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RESEARCH PAPER

High Trait Cheerfulness Individuals are More Sensitive to the Emotional Environment

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Abstract The aim of this paper was to study whether trait cheerfulness modulates changes in state cheerfulness as a result of exposing participants to affective stimuli. Two studies with a within-participant experimental design were carried out. Forty-eight (33 women) and sixty-four (45 women) undergraduate psychology students were selected as Sample 1 and Sample 2, respectively, for scoring high or low on the Trait Form of the State-Trait-Cheerfulness Inventory (STCI-T; Ruch et al. in Humor Int J Humor Res 9:303–339, 1996; Ruch et al. in Personal Individ Differ 22:477–491, 1997). Participants watched amusing, neutral, and sad film clips and reported their affective states before and after viewing them. In the second study, heart rate and skin conductance level were also recorded. Results showed that people with high trait cheerfulness reported greater changes in state cheerfulness when exposed to both amusing and sad film clips, showing larger increases and decreases in state cheerfulness, respectively, than participants with low trait cheerfulness. Effects were not mediated by social desirability. Furthermore, people with low trait cheerfulness showed a greater heart rate deceleration during the visioning of the clips compared to high trait cheerfulness participants, especially in an amusing scene with high emotional load. No modulation on trait cheerfulness was found for skin conductance level. Data with self-report and electrophysiological measures are discussed, highlighting that high trait cheerfulness people are more permeable to affective events, perhaps showing a better understanding and management of them.

Keywords State cheerfulness · Trait cheerfulness · Affective induction · Heart rate · Skin conductance level

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1 Introduction

Humor has been traditionally considered a complex and global concept that includes cognitive processes, emotional responses, and expressive elements (see, for example, Martin 2007). In this context, Ruch, Köhler, and van Thriel (1996, 1997) developed a theoretical approach focused on isolating the affective and cognitive basis of sense of humor to predict the emotional response to humor: cheerfulness, seriousness, and bad mood. Cheerfulness, which is the object of study of the present research, is considered an affective tendency or predisposition to participate and interact in contexts where humor is present, to appreciate and produce it, to have a low threshold for showing laughter, and to smile in response to humoristic stimuli, together with the expression of a set of positive affective states with relatively high arousal values. Therefore, cheerfulness, which is associated with positive, self-enhancing and affiliative humor styles (see, for example, Ruch and Hofmann 2012), is understood as a predictive variable of individual differences in exhilaration emotion. The concept comprises five facets, which have been empirically differentiated through multilevel confirmatory factor analysis (Carretero-Dios et al. 2011): the prevalence of a cheerful mood, a low threshold for smiling and laughter, a composed view of adverse life circumstances, a broad range of active elicitors of cheerfulness and smiling/laughter, and a generally cheerful interaction style. While cheerfulness facilitates an exhilaration response to humorous stimuli, two other dimensions inhibit this response: bad mood, understood as the opposite affective component and manifested as a lack of interest in participating in situations where humor might be present, and seriousness, described as a tendency to deeply analyze most things.

In the conceptualization of cheerfulness, some facets are described as general positive affective dispositions; in fact, a certain parallelism between cheerfulness and some qualities of positive emotions, such as joy or happiness, has been reported (e.g., Papousek and Schulter 2010). Empirically some data suggest that people who have high trait cheerfulness manifest higher and more stable psychological well-being, a better ability to cope with stressful situations, a greater capacity for creative thinking, and greater emotional management (Yip and Martin 2006); they also report more positive emotions and less negative emotions when confronted with emotional events (see Ruch and Hofmann 2012, for a review).

As in other personality dimensions (e.g., anxiety), cheerfulness can also be understood in terms not only trait by also state, which is defined by the presence of a cheerful, tranquil, and composed mood state as well as by the presence of hilarity, which is a merry, shallow, and outwardly directed mood state (Ruch and Köhler 2007; Ruch et al. 1997). Both trait and state affect the habitual and actual dispositions of exhilaratability (Ruch 1997). Self- and peer-evaluation data as well as joint factor analyses have found that both dimensions correlate positively, confirming the idea that traits represent dispositions for their respective states (Ruch et al. 1997). In this sense, the authors argue that high trait cheerfulness individuals enter state cheerfulness more easily, experience cheerfulness more often and more strongly, remain in the mood for longer until it disappears naturally, and are able to keep a high level of state cheerfulness when facing adversities or negative events (Ruch 1997; Ruch and Köhler 2007; Ruch et al. 1997).

The manifestations of cheerfulness have been studied from different perspectives, including the study of facial expressions with the Facial Action Coding System (FACS; Beermann and Ruch 2011), the differential activation of brain areas (Rapp et al. 2008), the response to affective induction (Ruch 1997), and the modulation of performance on

cognitive tasks (Papousek and Schulter 2010). However, to our knowledge, not many studies have investigated physiological parameters linked to cheerfulness. In the current study, we aimed to bridge this gap.

Heart rate (HR) and skin conductance level (SCL), associated with valence and arousal dimensions, respectively, have been considered classic references in the study of affective dimensions (see Kreibig 2010, for a review) as well as well-being and health (Tugade and Fredrickson 2004). However, in spite of these studies, the exact relationship between electrophysiological measures and other responses is not clear. For example, some authors have posited that there is a convergence between electrophysiological and so-called subjective measures, such as inventory and self-reports, whereas in other studies self-report changes were observed without concomitant autonomic variations (Mauss and Robinson 2009).

Some attempts have also been made to study sense of humor with psychophysiological parameters (Langevin and Day 1972; Newman and Stone 1996). Moreover, the psychophysiological correlates of humor appreciation have been investigated. For example, Lackner et al. (2013) observed the psychophysiological response to humor perception. They found that detecting punch lines in cartoons was associated with an increased cardiac response, which was modulated by participants' self-reported perception of the amusement. More recently, Fiacconi and Owen (2015) studied the temporal outline of humor elicitation using HR and facial electromyography. They discovered a greater physiological response when people were exposed to jokes as well as a decreased HR response at the onset of humor comprehension.

In spite of the connections found between humor appreciation and physiological variables, there is no literature establishing a clear relationship between cheerfulness, as a trait and a state, and periphery parameters of the autonomic nervous system. However, a relationship between them could be observed by attending at the elements that constitute the affective states referred by cheerfulness from a dimensional perspective (Russell 2003). Although cheerfulness is not considered an emotion itself, it promotes the manifestation, maintenance, and enhancement of positive affective states with high arousal, as amusement, joy, and happiness (Ruch and Hofmann 2012). Taking into account that heart rate and skin conductance level are useful measures to capture the nuances (valence and arousal) of these affective states (Kreibig 2010), it could be possible to find a close link between state cheerfulness and psychophysiological responses, and therefore, a trait cheerfulness modulation over them.

Ruch (1997) elicited state cheerfulness in participants exposed to amusing stimuli, observing the modulation of trait cheerfulness over state cheerfulness. In that study, the experimenter's behavior was experimentally manipulated while asking a set of questions to participants in order to create a neutral versus amusing condition. For a stronger manipulation, participants also had to recall a neutral versus amusing event at the end of the session. The amusing condition caused a greater increase in state cheerfulness with respect to the neutral condition. More importantly, higher state cheerfulness variations were observed in participants with high rather than low trait cheerfulness. Furthermore, the first group also showed more frequent, intense, and longer laughs. These results are very interesting, although they had some important shortcomings. The trait–state relationship was studied using a procedure to elicit a positive but not a negative affective state. Moreover, whether social desirability could have contaminated the data was not examined, as participants could have responded based upon their predictions about the experimenter's expectancies in some circumstances when they reported their feelings and thoughts.

No matter the limitations of that study, it is important to investigate the relationship between state–trait cheerfulness (Ruch et al. 1996, 1997). Therefore, new research should solve the limitations of the previous research and extend the study of the state–trait cheerfulness relationship to other affective states. This was precisely the main goal of the current research. Specifically, we aimed at investigating how trait cheerfulness modulates state cheerfulness not only when facing positive affective induction but also when facing negative affective induction. Using negative induction in this context is highly relevant because results from previous studies (Papousek and Schulter 2010; Ruch 1997; Zweyer et al. 2004) can be easily interpreted as a selective bias in high trait cheerfulness individuals toward positive events. If high trait cheerfulness individuals are more sensitive to both positive and negative affective content than low trait cheerfulness individuals, the explanation would not be a simple positive bias but rather a larger sensitivity to the emotional environment, which could underlay a better management of emotions.

