually or in small groups (e.g., Bless et al., 1996; Bodenhausen, Kramer, & Süsser, 1994; Brewer, Doughtie, & Lubin, 1980; Jallais & Corson, 2008; Krauth-Gruber & Ric, 2000).

Since it has been believed that multiple inductions contribute additively to a mood (Bower, 1981), further work has combined two or more techniques at once. Thus, the Velten MIP (Velten, 1968) has been successively paired with the hypnosis MIP (Natale & Hantas, 1982), the music MIP (Mayer, Gayle, Meehan, & Haarman, 1990), or the imagination MIP (Richardson & Taylor, 1982). Successful combinations of inductions usually use a first induction that occupies foreground attention and a second one that contributes to a congruent background atmosphere. One of the most commonly used combined MIPs was developed by Mayer, Allen, and Beauregard (1995). The authors associated a guided imagery task with music in order to increase the effectiveness of the MIP and the duration of the induced mood. This combined procedure has been used to induce positive or negative mood, as well as specific moods such as anger or fear (Corson, 2006; Corson & Verrier, 2007; Mayer et al., 1995).

Overall, these techniques were originally developed and successfully used to induce changes in the hedonic dimension of affect (valence). However, research has shown that affect is made up of at least two independent dimensions, valence and arousal (e.g., Russell, 1980; Russell & Feldman-Barrett, 1999). *Valence* is usually defined as the pleasant–unpleasant dimensions of mood, whereas *arousal* refers to a sense of mobilization of energy as activation versus deactivation or to the felt activation associated with affective phenomena (e.g., Feldman-Barrett, 2004; Kensinger & Schacter, 2006; Revelle & Loftus, 1992). Even if moods are usually defined as less intense than other affective states (e.g., Forgas, 1995), it is still possible to distinguish between negative moods with a lower (e.g., sadness) or higher (e.g., anger) level of arousal, as well as between positive moods with a lower (e.g., serenity) or a higher (e.g., happiness) level of arousal. Even if some studies on mood induction showed

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that any mood induction may simultaneously affect the dimensions of both valence and arousal (e.g., Gayle, 1997), the impact of MIPs on valence and arousal levels has yet to be systematically studied.

Nevertheless, some studies have compared the effectiveness of two or more MIPs on the induction of positive and negative moods, with somewhat inconsistent results (e.g., Albersnagel, 1988; Chartier & Ranieri, 1989; Clark, 1983; Isen & Gorgoglione, 1983). In their meta-analysis, Westermann et al. (1996) showed that even if most of the MIPs produced genuine changes in participants' mood after induction, they were not equally effective in inducing positive or negative mood states. For instance, the combined MIPs turned out to be among the most effective procedures in inducing negative mood, whereas film or story MIPs were clearly the most effective MIPs in inducing positive mood states. Even so, Slyker and McNally (1991) tested the relative effectiveness of four MIPs for inducing two specific negative mood states (i.e., anxiety and depression): instructions to get into the target mood, instructions + Velten, instructions + music, instructions + Velten + music (combined method). Their findings indicated that there were no reliable differences among MIPs (combined procedure or Velten) and thus suggested that a combined MIP is not necessarily more effective than a classic MIP. Westermann et al.'s (1996) meta-analysis also revealed that MIPs were generally more effective for negative than for positive mood inductions; this was especially true for combined MIPs. Consequently, many studies have been interested in the effectiveness and the magnitude of the observed effects in terms of the hedonic value of the mood induced (e.g., Albersnagel, 1988; Chartier & Ranieri, 1989; Clark, 1983; Isen & Gorgoglione, 1983; Slyker & McNally, 1991). But most of these studies did not systematically compare simple MIPs with combined MIPs. Moreover, the effectiveness of these MIPs on changes produced on the arousal dimension of mood has rarely been studied. Recently, two studies reported significant changes in valence and arousal ratings after a music + guided imagery MIP (Corson & Verrier, 2007) and an MIP using emotional images (Brunyé, Mahoney, Augustyn, & Taylor, 2009).