In order to achieve this goal, two experiments were carried out. In both experiments two groups of participants scoring high or low in trait cheerfulness watched amusing and sad film clips (in counterbalanced order), and their cheerfulness state (together with other states) was assessed with self-reported measures before and after the affective induction. In Experiment 2, as an additional aim, psychophysiological measures were also taken before and during the presentation of the films in order to investigate online modulation of the cheerfulness trait and the covariation between self-reported and electrophysiological measures.

2 Experiment 1

The purpose of Experiment 1 was twofold. First, we wanted to check that the affective inductions used in the present study elicited consistent and robust effects in state cheerfulness. Although some studies have reported state cheerfulness changes (Ruch 1997), there is less literature about how state cheerfulness is modified.

To elicit state cheerfulness variations, we used a validated set of film clips, using two for each emotional category (Fernández et al. 2011). In order to better study the differential effect of induction over state cheerfulness, we employed a within-participant manipulation (Carvalho et al. 2012; Codispoti et al. 2008). We hypothesized that state cheerfulness would increase after watching amusing clips, whereas it would decrease after sad clips (Hypothesis 1).

In line with previous evidence, proposing a direct relationship between trait and state cheerfulness (Ruch 1997; Ruch et al. 1996, 1997) and taking into account emotional nature as a fundamental feature in the conception of cheerfulness, which might lead high cheerfulness participants to show a larger general sensitivity to the emotional environment, we considered that participants with high trait cheerfulness might be induced to a larger extent than participants with low trait cheerfulness after watching both amusing and sad films, as measured by means of score changes in the state cheerfulness inventory (Hypothesis 2).

Furthermore, we thought it was necessary to demonstrate that the observed effects did not depend on social desirability. In order to avoid this issue, Marlowe and Crowne's Social Desirability Scale (MCSDS; Crowne and Marlowe 1960) was included.

3 Method

3.1 Participants

Experiment 1 included 48 undergraduates selected from an initial sample of 321 undergraduate students depending on their high versus low scores in trait cheerfulness obtained from the Trait Form of the State-Trait-Cheerfulness Inventory (STCI-T; Ruch et al. 1996). There were 23 participants in the high trait cheerfulness group (17 women, mean age 19.09, $SD = 1.44$; trait cheerfulness mean 3.31) and 25 participants in the low trait cheerfulness group (16 women, mean age 19.20, $SD = 1.78$; trait cheerfulness mean 2.89). In this and the following experiment, all participants spoke Spanish as a first language, had normal or corrected-to-normal visual acuity, and received course credits for their voluntary participation. A written consent was obtained prior to the experiment, and the study was conducted in accordance with the ethical standards of the 1964 Declaration of Helsinki. In order to get an effect size of $f = .20$ and a power of .80 with 2 independent groups and six repeated measurements averaged, the minimum sample required for this study was 28 participants (estimate with G*Power 3.1 software).

3.2 Measures and Stimuli

1. The Trait Form of the State-Trait-Cheerfulness Inventory (STCI-T; Carretero-Dios et al. 2014; Ruch et al. 1996). This instrument assesses cheerfulness (e.g., "Life gives me very few reasons to laugh"), seriousness (e.g., "I am a serious person"), and bad mood (e.g., "Compared to others, I really can be grumpy and grouchy") as temperamental dimensions of the sense of humor in trait manifestation using a Likert scale between 1 ("strongly disagree") and 4 ("strongly agree"). Although participants were chosen using this self-report, because of the time elapsed between the first time they completed the test and the experimental session, they had to fill out the trait cheerfulness part again when they started the experiment to check that they were in the correct group. During the experiment, participants only filled out the cheerfulness part. The reliability analysis provided a Cronbach's alpha of .94 for our sample. Mean comparison analysis between two samples was significant, $t(43) = -10.24$, $p < .001$.
2. The State Form of the State-Trait-Cheerfulness Inventory (STCI-S; López-Benítez et al. under review; Ruch et al. 1997). As in the trait version, this self-reported questionnaire evaluates cheerfulness (e.g., "I am ready to have some fun"), seriousness (e.g., "I am in a pensive frame of mind"), and bad mood (e.g., "I am in a crabby mood") as temperamental dimensions of sense of humor in state manifestations. In this case, during the experiment, participants only filled out the state cheerfulness part, answering 14 items and using a 4-point Likert scale between 1 ("strongly disagree") and 4 ("strongly agree"). Cronbach's alpha values for our sample oscillated between .90 and .97.
3. Scale for Mood Assessment (EVEA; Sanz et al. 2014). This instrument assesses joy (e.g., "I feel optimism"), anxiety (e.g., "I feel nervous"), hostility (e.g., "I feel angry"), and depression (e.g., "I feel sad") factors. Participants have to respond to 16 ítems using a 10-point Likert scale (scores ranging from 0, indicating total lack of affect, to 10, maximum intensity of it). Cronbach's alpha values were elevated for all four scales every time they were administered, ranging from .79 to .96 in our sample.

In the present paper, only assessment information directly related to the content of the films is provided, including joy and depression factors.

4. Self-Assessment Manikins (SAM; Bradley and Lang 1994; Moltó et al. 1999). SAM is an easy instrument used to measure the valence, arousal, and dominance affective dimensions. It consists of three different picture sets with five figures mixed with four points that generate a continuum for each factor. In the valence dimension, figures oscillate between a happy man (9) and a sad man (1); in the arousal dimension, the continuum vary between a stressed man (9) and a relaxed man (1); in the dominance dimension, figures fluctuate between a small man without control (1) and a big man with control (9). In this experiment, we only employed valence and arousal dimensions.
5. Discrete Emotions Scale (DES; Izard et al. 1974). This inventory provides a systematic measure to evaluate the emotions experienced by a person in an experimental situation. This experiment used a simplified version already utilized in previous studies (Fernández et al., 2011). Participants had to evaluate the following moods: amusement, sadness, anger, happiness, neutrality, disgust, fear, and tenderness. In this case, we employed an 11-point Likert scale, from 0 "Not at all" to 10 "Totally," for each label. Finally, in order to avoid facilitation effects with respect to films, the order of the presentation of the different labels was randomized for each participant. Only assessment information directly related to the content of the films (amusement, sadness, and neutrality factors) is provided in the present paper.
6. Marlowe and Crowne's Social Desirability Scale (MCSDS; Crowne and Marlowe 1960; Ferrando and Chico 2000). This inventory allows for the scoring of social desirability to evaluate the degree to which people voluntarily choose responses that are more socially desirable. This self-report is composed of questions about people's behavior in their own contexts (e.g., "I never hesitate to go out of my way to help someone in trouble"). Participants had to respond true or false to each question. The reliability analysis provided a Cronbach's alpha of .63 for our sample.
7. Films. In order to create an adequate induction depending on the affective material, six clips (two per affective state) were selected from a Spanish validated and updated films database that has been demonstrated as an effective and powerful tool to elicit affective states (Fernández et al. 2012; Fernández et al., 2011). This procedure of induction provokes a relatively differentiated affective state that can last for several minutes. The content for each clip was as follows: (a) *Bennie and Joon*–one man plays with food; (b) *There's Something About Mary*–a fight between a dog and a man; (c) *Blue 2*–people doing regular activities; (d) *Sticks*–a set of sticks moving on the screen; (e) *Champion*–a child sees his father dying; and (f) *City of Angels*–one woman dies because of an accident (see Table 1). Film clips *a* and *b* were used to elicit positive affective states, *c* and *d* to induce a neutral affective state, and *e* and *f* to trigger negative affective states.

3.3 Procedure

Participants came to the laboratory in subgroups of 3–5. They were each seated at a 90°—angle facing the screen in comfortable chairs at independent experimental booths located at opposite sides of a room with weak light. After that, written consent was obtained and instructions were given to the participants. It was explained that they would watch subsets of film clips. They would have to pay attention and try to empathize while watching the

Table 1 Scores of the valence, arousal, amusement, and sadness subscales for each film clip

Film	SAM valence	SAM arousal	DES amusement	DES sadness	Duration
Bennie and Joon	7.54	4.46	5	1	124
There's Something About Mary	6.94	4.38	5.27	1.67	179
Blue 2	4.85	3.31	1.23	1.46	40
Sticks	4.57	3.46	1.77	1	208
Champion	3.08	4.92	1.15	5.46	115
City of Angels	3.75	4.63	1.5	5.63	267

Duration was measured in seconds. While the first two and last two film clips were used to elicit positive and negative affective states, respectively, the third and fourth clips were employed to produce a neutral affective state (Fernández et al. 2011)

SAM Self-Assessment Manikins; *DES* Discrete Emotions Scale

clips. Moreover, they were told that they had to report their thoughts and feelings by filling out different types of self-reports before and after watching the clips. Finally, participants were informed that they would have to perform a task between clips. All of the self-reports and instructions were printed and placed close to the laptop. The experimental task was programmed using E-prime software (Schneider et al. 2002), and the clips were presented on a 15-inch screen located approximately 60 cm away from the participants. The duration of the session was approximately 75 min. In order to ensure that participants' responses were directly related to the manipulation and not to the social engagement with the study or the experimenter, a predefined and standardized protocol was created. It included all verbal encounters with participants and a timeline with specific statements about the duration of different parts of the experiment.

To strengthen the affective induction effect, the two films in each affective category were always displayed one after the other (amusing: *Bennie and Joon–There's Something About Mary*; neutral: *Blue 2–Sticks*; sad: *Champion–City of Angels*). In order to avoid possible confounding effects due to affective inductions, the order of amusing and sad clips was counterbalanced across participants. The two neutral films were always displayed between the two affective inductions. See Fig. 1 for the event sequence of the experiment.

Before the first affective content induction, participants completed STCI-T, EVEA, STCI-S, SAM, and DES self-reports. Then, half of the participants watched amusing clips, and the other half watched sad clips. A break of 10 s between films of the same affective category was included. Then all participants filled out STCI-S, SAM, and DES self-reports and performed a global–local task in which a big letter composed of smaller letters was presented and participants were to detect as quickly and accurately as possible either the big (i.e., global) or the small (i.e., local) letter by pressing a key (Kimchi and Palmer 1982).[1] The literature has sometimes described an excitation transfer effect (Bryant and Miron 2003; Zillmann 1983) in which a specific affective state could last long enough to be transferred to a new situation or context, increasing the intensity of an affective state

[1] As our main aim was to assess affective changes experienced by participants exposed to different affective inductions and the possible modulation of trait cheerfulness over these changes, we did not consider or analyze data from this task.

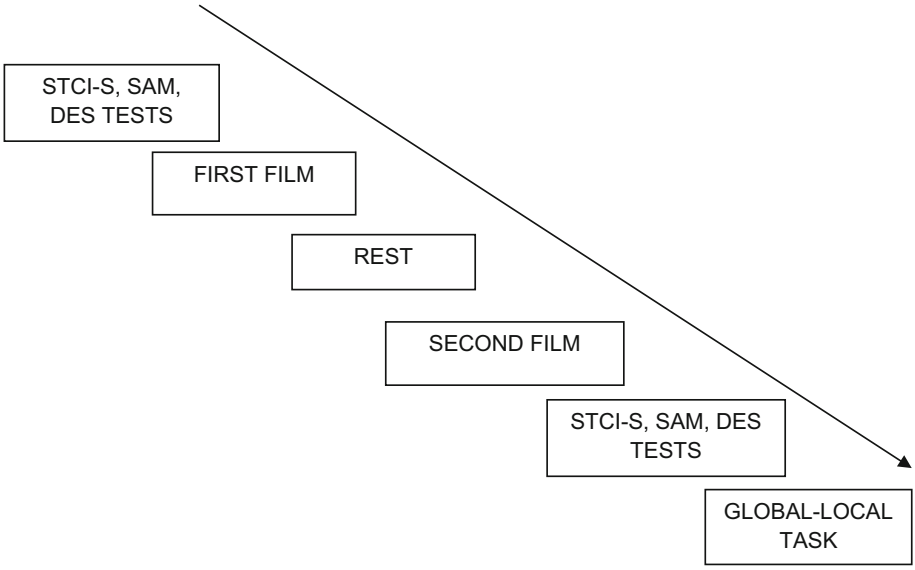

Fig. 1 Schematic representation of the experiment for the second (neutral) affective induction. The participants had to fill out the STCI-S (State Form of the State-Trait Cheerfulness Inventory), SAM (Self-Assessment Manikins), and DES (Discrete Emotions Scale) self-reports before and after watching two consecutive neutral film clips, which were separated by a 10-s period. Then, they completed STCI-S, SAM, and DES self-reports again and performed a global–local task. This sequence was repeated three times in the experiment, but in the first induction (amusing or sad), the participants filled out two additional self-reports at the beginning of the experiment: the STCI-T (Trait Form of the State-Trait Cheerfulness Inventory) and the EVEA (Scale for Mood Assessment). Finally, after the third induction (amusing or sad), at the end of the session, the MCSDS (Marlowe and Crowne's Social Desirability Scale) was administered

elicited later. In order to control the excitation transfer potential and promote the return of the participants' affective state to their baseline, we included an interval of 3 min between clips of different affective categories, which has been demonstrated to be an effective period of time in previous research (Fernández et al. 2011; Fredrickson and Levenson 1998).

Before the second (neutral content) induction, all of the participants completed STCI-S, SAM, and DES self-reports. Then they watched the neutral film clips, after which they again filled out the STCI-S, SAM, and DES self-reports and performed the global–local task. The purpose of presenting these two neutral films was for participants to achieve an affective state equivalent to the one they had at the beginning of the session.

Before the third affective content induction, all participants completed the STCI-S, SAM, and DES self-reports, then they watched the last films (one half watched the sad film clips, and the other half watched the amusing film clips), after which all of the participants filled out STCI-S, SAM, and DES self-reports and did the global–local task for the last time. Finally, the MCSDS was administered to check that participants' responses were not due to social desirability. To prevent confounding effects caused by having previous knowledge of the films, participants were asked whether they had watched them before the experiment and when.

3.4 Design and Statistical Analysis

Data were analyzed with the SPSS 15.0 statistical package. We used a mixed factorial design: 2 (trait cheerfulness group; high vs low) × 3 (affective induction; amusing vs neutral vs sad) × 2 (affective state assessment moment; pre vs post). To check for the effectiveness of our induction procedure, SAM and DES measures were treated as dependent variables. In order to check whether trait cheerfulness modulated state cheerfulness scores, these were considered as dependent variables. Additionally, to confirm that social desirability was not modulating results, MCSDS scores were introduced as a covariate.

4 Results

The different assessed variables changed in the expected direction, reflecting that the manipulation was effective (all $ps \leq .05$). In general, state cheerfulness, valence (SAM), and amusement (DES) increased and sadness (DES) decreased after participants watched amusing clips. The opposite pattern was observed after they watched sad clips. Neutrality (DES) scores increased after watching neutral films and decreased after watching amusing and sad films. Descriptive statistics can be found in Table 2.

Importantly, in the state cheerfulness measure, the affective induction × affective state assessment moment interaction was significant: $F(2, 92) = 97.91$, $p < .001$, $\eta^2 = .68$. While there were no differences in the pre-induction measures ($F < 1$), large and significant differences were observed in the post-induction measures: $F(2, 92) = 142.91$, $p < .001$, $\eta^2 = .87$. This was due to the fact that, after the induction with amusing clips, state cheerfulness increased—$F(1, 46) = 84.11$, $p < .001$, $\eta^2 = .65$—while inducing participants with sad clips reduced state cheerfulness: $F(1, 46) = 96.68$, $p < .001$, $\eta^2 = .68$. Neutral induction also mildly reduced cheerfulness: $F(1, 46) = 22.73$, $p < .001$, $\eta^2 = .33$.

More importantly, this interaction was significantly modulated by Trait Cheerfulness Group—$F(2, 92) = 6.26$, $p = .003$, $\eta^2 = .12$—confirming our predictions (see Table 2; Fig. 2). Although both groups showed an increase in the post-induction measures for amusing clips—$F(1, 22) = 48.95$, $p < .001$, $\eta^2 = .69$ and $F(1, 24) = 33.61$, $p < .001$, $\eta^2 = .58$ for high and low trait cheerfulness, respectively—and a decrease for sad clips—$F(1, 22) = 49.51$, $p < .001$, $\eta^2 = .69$ and $F(1, 24) = 51.30$, $p < .001$, $\eta^2 = .68$ for high and low trait cheerfulness, respectively—the effect of the induction was larger in the high trait cheerfulness group than the low trait cheerfulness group: $F(1, 46) = 4.80$, $p = .034$, $\eta^2 = .09$ and $F(1, 46) = 7.53$, $p = .009$, $\eta^2 = .14$ for amusing and sad clips, respectively (see Fig. 2). It is important to note that the modulation remained significant when social desirability was introduced as a covariate: $F(1,45) = 4.23$, $p = .045$, $\eta^2 = .09$ and $F(1,45) = 6.14$, $p = .017$, $\eta^2 = .12$ for the amusing and sad affective conditions, respectively. This shows that participants' reports did not depend on their predictions about how they should respond to the experimenter.