Because of the growing research interest in arousal effects on cognitive processing, studies investigating the impact of MIPs on both the valence and arousal dimensions are needed. The objective of the present study was to examine the influence of two widely used MIPs on the magnitude of change in self-reported valence and perceived arousal. We decided to address this question by comparing the effectiveness of two MIPs—that is, music + guided imagery (Mayer et al., 1995) and autobiographical recall (Strack et al., 1985)—since they are used in research. Both MIPs have been found to influence valence in expected directions, but not much is known about their influence on the dimension of arousal. We were interested in whether these MIPs would exert effects on the latter dimension of mood and whether they would differ in their effectiveness regarding changes in valence and/or perceived arousal. We investigated this issue by inducing four specific moods varying along both the valence and the arousal dimensions: two negative mood states with a low (e.g., sadness) or a high (e.g., anger) level of arousal and two positive moods with a low (e.g., serenity) or a high (e.g., happiness) level of arousal. In order to assess the effectiveness of the MIPs, we gathered valence and arousal self-report measures prior to and after the induction. If the MIPs simultaneously affect both valence and arousal levels (e.g., Gayle, 1997), we would expect an increase of the arousal level following an anger or happiness mood induction and a decrease of the arousal level following a sadness or serenity mood induction in the autobiographical recall condition, as well as in the combined MIP condition. Both the autobiographical recall and the combined MIP should also produce changes in valence in the predicted direction. Moreover, we expected the combined MIP to be more effective than the autobiographical recall for the induction of negative mood states (Westermann et al., 1996). In line with studies that have shown the influence of music on arousal (e.g., Hirokawa, 2004; Peretz, 2001), this combined MIP should also produce greater changes on the arousal level than should autobiographical recall.

METHOD

Participants

One hundred sixty undergraduate students (91% females; M = 19.4 years, SD = 3.47) at the University of Nantes were randomly assigned to one of the eight conditions of a 4 (condition: happy, serene, angry, and sad) × 2 (procedure: autobiographical recall vs. music + guided imagery) between-participants design. Twenty-three participants were induced in a happy mood (positive mood, high arousal), 20 were induced in a serene mood (positive mood, low arousal), 20 induced in sadness (negative mood, low arousal), and 22 induced in anger (negative mood, high arousal) using the music + guided imagery MIP (Mayer et al., 1995). The autobiographical recall MIP was proposed to the remaining participants, so that 18 participants were induced in a happy mood, 19 were induced in a serene mood, 19 were induced in sadness, and 19 were induced in anger.

Mood Induction Procedure

Autobiographical recall. This technique was originally described by Mosak and Dreikurs (1973). A modified version has been developed by Krauth-Gruber and Ric (2000). According to this version, participants are asked to recall and write down a happy or sad event that they experienced in the past. The participants in the serenity and anger conditions were asked to recall and write down a situation in which they had experienced serenity or anger. The participants were encouraged to provide as many details as they could and to report events as vividly as possible. The participants were given 10 min to perform this task.

Combined procedure. Happiness, serenity, anger, and sadness were induced using the combined MIP developed by Mayer et al. (1995). This procedure associates music and guided imagery. According to this MIP, participants first listened to 4 min of the following pieces of music previously used by Mayer et al. (1995): Delibes's *Coppélia* and Bach's *Brandenburg Concerto No. 2* (to induce a happy mood), Chopin's *Préludes* and Prokofiev's *Alexander Nevsky* (to induce a sad mood), and Holst's *The Planets* and Moussorgsky's *Night on Bald Mountain* (to induce anger). The musical selections used to induce serenity were compositions from Garceau and Iachini (2001) previously used by Corson (2006). Afterward, the experimenter lowered the volume of the music, and the participants performed a guided imagery task. Sentences describing a situation of everyday life—for example, "It's your birthday and your friends throw you a terrific surprise party" or "You are told by a young relative that she has cancer and only six months to live"—were then dis-

played on a screen. Sentences used to induce happiness, anger, and sadness were the French translations of the sentences used by Mayer et al. (1995), and sentences that were used to induce serenity were developed and successfully used by Corson (2006) and Corson and Verrier (2007). The participants were asked to imagine as vividly as possible the situation described. Each sentence (eight sentences in total) remained on the screen for 30 sec.

Measurement of Valence and Arousal

Before and after the mood induction phase, the participants were asked to complete questionnaires in order to assess their mood on both the valence and arousal dimensions.

Valence. To assess the valence dimension of their mood, the participants were asked to fill in a modified version of the Brief Mood Introspection Scale (BMIS; Mayer & Gaschke, 1988; modified by Corson, 2006; Corson & Verrier, 2007). The BMIS is a 16-item self-report questionnaire in which each adjective is rated on a 7-point scale. This modified mood scale is made up of 16 adjectives—that is, 4 adjectives specific to each mood state—that provide a sharper description of the four moods induced (see the Results section for further details). Mean scores were obtained for each group of adjectives.