Table 2 Mean and standard deviation of the state cheerfulness, valence, arousal, amusement, neutrality, and sadness variables as a function of trait cheerfulness group, affective state assessment moments, and affective induction conditions

Measures	High trait cheerfulness					
	Pre			Post		
	A	N	S	A	N	S
State cheerfulness	35.48 (12.81)	36.78 (10.43)	36.52 (9.94)	47.78 (7.63)	32.04 (13.32)	22.83 (7.41)
SAM valence	6.26 (1.66)	6.30 (1.61)	5.91 (1.83)	8.26 (1.39)	5.35 (2.25)	3.52 (2.31)
SAM arousal	5.61 (2.39)	5.48 (2.33)	5.09 (2.25)	5.35 (2.29)	4.57 (2.54)	4.48 (2.23)
DES amusement	4.48 (2.56)	5.04 (2.48)	4.17 (2.96)	8.70 (1.15)	2.52 (2.91)	1.30 (1.92)
DES neutrality	5.43 (3.00)	4.70 (2.29)	5.91 (2.92)	1.61 (2.23)	4.96 (3.78)	2.39 (2.62)
DES sadness	1.52 (2.61)	1.43 (2.39)	1.00 (2.00)	0.57 (1.12)	1.87 (2.55)	7.22 (2.30)
Measures	Low trait cheerfulness					
	Pre			Post		
	A	N	S	A	N	S
State cheerfulness	32.00 (7.92)	29.72 (7.14)	28.68 (6.52)	39.56 (8.34)	25.08 (7.18)	20.96 (4.99)
SAM valence	6.04 (1.57)	5.52 (1.53)	5.48 (1.78)	7.44 (1.45)	4.04 (1.88)	3.04 (1.51)
SAM arousal	5.12 (2.15)	4.80 (2.10)	5.04 (2.47)	5.36 (2.40)	5.20 (2.36)	4.56 (2.10)
DES amusement	3.20 (2.63)	3.36 (2.22)	2.44 (1.98)	6.28 (2.64)	1.48 (1.69)	0.92 (1.12)
DES neutrality	5.76 (2.91)	5.88 (2.76)	6.00 (2.35)	4.00 (2.60)	5.12 (2.49)	3.40 (1.96)
DES sadness	1.24 (2.26)	1.20 (1.71)	1.28 (1.88)	1.00 (1.53)	1.40 (1.73)	6.28 (2.46)

A amusing; *N* neutral; *S* sad; *SAM* Self-Assessment Manikins; *DES* Discrete Emotions Scale

5 Discussion

In this experiment, we wanted to study variations in state cheerfulness produced by an affective induction procedure that used film clips from a validated database. More importantly, we aimed to investigate whether trait cheerfulness modulated these variations independent of social desirability.

Results showed reliable affective induction effects in the expected direction, with state cheerfulness increasing or decreasing as a consequence of watching amusing or sad films, respectively. More importantly, this effect was modulated by trait cheerfulness, confirming our predictions and demonstrating that participants characterized by high trait cheerfulness reported larger induction effects than participants with low trait cheerfulness for both amusing and sad films. Importantly, this effect remained significant when social desirability was introduced as a covariate, supporting the idea that participants' responses were specifically expressed their feelings and thoughts after watching the film clips and were not meant to respond to experimental demands.

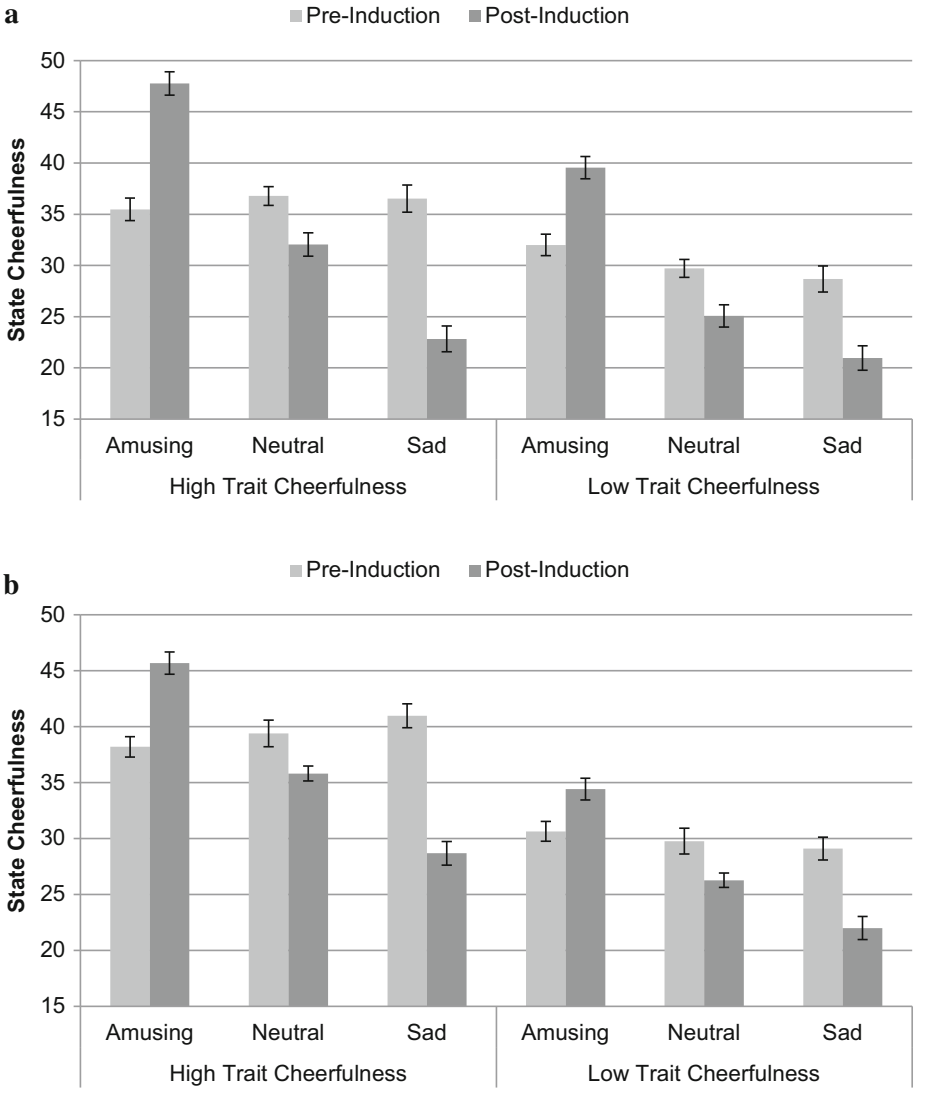

Fig. 2 Changes in state cheerfulness depending on high and low trait cheerfulness in the pre- and post-induction conditions as a consequence of watching amusing, neutral, and sad film clips. The error bars represent the standard error of the mean, with variability between participants removed by means of Coussineau's method. **a** Data from Experiment 1, and **b** is data from Experiment 2

6 Experiment 2

Before entertaining theoretical accounts or the important implications of those results, we decided to replicate the pattern of data in a follow-up experiment. Thus, we expected to replicate the finding that participants with high trait cheerfulness would increase in state cheerfulness further after watching amusing films and would decrease in state cheerfulness further after watching sad films, as compared with participants characterized by low trait

cheerfulness. Moreover, we did not expect this difference to be mediated by social desirability (Hypothesis 1). Furthermore, in this new experiment we investigated whether the modulation of trait cheerfulness over state variations after induction were restricted to self-report measures or extended to electrophysiological measures such as HR and SCL. We expected affective induction to produce the usual changes in HR and SCL. In line with the self-report measures, we expected these changes to be larger for participants with high trait cheerfulness versus low trait cheerfulness (Hypothesis 2).

7 Method

7.1 Participants

Experiment 2 included 64 psychology undergraduate students, selected from an initial sample of 889 undergraduate students, volunteered for the experiment in exchange for course credits. There were 31 participants in the high trait cheerfulness group (25 women, mean age 21.13, $SD = 5.39$; trait cheerfulness mean, 3.51) and 33 participants in the low trait cheerfulness group (20 women, mean age 21.12, $SD = 5.59$; trait cheerfulness mean, 2.54). Among them, nine participants were excluded from the SCL analysis due to recording problems throughout the experiment. Additionally, partial data from three participants were removed from the SCL analyses (two for the first sad film clip and one for the second sad clip) and partial data from nine participants were removed from the HR analyses (three for *Bennie and Joon*, one for *There's Something about Mary*, one for *Blue 2*, two for *Champion*, and two for *City of Angels*) due to recording problems in these specific moments. Although in order to get an effect size of $f = .20$ and a power of .80 with two independent groups and six repeated measurements the minimum sample required for this study was 28 participants (as estimated with G*Power 3.1 software), we increased the number of participants to 64 given that electrophysiological measures are usually noisier and that, usually, it is necessary to exclude some participants.

7.2 Procedure

The procedure, sequence of events, duration, and environmental laboratory conditions were similar to those of Experiment 1 with the following differences: (a) participants performed the session individually instead of running it in subgroups of 3–5 people, (b) we included the EVEA self-reports in all affective inductions, (c) the irrelevant task was removed and replaced by 3-min adaptation periods in order to adapt the experiment to psychophysiological characteristics, and (d) self-reports were administered four times instead of six in order to simplify the procedure. After each affective induction, self-reports scores were considered post-induction measures and also as pre-tests for the next induction period.

After they arrived at the laboratory, participants were given instructions and written consent was obtained. After that, HR and SCL electrodes were placed on the skin and a test to screen for electrode performance was carried out. As in Experiment 1, a previously specified protocol for the procedure was used. Participants were told about the importance of avoiding any movement with the goal of keeping the recording as clean as possible. At the beginning of the experiment, participants filled out the STCI-T, STCI-S, SAM, DES, and EVEA self-reports. Later, a 3-min adaptation period was conducted where participants

had to relax while seeing a white fixation point superimposed over the black background of the screen. Subsequently, half of the participants watched the two consecutive amusing film clips and the other half watched the two consecutive sad film clips and again completed the STCI-S, SAM, DES, and EVEA self-reports (see Fig. 3). After the participants filled out self-reports, a new 3-min adaptation period occurred, and the same sequence started again. To complete the counterbalance, in the final affective induction, half of the

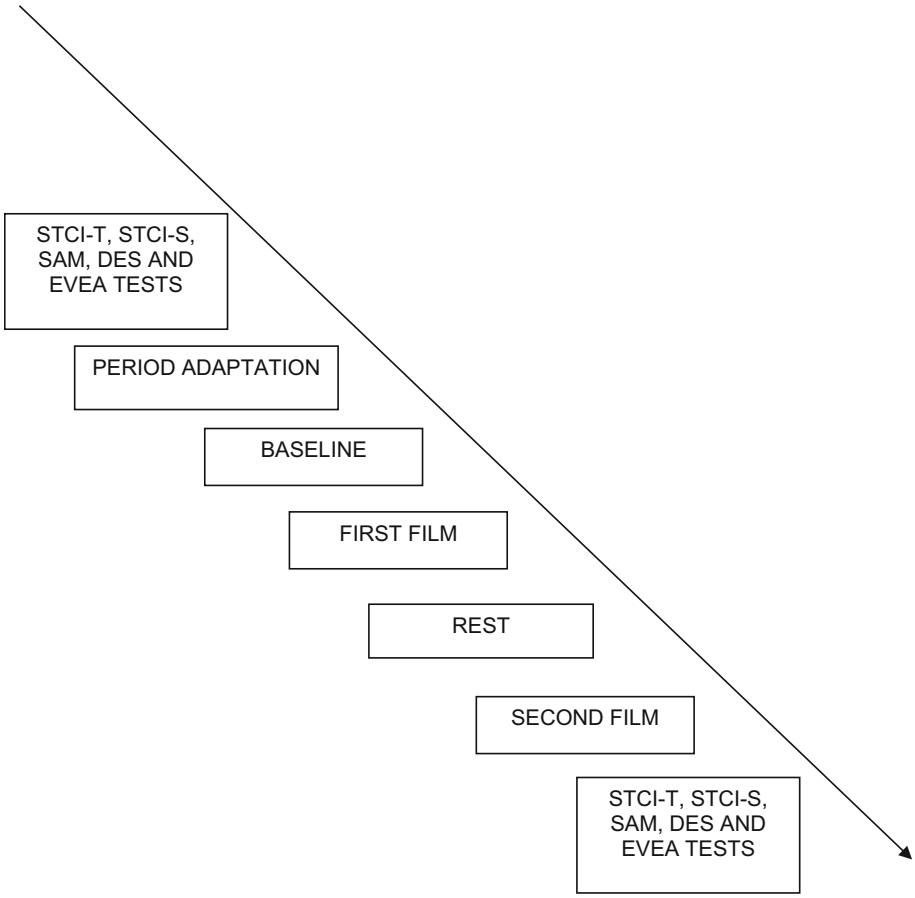

Fig. 3 Schematic representation of the experiment for the first affective content induction. At the beginning, the participants had to fill in the STCI-T (Trait Form of the State-Trait Cheerfulness Inventory), STCI-S (State Form of the State-Trait Cheerfulness Inventory), SAM (Self-Assessment Manikins), DES (Discrete Emotions Scale), and EVEA (Scale for Mood Assessment) self-reports. Then came the three-minute adaptation period, of which the last 10 s were taken as a baseline. After that, half of the participants watched the two consecutive amusing film clips, and the other half watched the two consecutive sad film clips, which were separated by a 10-s period. Then, the participants had to take the STCI-S, SAM, DES, and EVEA self-reports again, which were considered post-induction measures and also as pre-tests for the next induction period. This sequence was repeated two more times in the experiment. In the second affective content induction, the participants watched two consecutive neutral films and did not fill in the STCI-T self-report. In the third affective content induction, the first half of the participants watched the two sad film clips and the other half watched the two amusing film clips. Finally, the MCSDS (Marlowe and Crowne's Social Desirability Scale) was administered at the end of the session

participants watched the two consecutive sad film clips and the other half watched the two consecutive amusing film clips. Finally, all participants completed the MCSDS scale.

7.3 Self-report Measures

The same self-reports as in Experiment 1 were used in this experiment. In this case, Cronbach's alpha values for our sample were as follows: (a) Trait Form of the State–Trait Cheerfulness Inventory—.97; (b) Scale for Mood Assessment—from .76 to .96; (c) State Form of the State–Trait Cheerfulness Inventory —from .95 to .98; and (d) Marlowe and Crowne's Social Desirability Scale —.78. The mean comparison analysis between two trait cheerfulness samples was significant: $t(46) = 11.89$, $p < .001$.

7.4 Psychophysiological Measures

HR and SCL were registered during the experiment on a BIOPAC MP150 system using AcqKnowledge 3.9 (BIOPAC Systems Inc.). Baselines and records during the clips were considered to be target conditions for the analysis. After filling out self-reports and before starting each affective induction (amusing, neutral, or sad), participants had a time period of 3 min to relax, and the last 10 s were taken as the baseline for clips with the same affective content. HR was recorded by three electrodes using the II configuration. Before placing the electrodes, the wrists and left ankle were cleaned with alcohol. A rate of 1000 samples per second and a gain of 5000 were used. SCL was recorded using two Ag–Ag–Cl 8 mm electrodes fixed to the middle phalanx of the index and ring fingers of the non-dominant hand with K-Y jelly filling (Grey and Smith 1984). In this case, the zones were cleaned with distilled water before the electrodes were placed. For the conductance level, a rate of 125 samples per second and a gain of 5 μΩ/V were used. A recording between 0 and 5 microSiemens (μS) was carried out. In order to avoid artifacts, a pre-analysis 5-point digital filter bandpass was applied to the HR. HR was analyzed using the MATLAB R2010a tool and the KARDIA program (Perakakis et al. 2010). In the first step, a MATLAB algorithm showed the raw electrocardiogram (ECG), detecting each R–R interval as well as R-wave identification marks, which were viewed by the experimenter to identify artifacts. R-waves were corrected to remove identification marks that were incorrectly specified (e.g., R-waves that were missed by the program were scored and marks that were coded as R-waves were removed). In the second step, inter-beat intervals were transformed off-line into HR in beats per minute with the KARDIA program. To process the SCL signal, a MATLAB algorithm was employed to plot target conditions graphically. Data were carefully visualized to detect movements or artifacts, which were edited to minimize their impact following a strategy for interpolation between adjacent points (Table 4).