Arousal. Following the valence evaluation, the participants were given a matrix from Eich and Metcalfe (1989)—an adaptation of the *affect grid* designed by Russell, Weiss, and Mendelsohn (1989)—in order to provide a measure of the arousal level of their current mood state. This simple scale has already been successfully used to assess changes in perceived arousal after mood induction (Corson, 2006; Corson & Verrier, 2007; Eich & Metcalfe, 1989) and is thought to reflect the synthesis of several specific physiological measures (Revelle & Loftus, 1992).

This matrix consists of 81 squares (9 lines × 9 columns). The horizontal dimension of the matrix indicates valence, and the vertical dimension indicates arousal level. The center of the matrix would represent neutral feelings: neither happy nor sad and neither aroused nor unaroused. The participants who experienced a high level of arousal would mark a square located at the top of the matrix, whereas the participants who felt slightly aroused or unaroused would mark at the bottom of the matrix. The participants were asked to mark the square that best reflected their current feelings. Scores of arousal were calculated by transforming the marks made by the participants along the vertical axis of the matrix into scores ranging from −4 (*very low arousal/unaroused*) to +4 (*extremely aroused*).

Procedure

The participants first completed the BMIS and the matrix before any mood induction in order to provide a measure of their current mood state on both valence and arousal dimensions.

Upon completion of the first questionnaire, an MIP (autobiographical recall or music + guided imagery) was proposed to small groups of participants (up to 10 at a time).

In order to reduce demand effects (Hertel & Rude, 1991; Parrott & Hertel, 1999), the participants in the autobiographical recall condition were told that they would participate in an experiment about autobiographical memory. They were then given 10 min to perform the autobiographical recall task.

The participants in the combined MIP condition first listened to music for 4 min, with instructions to relax and listen carefully to the music.

Finally, the participants filled out the BMIS and the matrix and were debriefed concerning the experiment. The participants in the sadness condition were allowed the opportunity to listen to the "happy" music in order to improve their mood at the end of the session.

RESULTS

The results are arranged in two sections. First, we examined the effectiveness of each MIP on a valence and on an arousal dimension. Second, we compared the two MIPs regarding their efficiency to affect both the valence and arousal dimensions of mood.

Assessment of Valence

We first examined the ratings of the adjectives denoting each mood in the BMIS. Table 1 provides mean scores computed for each of the four subscales of the BMIS (happiness: plein d'entrain/*lively*, heureux/*happy*, enjoué/*cheerful*, joyeux/*peppy*; sadness: triste/*sad*, cafardeux/*gloomy*, malheureux/*unhappy*, déprimé/*depressed*; anger: furieux/*furious*, hostile/*hostile*, enragé/*mad*, en colère/*angry*; serenity: paisible/*peaceful*, serein/*serene*, calme/*calm*, détendu/*relaxed*) and for each MIP (autobiographical recall and music + guided imagery).

Autobiographical recall. The mood manipulation was not equally effective in inducing all moods. Comparisons between the first and the second completions of the BMIS showed that for the happiness group, the ratings for the adjectives describing happiness increased [$F(1,71) = 7.27$, $MS_e = 0.48$, $p < .001$, $\eta^2 = .09$], whereas the ratings for the adjectives describing sadness and serenity did not increase significantly [$F(1,71) = 0.02$, $MS_e = 0.58$, n.s.,

Table 1
Mean Ratings and Standard Deviations for Adjectives Denoting Happiness, Serenity, Sadness, and Anger for Each Mood Condition Before and After Induction