8 Analysis and Design

1. *Self-report Measures* As in Experiment 1, we used a mixed factorial design: 2 (trait cheerfulness group; high vs low) × 3 (affective induction; amusing vs neutral vs sad) × 2 (affective state assessment moment; pre vs post). Again, to check for the effectiveness of our induction procedure, SAM, DES, and EVEA measures were treated as dependent variables. In order to check whether trait cheerfulness modulated

Table 3 Means and standard deviations of HR and SCL subtracted from baseline for each film clip as a function of trait cheerfulness group

Film clips	High trait cheerfulness		Low trait cheerfulness	
	HR	SCL	HR	SCL
Bennie and Joon	−2.50 (3.65)	0.27 (0.62)	−3.59 (2.61)	0.25 (0.47)
There's Something About Mary	−1.98 (3.42)	0.16 (0.46)	−3.31 (3.01)	0.24 (0.64)
Blue 2	0.25 (3.46)	0.12 (0.23)	−1.81 (3.90)	0.06 (0.19)
Sticks	0.49 (3.84)	−0.14 (0.31)	−2.20 (5.72)	−0.16 (0.32)
Champion	−1.40 (4.64)	0.43 (0.61)	−4.72 (4.39)	0.36 (0.52)
City of Angels	−1.40 (4.52)	0.25 (0.59)	−3.71 (4.65)	0.20 (0.46)

HR heart rate; *SCL* skin conductance level

state cheerfulness scores, they were treated as dependent variables. Additionally, to confirm that the results did not depend on social desirability, an ANCOVA was carried out that included MCSDS scores as a covariate.

2. *Psychophysiological Measures* The mean change in HR and SCL for each film was calculated and subtracted from the mean score obtained in relation to the 10 s before the onset of each affective induction (baseline). For the analysis, Bonferroni corrected comparisons between experimental conditions were conducted to ensure that spurious effects were not declared as significant effects. In this case, the subtracted HR and SCL values for film clips with the same affective content were combined. Then, we checked whether the observed changes were modulated by trait cheerfulness. The index of change in terms of both HR and SCL was analyzed as a function of the trait cheerfulness score (high vs low), the content of the film (amusing vs neutral vs sad), and the film's position for each affective category (film 1 vs film 2). Descriptive statistics can be found in Table 3. Again, the last variable was included to detect possible habituation effects in electrophysiological measures due to the repetition of the same affective content.

In a further step, and following an analysis strategy used for the affective clips, which consisted in segmenting each clip (Carvalho et al. 2012; Codispoti et al. 2008), amusing and sad clips were divided into 10-s periods (to get the same period as baseline). A time variable was created, and mean psychophysiological scores were obtained for each period. Data were analyzed by subtracting these values from the mean scores obtained in the baseline. Moreover, extracts with the highest affective load were selected. To do this, two judges watched the clips and indicated moments when affective content was more intense for both amusing and sad films. As a result, segments with the highest affective impact were as follows: (1) *Bennie and Joon*: segments 6–11 (the protagonist plays with food); (2) *There's Something About Mary*: segments 5–11 (a woman displays eccentric behavior) and segments 12–18 (a man fights with a dog); (3) *Champion*: segments 1–6 (a kid speaks with his father while he is dying); and (4) *City of Angels*: segments 4–10 (there is a traffic accident) and 18–27 (a man speaks with a woman while she is dying). A repeated-measures ANOVA for each amusing and sad film clip was carried out on the 10-s segments for each film as well as on extracts with the most intense affective content.

Table 4 Mean and standard deviation of the state cheerfulness, valence, arousal, amusement, neutrality, sadness, joy, and depression variables as a function of trait cheerfulness group, affective state assessment moment, and affective induction conditions

Measures	High trait cheerfulness					
	Pre			Post		
	A	N	S	A	N	S
State cheerfulness	38.19 (9.12)	39.39 (10.49)	40.97 (7.17)	45.68 (7.11)	35.81 (8.75)	26.68 (8.78)
SAM valence	6.45 (2.19)	6.58 (2.14)	6.74 (1.44)	7.42 (1.57)	5.61 (1.87)	4.29 (1.70)
SAM arousal	4.16 (2.05)	5.19 (1.97)	4.16 (1.86)	4.90 (2.24)	3.71 (1.92)	4.58 (1.89)
DES amusement	3.71 (2.71)	5.00 (3.34)	5.13 (2.31)	7.23 (2.26)	3.45 (2.77)	2.26 (2.02)
DES neutrality	5.71 (3.81)	3.07 (3.05)	5.26 (3.02)	3.52 (2.83)	5.81 (3.41)	2.39 (2.71)
DES sadness	0.55 (1.57)	2.32 (3.11)	0.13 (0.43)	0.19 (0.60)	0.55 (1.57)	5.39 (2.97)
EVEA joy	6.20 (2.61)	6.26 (2.07)	6.85 (1.62)	7.33 (1.46)	5.46 (2.33)	4.33 (2.10)
EVEA depression	1.51 (1.69)	2.29 (2.69)	0.71 (0.96)	0.46 (0.90)	1.54 (1.76)	4.02 (2.26)
Measures	Low trait cheerfulness					
	Pre			Post		
	A	N	S	A	N	S
State cheerfulness	30.63 (9.57)	29.76 (11.59)	29.09 (8.81)	34.42 (10.15)	26.27 (7.26)	22.00 (6.40)
SAM valence	5.61 (1.78)	5.36 (2.38)	5.18 (1.53)	6.27 (1.82)	4.64 (1.39)	3.45 (1.54)
SAM arousal	3.85 (1.87)	4.97 (1.88)	4.03 (2.02)	4.76 (2.08)	3.73 (2.04)	4.91 (1.89)
DES amusement	2.39 (2.16)	3.61 (3.39)	2.09 (2.10)	5.09 (2.97)	1.64 (1.75)	1.30 (1.76)
DES neutrality	6.70 (3.15)	3.82 (3.05)	6.55 (3.05)	3.73 (2.70)	6.27 (2.92)	3.76 (2.85)
DES sadness	1.52 (2.14)	3.24 (3.42)	1.33 (1.99)	1.18 (1.69)	1.52 (2.03)	5.85 (2.43)
EVEA joy	4.05 (2.82)	3.89 (3.02)	3.70 (2.57)	4.92 (2.54)	2.80 (2.23)	2.11 (2.05)
EVEA depression	2.23 (1.89)	2.91 (2.91)	2.02 (1.77)	1.24 (1.51)	2.15 (1.89)	4.65 (2.11)

A amusing; *N* neutral; *S* sad; *SAM* Self-Assessment Manikins, *DES* Discrete Emotions Scale; *EVEA* Scale for Mood Assessment

9 Results

9.1 Self-report Analysis

As in Experiment 1, the assessed variables changed in the expected direction, reflecting the effectiveness of the manipulation (all $ps \leq .05$). In general, state cheerfulness, valence (SAM), amusement (DES), and joy (EVEA) increased and sadness (DES) and depression (EVEA) decreased after participants watched amusing clips. The opposite pattern was observed after they watched sad clips. Neutrality (DES) scores increased after they watched neutral films and decreased after they watched amusing and sad films. Descriptive statistics can be found in Table 4.

The affective induction × affective state assessment moment interaction was, again, significant for state cheerfulness—$F(2, 124) = 53.25$, $p < .001$, $\eta^2 = .46$—showing the

effectiveness of the induction. Although there were no differences in the pre-induction measures ($F < 1$), significant differences were found in the post-induction measures—$F(2, 124) = 103.54$, $p < .001$, $\eta^2 = .63$—as amusing induction increased state cheerfulness—$F(1, 62) = 27.21$, $p < .001$, $\eta^2 = .31$—while induction with sad clips reduced state cheerfulness: $F(1, 62) = 150.89$, $p < .001$, $\eta^2 = .71$. Neutral induction also reduced cheerfulness mildly: $F(1, 62) = 10.79$, $p = .002$, $\eta^2 = .15$.