	Before Mood Induction								After Mood Induction							
	Happiness		Serenity		Sadness		Anger		Happiness		Serenity		Sadness		Anger	
Mood Group	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Autobiographical Recall																
Happiness ($n = 18$)	**3.60**	**1.46**	4.69	1.31	2.04	0.96	1.82	1.31	**4.22**	**1.59**	4.88	1.12	2.06	1.40	1.28	0.44
Serenity ($n = 19$)	4.69	1.31	**3.59**	**1.46**	2.04	0.96	1.81	1.19	4.87	1.12	**4.22**	**1.59**	2.05	1.40	1.27	0.44
Sadness ($n = 19$)	4.90	0.91	4.34	0.92	**2.07**	**1.10**	1.33	0.46	4.27	1.01	3.06	1.27	**3.38**	**1.23**	1.51	0.84
Anger ($n = 19$)	4.98	0.96	4.31	1.26	1.64	1.00	**1.72**	**1.14**	3.71	1.56	3.15	1.41	2.16	1.05	**2.73**	**1.31**
Combined Procedure																
Happiness ($n = 23$)	**4.50**	**1.80**	4.86	1.36	2.06	1.39	1.29	0.50	**4.69**	**1.56**	5.34	1.11	1.50	0.63	1.25	0.57
Serenity ($n = 20$)	4.27	0.81	**5.52**	**0.99**	2.20	1.48	1.65	0.96	4.40	0.82	**6.07**	**0.95**	2.21	1.34	1.47	0.76
Sadness ($n = 20$)	4.62	1.32	4.75	0.89	**2.01**	**1.56**	1.70	1.21	3.21	1.21	4.33	0.97	**2.60**	**1.35**	1.61	1.14
Anger ($n = 22$)	3.96	0.94	5.11	1.25	1.92	1.32	**1.18**	**0.38**	3.09	1.13	4.07	1.41	2.23	1.39	**1.78**	**1.08**

Note—Scores relevant for each mood induction are in bold.

and $F(1,71) = 0.39$, $MS_e = 0.74$, n.s., respectively] and those describing anger decreased [$F(1,71) = 5.82$, $MS_e = 0.45$, $p < .05$, $\eta^2 = .08$]. But for the serenity group, the ratings for the adjectives denoting serenity [$F(1,71) = 0.27$, $MS_e = 0.73$, n.s.], as well as the ratings for the adjectives denoting happiness [$F(1,71) = 0.01$, $MS_e = 0.48$, n.s.], anger [$F(1,71) = 0.81$, $MS_e = 0.45$, n.s.], or sadness [$F(1,71) = 2.04$, $MS_e = .58$, n.s.] remained stable. For the sadness group, the ratings for the adjectives denoting sadness increased [$F(1,71) = 27.54$, $MS_e = 0.58$, $p < .0001$, $\eta^2 = .28$], whereas the ratings for the adjectives denoting anger, happiness, and serenity remained stable or decreased [$F(1,71) = 0.71$, $MS_e = 0.48$, n.s.; $F(1,71) = 32.01$, $MS_e = 0.48$, $p < .0001$, $\eta^2 = .31$; and $F(1,71) = 5.15$, $MS_e = 0.73$, $p < .05$, $\eta^2 = .07$, respectively]. Finally, for the anger group, the ratings for the adjectives denoting anger and sadness increased [$F(1,71) = 21.50$, $MS_e = 0.45$, $p < .0001$, $\eta^2 = .23$, and $F(1,71) = 4.27$, $MS_e = 0.58$, $p < .05$, $\eta^2 = .06$, respectively], whereas the ratings for the adjectives denoting happiness and serenity decreased [$F(1,71) = 26.34$, $MS_e = 0.48$, $p < .0001$, $\eta^2 = .27$, and $F(1,71) = 21.04$, $MS_e = 0.73$, $p < .0001$, $\eta^2 = .23$, respectively].

Comparisons within the second set of BMIS ratings showed that the groups were in fairly different moods after the induction procedure. The adjectives denoting happiness were assigned a higher value by the happiness group than by the other mood groups [$F(1,71) = 3.85$, $MS_e = 1.95$, $p < .05$, $\eta^2 = .05$]. The adjectives describing anger were assigned a higher value by the anger group than by the other mood groups [$F(1,71) = 22.72$, $MS_e = 1.02$, $p < .0001$, $\eta^2 = .24$]. Similarly, the sadness group gave higher ratings to the adjectives denoting sadness than did the other groups [$F(1,71) = 16.95$, $MS_e = 1.53$, $p < .001$, $\eta^2 = .19$]. Finally, the serenity group gave a higher value to the congruent adjectives than did the other groups [$F(1,71) = 6.68$, $MS_e = 1.66$, $p < .05$, $\eta^2 = .09$].

Combined procedure. Like autobiographical recall, this mood manipulation was not equally effective in inducing all moods. For the happiness group, from the first to the second measurement with the BMIS, the scores for the adjectives denoting happiness and anger remained stable [$F(1,81) = 0.24$, $MS_e = 0.47$, n.s., and $F(1,81) = 0.16$, $MS_e = 0.13$, n.s., respectively], whereas the ratings for the adjectives describing sadness decreased [$F(1,81) = 9.57$, $MS_e = 0.38$, $p < .01$, $\eta^2 = .11$], and those for the serene adjectives increased [$F(1,81) = 5.75$, $MS_e = 0.45$, $p < .05$, $\eta^2 = .07$]. For the serenity group, the ratings for the adjectives denoting serenity increased [$F(1,81) = 6.62$, $MS_e = 0.46$, $p < .05$, $\eta^2 = .08$], whereas the ratings for the adjectives describing happiness, anger, and sadness remained stable [$F(1,81) = 0.33$, $MS_e = 0.47$, n.s.; $F(1,81) = 2.33$, $MS_e = 0.13$, n.s.; and $F(1,81) = 0.04$, $MS_e = 0.38$, n.s., respectively]. For the sadness group, the ratings for the adjectives denoting sadness increased [$F(1,81) = 8.99$, $MS_e = 0.38$, $p < .01$, $\eta^2 = .10$], whereas the ratings for the adjectives describing happiness, anger, and serenity decreased or remained stable [$F(1,81) = 42.21$, $MS_e = 0.47$, $p < .0001$, $\eta^2 = .34$; $F(1,81) = 0.58$, $MS_e = 0.13$, n.s.; and $F(1,81) = 3.72$, $MS_e = 0.45$, n.s., respectively]. Finally, for the anger group, the ratings for adjectives denoting anger increased [$F(1,81) = 30.47$, $MS_e = 0.13$, $p < .0001$, $\eta^2 = .27$], whereas the ratings for the adjectives denoting sadness did not increase significantly [$F(1,81) = 2.90$, $MS_e = 0.38$, n.s.]. Ratings for happiness and serenity decreased in the anger group [$F(1,81) = 17.82$, $MS_e = 0.47$, $p < .0001$, $\eta^2 = .18$, and $F(1,81) = 25.74$, $MS_e = 0.46$, $p < .0001$, $\eta^2 = .24$, respectively].

After induction—that is, within the second set of BMIS—analyses revealed that the happiness group gave a higher value to the ratings of adjectives denoting happiness than did the other mood groups [$F(1,71) = 14.23$, $MS_e = 1.49$, $p < .001$, $\eta^2 = .15$]. However, the adjectives denoting anger were not assigned a higher value by the anger group, in comparison with the other groups [$F(1,71) = 2.24$, $MS_e = 0.83$, n.s.]. The sadness group gave higher ratings than did the other groups to the adjectives denoting sadness [$F(1,71) = 3.99$, $MS_e = 1.45$, $p < .05$, $\eta^2 = .05$]. Similarly, the serenity group gave higher ratings to the adjectives describing serenity than did the other groups [$F(1,71) = 26.26$, $MS_e = 1.28$, $p < .0001$, $\eta^2 = .24$].

Assessment of Arousal

Table 2 provides mean arousal ratings derived from the matrix, reported by the participants in the four mood conditions before and after autobiographical recall and the combined MIP.

Autobiographical recall. This mood manipulation procedure was equally effective in influencing arousal. The data were analyzed using a 4 (condition: happiness, anger, sadness, and serenity) × 2 (time: before vs. after induction) ANOVA with condition as a between-subjects factor and time as a within-subjects factor.

As was expected, the analyses showed that the arousal scores for the happiness and anger groups increased between the two measures of arousal (pre- and postinduction) [$F(1,71) = 7.54$, $MS_e = 1.06$, $p < .01$, $\eta^2 = .09$, and $F(1,71) = 7.15$, $MS_e = 1.06$, $p < .01$, $\eta^2 = .09$, respectively], whereas those for the sadness group decreased [$F(1,71) = 8.92$, $MS_e = 1.06$, $p < .01$, $\eta^2 = .11$]. Only the scores for the serenity group remained stable [$F(1,71) = 1.21$, $MS_e = 1.06$, n.s.].