Importantly, reconfirming our hypothesis, this interaction was modulated by the trait cheerfulness group: $F(2, 124) = 4.46$, $p = .013$, $\eta^2 = .07$ (see Table 4; Fig. 2). As in Experiment 1, both groups showed an increase in the post-induction measures for amusing clips—$F(1, 30) = 34.32$, $p < .001$, $\eta^2 = .53$ and $F(1, 32) = 4.87$, $p = .035$, $\eta^2 = .13$ for high and low trait cheerfulness, respectively—as well as a decrease for sad clips: $F(1, 30) = 85.22$, $p < .001$, $\eta^2 = .74$ and $F(1, 32) = 64.85$, $p < .001$, $\eta^2 = .67$ for high and low trait cheerfulness, respectively. Importantly, however, the effect of the induction was again larger in the high trait cheerfulness group compared to the low trait cheerfulness group, remaining significant when social desirability was introduced as a covariate for amusing and sad clips: $F(1, 61) = 5.33$, $p = .024$, $\eta^2 = .08$ and $F(1, 61) = 9.35$, $p = .003$, $\eta^2 = .13$, respectively.

9.2 Psychophysiological Analysis

HR In order to check differences between affective materials, Bonferroni post hoc tests were conducted. We discovered statistically significant differences between the neutral and other content of films [neutral vs amusing ($p = .023$) and neutral vs sad ($p = .018$)], but not between amusing and sad conditions. Participants showed a decreased HR as a consequence of seeing amusing (−2.85) and sad film clips (−2.89) compared to neutral film clips (−.92). In short, the data indicated that our manipulation of the affective content of films was effective.

In order to study the modulation of trait cheerfulness over the differential effect elicited by film clips, a 2 (trait cheerfulness group) × 3 (affective induction) × 2 (film position) repeated-measures ANOVA was carried out. We found the expected main effect of affective induction to be significant: $F(2, 118) = 6.68$, $p = .002$, $\eta^2 = .10$. Participants' HR decreased further as a consequence of seeing amusing (−2.85) and sad clips (−2.81) compared to the neutral film clips (−.82). Moreover, and more importantly, the main effect of the trait cheerfulness group was also significant: $F(1, 59) = 11.99$, $p = .001$, $\eta^2 = .17$. Low trait cheerfulness participants showed a larger decrease in the HR score than high trait cheerfulness people (−3.22 vs −1.09, respectively).

In order to analyze this effect more specifically, a trait cheerfulness group × time ANOVA was carried out for each affective clip. Main significant effects were found in the trait cheerfulness group for the *Champion, City of Angels,* and *There's Something About Mary* film clips: $F(1, 60) = 10.44$, $p = .002$, $\eta^2 = .15$; $F(1, 60) = 4.50$, $p = .038$, $\eta^2 = .07$; and $F(1, 61) = 4.58$, $p = .036$, $\eta^2 = .07$, respectively. Participants with low trait cheerfulness showed a higher decrease in HR score compared to participants with high trait cheerfulness (−4.82 vs −1.05 for *Champion*, −4.09 vs −1.48 for *City of Angels*, and −4.45 vs −1.98 for *There's Something About Mary*). Additionally, a trait cheerfulness group × time interaction was observed only for the second amusing film: $F(17, 1037) = 2.28$, $p = .002$, $\eta^2 = .04$ (see Fig. 4). Therefore, the HR decrease difference for low versus high trait cheerfulness people varied depending on segments in this clip.

Similar analyses were carried out including only extracts with the highest affective load. The analyses confirmed the previous results. Main significant effects were found for the

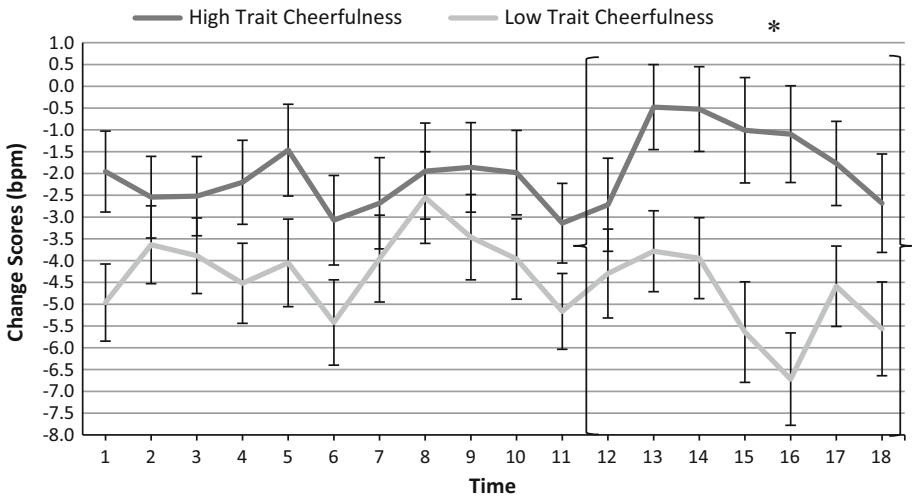

Fig. 4 Differential scores in HR for both low and high trait cheerfulness groups for the second amusing film clip, which was segmented into 18 parts of 10 s each. The results showed a larger general HR decrease for low versus high trait cheerfulness people. This difference was greater at the final part of the clip (segments 12–18). *$p < .05$

trait cheerfulness group for *Champion* (segments 1–6), *City of Angels* (segments 18–27), and *There's Something About Mary* (segments 12–18): $F(1, 62) = 10.86$, $p = .002$, $\eta^2 = .15$; $F(1, 60) = 5.01$, $p = .029$, $\eta^2 = .08$; and $F(1, 61) = 7.98$, $p = .006$, $\eta^2 = .12$, respectively. Participants with low trait cheerfulness showed a higher decrease in HR score compared to high trait cheerfulness (−4.84 vs −.43 for *Champion*, −3.64 vs −.92 for *City of Angels*, and −4.93 vs −1.47 for *There's Something About Mary*). Again, we found a trait cheerfulness group × time interaction specifically for the second set of segments with high affective impact in the second amusing film clip: $F(6, 366) = 2.24$, $p = .039$, $\eta^2 = .04$. Again, the HR decrease difference for low versus high trait cheerfulness people varied depending on segments in this clip (see Fig. 4).

SCL In order to check differences between affective materials, Bonferroni post hoc tests were conducted. Statistically significant differences between the neutral and the other conditions were found (neutral vs amusing [$p = .004$] and neutral vs sad [$p < .001$]). Moreover, we did not find differences between the amusing and sad conditions. Participants showed an increased SCL as a consequence of seeing amusing (.23) and sad film clips (.31) compared to neutral film clips (−.03). Again, SCL analysis indicated that our manipulation was adequate.

In order to study the differential effect elicited by film clips depending on trait cheerfulness, a 2 (trait cheerfulness group) × 3 (affective induction) × 2 (film position) repeated-measures ANOVA was carried out. Analysis showed the main effects of an affective induction and a film position: $F(2, 106) = 15.06$, $p < .001$, $\eta^2 = .22$ and $F(1, 53) = 27.03$, $p < .001$, $\eta^2 = .34$, respectively. Moreover, film position was modulated by affective induction: $F(2, 106) = 3.96$, $p = .002$, $\eta^2 = .07$. Amusing and sad film clips displayed in the first position elicited greater increases in SCL scores than films displayed later (.26 vs .20 and .40 vs .23, respectively). This was the case even for neutral film clips (.09 vs −.15). However, no main effect or interaction with the group was observed.

A trait cheerfulness group × time ANOVA was carried out for each affective clip. No interactions were observed. Similar to HR, an analysis with the highest affective load extracts was carried out. However, we did not discover any significant interaction. Therefore, SCL did not depend on trait cheerfulness.

10 Discussion

In the present study, we aimed to replicate the modulatory effect of trait cheerfulness over state cheerfulness. We also wanted to study whether this effect would be observed when employing psychophysiological measures such as HR and SCL. The self-report measures from Experiment 2 replicated the pattern of data found in Experiment 1, as high trait cheerfulness participants showed a larger effect of affective induction on state cheerfulness as a consequence of watching both amusing and sad film clips. Moreover, this difference was not modulated by the participants' social desirability.

A different pattern was observed, however, when psychophysiological measures were used. Participants with low trait cheerfulness showed a larger decrease in HR while viewing the affective clips than did the high trait cheerfulness individuals. That decrease was more prominent and significant for the film clips from *Champion*, *City of Angels*, *and There's Something About Mary*, especially during the more intense moments of the latter film. However, we did not observe any relationship between SCL and trait cheerfulness. Therefore, the results suggest different processes when electrophysiological and self-report measures are used to study the trait cheerfulness modulation of affective events.