Table 2
Mean Ratings and Standard Deviations for Arousal Scores for Each Mood Group and Each Mood Induction Procedure Condition Before and After Mood Induction

	Before Mood Induction		After Mood Induction	
	M	*SD*	*M*	*SD*
Autobiographical Recall				
Happiness ($n = 18$)	−0.83	1.62	0.11	2.00
Serenity ($n = 19$)	−0.63	1.67	−1.00	1.53
Sadness ($n = 19$)	−0.37	1.07	−1.37	1.12
Anger ($n = 19$)	−0.74	1.33	0.16	1.38
Combined Procedure				
Happiness ($n = 23$)	0.57	1.97	0.43	1.53
Serenity ($n = 20$)	−0.20	1.32	−1.65	1.60
Sadness ($n = 20$)	0.05	1.67	−1.25	1.45
Anger ($n = 22$)	−1.09	1.54	−0.77	1.74

Comparisons within the second set of arousal assessment (postinduction) showed a significant condition × time interaction [$F(3,71) = 8.14$, $MS_e = 1.06$, $p < .001$, $\eta^2 = .22$], indicating that the arousal scores of the four groups differed significantly from each other. As was expected, the happiness and anger groups reported higher levels of arousal than did the serenity and sadness groups [$F(1,71) = 13.87$, $MS_e = 2.35$ $p < .001$, $\eta^2 = .16$]. On the one hand, the arousal scores for the happiness and anger groups did not differ significantly [$F(1,71) = 0.01$, $MS_e = 2.35$, n.s.]. On the other hand, no significant differences were observed between the arousal scores for the sadness and serenity groups [$F(1,71) = 0.55$, $MS_e = 2.35$, n.s.]. Follow-up analyses revealed that the happiness group reported higher arousal scores than did the sadness group [$F(1,71) = 8.62$, $MS_e = 2.35$, $p < .01$, $\eta^2 = .11$] and the serenity group [$F(1,71) = 4.85$, $MS_e = 2.35$, $p < .05$, $\eta^2 = .06$]. In the same way, scores obtained for the anger group were higher than those observed for the sadness group [$F(1,71) = 9.42$, $MS_e = 2.35$, $p < .01$, $\eta^2 = .12$] and the serenity group [$F(1,71) = 5.42$, $MS_e = 2.35$, $p < .05$, $\eta^2 = .07$].

Combined procedure. The data (Table 2) were analyzed using a 4 (condition) × 2 (time) ANOVA. The results revealed main effects of condition [$F(3,81) = 5.67$, $MS_e = 3.62$, $p < .001$, $\eta^2 = .17$] and time [$F(1,81) = 10.64$, $MS_e = 1.63$, $p < .01$, $\eta^2 = .56$]. The analyses also revealed a significant condition × time interaction [$F(3,81) = 4.88$, $MS_e = 1.63$, $p < .01$, $\eta^2 = .15$].

Analyses showed that the arousal scores for the participants in the happiness and anger groups did not differ significantly from the first to the second administration of the matrix [$F(1,81) = 0.12$, $MS_e = 1.63$, n.s., and $F(1,81) = 0.68$, $MS_e = 1.63$, n.s., respectively]. At the same time, the scores reported by the sadness group and the serenity group decreased significantly [$F(1,81) = 10.34$, $MS_e = 1.63$, $p < .01$, $\eta^2 = .11$, and $F(1,81) = 12.87$, $MS_e = 1.63$, $p < .001$, $\eta^2 = .14$, respectively].

Analyses postinduction indicated that the happiness group differed significantly from the three other groups [$F(1,81) = 18.34$, $MS_e = 2.52$, $p < .0001$ $\eta^2 = .18$]. Indeed, the participants in the happiness group reported a higher level of arousal than did those in the anger group [$F(1,81) = 6.52$, $MS_e = 2.52$, $p < .05$, $\eta^2 = .07$], the sadness group [$F(1,81) = 12.07$, $MS_e = 2.52$, $p < .001$, $\eta^2 = .13$], and the serenity group [$F(1,81) = 18.47$, $MS_e = 2.52$, $p < .0001$, $\eta^2 = .19$]. In contrast, the anger group did not differ in arousal scores from the sadness group [$F(1,81) = 0.95$, $MS_e = 2.52$, n.s., and the serenity group $F(1,81) = 3.20$, $MS_e = 2.52$, n.s.]. No difference was observed between the sadness and the serenity group [$F(1,81) = 0.63$, $MS_e = 2.52$, n.s.].

Comparison of the Two MIPs

To assess the magnitude of change produced in valence and arousal, we calculated two scores for each participant and for each MIP. For the valence dimension, the score consisted of the valence score to the target adjectives after induction minus the valence score to the target adjectives before induction. For the arousal dimension, the score consisted of the arousal score after induction minus the arousal score before induction. We conducted a 2 (procedure) × 4 (condition) ANOVA on these two (valence and arousal) scores.

Valence. Overall, these analyses showed no significant difference between autobiographical recall and music + guided imagery [$F(1,152) = 3.24$, $MS_e = 1.01$, n.s.]. However, when each mood was regarded separately, analyses showed that autobiographical recall reported greater sadness mood change than did the combined procedure [$F(1,152) = 4.91$, $MS_e = 1.01$, $p < .05$, $\eta^2 = .03$]. The two techniques did not differ in the amplitude of the change produced in valence for the other three moods—that is, happiness, serenity, and anger.

Arousal. Analyses indicated that autobiographical recall led to greater increases of perceived arousal than did the combined procedure [$F(1,152) = 8.36$, $MS_e = 2.73$, $p < .01$, $\eta^2 = .05$]. When each mood was regarded separately, the analyses showed differences between the two MIPs in the happy mood condition, indicating that the increase of the arousal level was greater with autobiographical recall than with the combined technique [$F(1,152) = 4.26$, $MS_e = 2.73$, $p < .05$, $\eta^2 = .03$]. In the serene mood condition, a reverse pattern was obtained, showing that the combined technique produced stronger changes in arousal level than did autobiographical recall [$F(1,152) = 4.17$, $MS_e = 2.73$, $p < .05$, $\eta^2 = .03$]. Finally, the MIPs were just as effective in modifying arousal of the participants in the sadness and anger conditions.

DISCUSSION

The aim of this study was to test the effectiveness of autobiographical recall MIP and music + guided imagery MIP and to compare both, using changes in valence and perceived arousal. Overall and as expected, the analyses indicated that both autobiographical recall and the combined MIPs affected valence and perceived arousal dimensions of mood. This is consistent with previous research showing that MIPs simultaneously lead to changes in both valence and arousal dimensions (e.g., Gayle, 1997). This result is quite significant because the two MIPs chosen in our study are commonly used to induce either a positive or a negative mood state (e.g., Westermann et al., 1996). Some inconsistent findings regarding the influence of mood states associated with the use of such MIPs could thus result from changes in the arousal level after induction, changes that have not been systematically assessed.

In addition, some differences appeared between the two MIPs used in our study. On the one hand, autobiographical recall was very effective in inducing the four specific moods. Indeed, the participants' mood states were modified as expected after induction on the dimensions of both valence and arousal—that is, positive valence or negative valence in a positive or a negative mood state, an increase of the perceived arousal level in happiness and anger conditions, and a decrease of the perceived arousal level in serenity and sadness conditions. Analyses conducted on the ratings postinduction confirmed these first findings by

indicating that the participants in the happiness condition were happier, the participants in the anger condition were angrier, the participants in the serenity condition were more serene, and the participants in the sadness condition were sadder than the other participants.

On the other hand, the combined MIP led to more complex results. As was expected and consistent with Mayer et al. (1995), the combined MIP fostered changes in the valence dimension for anger and sadness inductions, but also for serenity induction. However, this MIP failed to produce changes in the happiness induction. When looking more closely at the results, one explanation for this absence of change from pre- to postinduction in the valence dimension for the happiness induction could be that some of the participants may already have been as happy as possible prior to induction. Indeed, despite the random distribution of the participants across the mood conditions, the participants in the happiness, combined MIP condition were especially happy prior to induction and significantly happier than the participants in the happiness, autobiographical recall condition [$F(1,152) = 5.18$, $MS_e = 1.59$, $p < .05$, $\eta^2 = .03$]. This could also explain the difference regarding the relative effectiveness of the two MIPs in inducing a happy mood. Despite the superiority of the happiness ratings after induction, this is consistent with findings suggesting that when participants begin experiments in a positive mood state, as in the present study, this positive mood state is then hard to enhance. Positive mood states such as elation are especially difficult to induce in a laboratory setting (see Westermann et al., 1996). In the same fashion, despite the change in anger ratings from pre- to postinduction, no difference was observed between mood groups on the anger ratings after induction. This indicates that changes in the anger ratings were not large enough to produce a significant difference after induction. This combined MIP thus appears to be effective in inducing a negative mood state such as sadness, but not for anger (Westermann et al., 1996).