11 General Discussion

Two studies were carried out to explore whether trait cheerfulness modulated participants' affective responses after watching films that differed in valence. In the first study, the State Form of the State-Trait Cheerfulness Inventory (STCI-S) was used to measure changes in cheerfulness state after induction. In the second study, we added the HR and SCL measures. For both amusing and sad film clips, participants with high trait cheerfulness exhibited larger changes in state cheerfulness after induction than the low trait cheerfulness participants, regardless of social desirability.

Ruch (1997) found that high trait cheerfulness people reported greater state cheerfulness changes than low trait cheerfulness people when they were exposed to amusing stimuli. The results from that study can be easily explained on the basis of a more pronounced positive bias in high trait cheerfulness individuals, as they tend to express a positive affective state and show a positive state. However, cheerfulness is also related to better coping with stressful situations (Papousek and Schulter 2010; Zweyer et al. 2004). Therefore, one could also expect a lower affective impact of negative situations on high than low trait cheerfulness people, which could reflect the action of a mechanism that protects them from such situations. In our two studies, however, the data did not support this hypothesis. On the contrary, high trait cheerfulness individuals reported greater changes in affective state than low trait cheerfulness individuals for the negative affective induction as well. Therefore, instead of a positive bias or protection mechanism, cheerfulness would be related to a greater permeability to the affective environment, perhaps explaining high trait cheerfulness people's better management of emotions. In fact, it has

been demonstrated that cheerfulness is related to regulatory processes and emotional intelligence (Papousek and Schulter 2010). For example, Yip and Martin (2006) found a positive correlation (.27) between trait cheerfulness and the emotional management factor of the Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT; Mayer et al. 2002), which involves abilities such as openness to positive and negative feelings and monitoring as well as reflection of emotions.

Results within the virtues and strengths literature have also established a relationship between humor and social/emotional intelligence. For example, Beermann and Ruch (2009) found that humanity, understood as being involved in relating to others in a benevolent and empathetic way (e.g., social intelligence or kindness). was one of the virtues more related to humor. Müller and Ruch (2011) found similar results. Therefore, together with previous research (Ruch et al. 1996), our data support the idea that the concept of cheerfulness itself involves permeability to the emotional environment.

Differences in arousal cannot explain the observed pattern of results. We grouped and analyzed participants' arousal levels in the two studies before and after facing amusing and sad stimuli. The results showed that arousal levels did not differ between the affective film clips, $F(1, 111) = 0.11$, $p = .74$, $\eta^2 = .001$. Furthermore, there were no significant differences in baseline arousal between high versus low trait cheerfulness individuals, $F(1, 110) = 0.47$, $p = .50$, $\eta^2 = .004$. Finally, no affective induction × affective state assessment moment interaction was observed, $F(1, 111) = 1.04$, $p = .31$, $\eta^2 = .009$, which reveals that affective material did not elicit differences in arousal levels.

Therefore, the higher affective state management observed in high cheerfulness individuals seems to be specifically related to valence. It is not clear, however, whether this also affects electrophysiological regulation. Our results with these measures were not so conclusive. Both high and low trait cheerfulness individuals showed the expected general effect of induction for HR and SCL (decreased HR and increased SCL during affective compared to neutral induction). Furthermore, whereas trait cheerfulness did not modulate the observed increase in SCL, the observed decrease in HR differed across groups. Low trait cheerfulness individuals generally showed a more pronounced decrease in HR, especially in the *Champion*, *City of Angels*, and *There's Something About Mary* clips, compared to high cheerfulness group.

In the present research, the inclusion of "objective" measures was aimed at investigating whether self-report results could be extrapolated to different response systems. Some theories establish that a significant emotional event triggers a subjective, physiology, and behavior emotional response, which are interrelated and synchronized (Scherer 2005), while other authors posit that there is no one-to-one correlation between different response systems, so a "subjective" change may occur as a result of exposure to an affective stimulus without physiological variations and vice versa (see Mauss and Robinson 2009, for a review). In this sense, physiological results would support the last idea, highlighting the need to explore different response systems from a multidisciplinary and independent perspective by means of various techniques.

In Ruch and colleagues' theoretical approach, cheerfulness is understood as an affective dimension that is closely linked to positive emotions and includes expressive, communicative, affective, cognitive, and social elements (Martin 2007; Ruch et al. 1996, 1997). Hence, in terms of explanatory and predictive power, one possible explanation may be that social and cognitive elements could have higher relevance to humor and cheerfulness than physiological parameters (Yovetich et al. 1990). This could explain the pattern of results observed for SCL (i.e., no group differences), which has been traditionally linked to

arousal (e.g., Cuthbert et al. 2000), therefore also explaining the lack of group differences in arousal measures reported above.

However, the pattern of results observed for HR, which was the opposite of what we expected, needs a different kind of explanation. In our study, compared with low trait cheerfulness individuals, high trait cheerfulness individuals showed a reduced decrease in HR while facing either amusing or sad clips, but they reported larger changes in self-report measures after watching the clips. Some studies have pointed out that HR deceleration can be understood as reflecting alertness, sustained attention, and orienting processes (Carvalho et al. 2012; Codispoti et al. 2008; Fernández et al. 2012). Therefore, low trait cheerfulness individuals might need more attentional focusing to have a specific affective state induced, whereas high trait cheerfulness individuals would be induced more naturally, due to their larger permeability to the emotional environment, with scarce attentional deployment. Nevertheless, further studies are needed to test that hypothesis.

Importantly, taking into account that cheerfulness is associated with emotional regulation and emotional intelligence, a tentative explanation for the overall pattern of data observed in the two experiments reported in this paper might be that high trait cheerfulness individuals can better manage their affective states, leading to the reduced physiological impact of the affective environment. The fact that low trait cheerfulness individuals have worse management of their affective states would explain the larger physiological impact.

Previous research has described a relationship among cheerfulness, well-being, and health (Martin et al. 2003; Papousek and Schulter 2010; Zweyer et al. 2004). For instance, a recent study showed that trait cheerfulness was positively correlated with positive indicators of well-being, such as life satisfaction and happiness, and negatively with negative dimensions of well-being, such as anxiety and depression (Carretero-Dios et al. 2014). Delgado-Domínguez et al. (2014) demonstrated that cheerfulness was also associated with a lower inflammatory marker level among patients with ankylosing spondylitis disease. More recently, Delgado-Domínguez et al. (2016) found that state cheerfulness was related to lower values of self-reported disease activity and C-reactive protein in patients with rheumatoid arthritis.

Therefore, by taking our results and previous research into account, it is possible that the better permeability to the affective environment of high cheerfulness individuals together with their improved management and communication of emotions could contribute to their well-being and high health in comparison to low cheerfulness people. This is evidenced by a lower cardiac impact when facing affective stimuli. In any case, we consider it necessary to replicate the present data as well as to use other affective state measures to ensure that the effect is not spurious.

Despite the potential importance of the obtained results, our studies had some shortcomings. First, we did not incorporate a neutral stimulus at the beginning of the experiment to ensure that all of the participants showed an equivalent initial affective state. Future studies should replicate the current pattern of data while ensuring an initial affective state and perhaps adding facial expression measures to the self-report and psychophysiological measures used in the current experiments. In this way, it will be possible to explore whether cheerfulness also influences facial expression, in terms of intensity, duration, and frequency, after being exposed to stimuli with less pictorial load than films, such as music or images, in which humor is not present. However, it might be interesting to incorporate bad moods and seriousness into future studies, as cheerfulness and bad mood are considered opposite affective dimensions (Ruch et al. 1996, 1997). To our knowledge, no study to date has explored the role of bad mood in affective inductions. Moreover, taking

into account the possible relevance of the cognitive dimension, it would be intriguing to determine whether seriousness exerts a moderating effect on affective induction.

In summary, high and low trait cheerfulness individuals were exposed to a set of affective clips. The results showed that the high trait cheerfulness people reported larger affective changes than the low trait cheerfulness people after viewing amusing and sad clips, reflecting a greater permeability to the affective environment and better communication of emotions. Moreover, they experienced a lower decrement in HR while viewing the clips, which might indicate better emotional management. These results have important implications. Therefore, it would be fruitful to consider sense of humor, and specifically trait cheerfulness, to be an important tool in emotional intelligence intervention programs, which can incorporate humoristic stimulations into the process of managing and understanding of emotions. In a similar way, given the established relationship between trait cheerfulness and health, it would be useful to develop and implement procedures to train cheerfulness in order to enhance a set of personality characteristics related to well-being and health, such as HR, optimism, and resilience.

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