At the same time, as was expected, this MIP produced a decrease of the perceived arousal level in both the sadness and the serenity conditions. But, contrary to our expectations, the combined MIP did not lead to a significant increase of the perceived arousal level in either the happiness induction or the anger induction. This finding is quite surprising because many studies have shown the influence of listening to music on arousal (e.g., Peretz, 2001; Sloboda & Juslin, 2001). One explanation could be that the musical excerpts used in our study were not as effective as was expected for inducing changes in the perceived arousal level of our population, thus reducing the effectiveness of the combined MIP. Future research will benefit from investigating this question by adding an objective measure of arousal such as skin conductance, which has been extensively used in emotion research and is thought to provide an objective measure of fluctuations in the level of arousal (Bradley, Codispoti, Cuthbert, & Lang, 2001; Bradley & Lang, 2000; Greenwald, Cook, & Lang, 1989; Lang, Greenwald, Bradley, & Hamm, 1993).

Our second hypothesis was related to the supposed superiority of the combined MIP, especially for negative mood states. Such combinations of two (or more) MIPs were created to increase the effectiveness of the mood induction (e.g., Gilet, 2008; Westermann et al., 1996). We thus expected to show greater mood changes in the combined MIP condition than in the autobiographical recall condition. Our second hypothesis was partially confirmed: The comparison of the magnitude of changes produced in both the valence and the perceived arousal dimensions indicated that the two MIPs were just as effective in modifying valence in the expected direction. However, concerning perceived arousal, our results showed, surprisingly, that greater changes (increase and decrease) were obtained in the autobiographical recall condition than in the combined MIP condition. This is not consistent with the idea that two or more inductions contribute additively to a mood (Bower, 1981) and, thereby, increase the effectiveness of the MIP. This result is also surprising because the influence of music on valence, as well as arousal level, is quite well established (e.g., Hirokawa, 2004; Peretz, 2001). Indeed, numerous studies have examined the relationship between listening to music and mood, showing that specific emotions or mood states can be identified in and induced by musical excerpts (Bigand, Vieillard, Madurell, Marozeau, & Dacquet, 2005; Mayer et al., 1995; Zentner, Grandjean, & Scherer, 2008).

As was mentioned above, the results of the present research highlighted some differences regarding the effectiveness of the two MIPs, even though the combined MIP and autobiographical recall did lead to changes in the participants' mood states. In addition, by influencing differently the two components of mood—that is, valence and perceived arousal—the autobiographical recall and the combined MIP may have elicited qualitatively different mood states. For instance, in the autobiographical condition, a happy mood is partly achieved through the association of an increase in happiness ratings and a decrease in anger ratings, but, in the combined MIP, the happy mood results from an increase in serenity ratings and a decrease in sadness ratings. Future research would benefit from investigating more closely these qualitative changes in mood states elicited by different MIPs.

Although MIPs foster genuine changes in participants' moods, these changes are sometimes subtle and may depend on the type of MIP used, as well as the characteristics of the mood to be induced per se. In addition to valence and arousal dimensions, mood states can be distinguished in terms of their association with approach/avoidance behaviors. Recent work has suggested that approach or avoidance motivation is not only a matter of hedonic tone; happiness and anger moods are approach oriented, whereas sadness and serenity are associated with an avoidance motivation (Baas, De Dreu, & Nijstad, 2008; Harmon-Jones, Harmon-Jones, Abramson, & Peterson, 2009). Further research is needed to investigate more thoroughly the impact of this particular dimension of mood on the effectiveness of MIPs.

The results of the present study illustrate how autobiographical recall is a more effective MIP than is the

combined MIP. It is, indeed, very effective in inducing happiness, serenity, anger, and sadness in participants by producing genuine changes in both valence and perceived arousal. Furthermore, administration time is relatively short, varying from 6 to 10 min (see Martin, 1990), and this MIP is suitable for mood induction in a group setting, as well as for individual testing. In addition, our study clearly shows that the best MIP for small groups should be an autobiographical recall MIP. However, and contrary to the combined MIP, the autobiographical recall MIP is particularly sensitive to demand effects; experimenters should, then, use tools to reduce such effects (see Parrott & Hertel, 1999).

The aim of this study was to examine the relative efficiency of two well-known MIPs, using valence and arousal changes. The findings of the present study confirmed the influence of MIP on both the valence and the arousal dimensions of mood. This study also revealed, surprisingly, a poorer efficiency of the combined MIP than of autobiographical recall. Future research is needed to confirm these first results. Nevertheless, our study provides important results for researchers wishing to select laboratory-based MIPs for mood-oriented research.

AUTHOR NOTE

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