The effect of positive mood on flexible processing of affective information

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Abstract

Recent efforts have been made to understand the cognitive mechanisms underlying psychological resilience. Cognitive flexibility in the context of affective information has been related to individual differences in resilience. However, it is unclear whether flexible affective processing is sensitive to mood fluctuations. Furthermore, it remains to be investigated how effects on flexible affective processing interact with the affective valence of information that is presented. To fill this gap, we tested the effects of positive mood and individual differences in self-reported resilience on affective flexibility, using a task switching paradigm (N=80). The main findings showed that positive mood was related to lower task switching costs, reflecting increased flexibility, in line with previous findings. In line with this effect of positive mood, we showed that greater resilience levels, specifically levels of Acceptance of self and life, also facilitated task set switching in the context of affective information. However, the effects of resilience on affective flexibility seem more complex. Resilience tended to relate to more efficient task switching when negative information was preceded by positive information, possibly because the presentation of positive information, as well as positive mood, can facilitate task set switching. Positive mood also influenced costs associated with switching affective valence of the presented information. This latter effect was indicative of a reduced impact of no longer relevant negative information and more impact of no longer relevant positive information. Future research should confirm these effects of individual differences in resilience on affective flexibility, considering the affective valence of the presented information.

Keywords: positive emotions; cognitive flexibility; resilience; individual differences

Over the last decades experimental psychopathology research on affective disorders has mainly focused on cognitive processes underlying emotional vulnerability and development, maintenance and recurrence. However, individuals differ greatly in how they deal with both positive and negative life events and more recently researchers have become interested in the mechanisms of ‘resilience’ and trying to understand why some people are able to withstand whatever life throws at them. The aim of this study was to further extend this research by investigating possible cognitive mechanisms that underlie psychological resilience, and whether these cognitive processes are sensitive to mood state.

Particularly in the last few decades researchers have extended their focus from emotional vulnerability to psychological resilience. However, one of the main difficulties in studying resilience is the wide variety of definitions. While psychological resilience has been defined as people’s ability to resist, recover, or bounce back from the negative effects of stress and adversity (e.g. Lazarus, 199; Leipold & Greve, 2001), thus reflecting a resistance to negative change, many definitions also stress the concept of adaptation to change and being sensitive to situational demands. Resilience is often described as a process that reflects adaptation to a changing environment, adaptation when faced with adversity, flexibility of functioning in response to changing situational demands, and having the belief in one’s own capacity to cope with such events (e.g. Block & Block, 1980; Connor & Davidson, 2003; Luthar, Cicchetti, & Becker, 2000; Wagnild & Young, 1993). Broadly speaking, resilience thus reflects both a resistance to the effects of stress and adversity, and the ability to adapt to (changing) situational needs, highlighting the multifaceted nature of resilience. Moreover, although the focus is often on adaptation in the face of adversity, it has been argued that positive life events also necessitate resilience characteristics to adapt to changed situational demands (Fletcher & Sarkar, 2013).

A key aspect of adaptation to changing situational demands is considered to be psychological flexibility. Psychological flexibility has been used as an umbrella term referring to a range of abilities relating to adaptation to fluctuating situational demands, shifting mindsets or behavior when compromising functioning, and maintaining a balance among important life domains (Kashdan & Rottenberg, 2010). Indeed, psychological flexibility with a sensitivity to context or situation is considered to be crucial for mental health and sustainable well-being (Kashdan & Rottenberg, 2010). Psychological flexibility can manifest itself at different levels of behavior, emotion, and cognition, which is also reflected in the different operationalizations of psychological flexibility in the literature. Previous findings show that flexibility in the use of different (behavioral or cognitive) emotion regulation strategies, depending on the context or situation, will lead to better or healthier adjustment (Bonanno & Burton, 2013).Thus, effectively using different emotion regulation strategies that are situationally appropriate. Similarly, higher levels of resilience have been related to more flexibility in emotional responses to positive versus negative stimuli, thus switching in the experienced/expressed emotional response depending on the situational demands (Waugh, Thompson, & Gotlib, 2011). Block and Block (p. 318, 2006) specifically highlighted this need for contextual sensitivity, proposing that resilience entails the dynamic ability “to reduce behavioral control as well as to situationally increase behavioral control, to expand attention as well as to narrow attention” in response to situational requirements.

In the current study we focus more directly on the cognitive process that reflects the ability to deliberately switch between modes of thought or mental sets, i.e. cognitive flexibility. Cognitive flexibility is considered a component of executive functioning and often operationalized as task set switching (Meiran, 2010). Recent research has directly linked greater flexibility in cognitive processing of affective information to resilience (Genet & Siemer, 2011). Genet and Siemer (2011) used a task switching paradigm in which individuals had to shift between task sets that required them to focus on affective or non-affective characteristics of emotional words. These two task sets, focusing on affective or non-affective aspects of emotional information, are a useful analogue for cognitive strategies that can increase or decrease the emotional impact of information. These authors refer to cognitive flexibility (i.e. task switching) in the context of emotional information as 'affective flexibility'. Cognitive flexibility, the ability to (deliberately) switch between modes of thought or mental sets, is considered important for emotion regulation (Gross, 2007), and effective emotion regulation in turn contributes to resilience (Ong, Bergeman, Bisconti, Wallace, 2006), thus cognitive flexibility in the context of emotional information may be essential for resilience (Genet & Siemer, 2011). Such control over thoughts or mental sets might actually contribute to flexibility in the use of different emotion regulation strategies across situations or modulation of emotional responses across situations.

In the initial study linking affective flexibility to resilience (Genet & Siemer, 2011), the valence of the emotional information (i.e. the presented word) was not taken into account when examining task switching performance. However, resilience is considered to reflect adaptation to changing situational demands, so the presence of positive and negative information can create different 'emotional contexts' that likely require or evoke different cognitive responses to adapt to the context. Indeed the cognitive tuning hypothesis (Schwarz, 1990) proposes that moods and affective information can act as cues providing us information about the situational requirements, for example whether a situation is problematic or benign. The presence of negative information could signal a problematic situation, requiring attention to the source of the problem, in line with the cognitive tuning hypothesis (Schwarz, 1990). Positive information, on the other hand, could signal being in a benign and safe environment, so different situational requirements allow for a different cognitive response. Additionally, in terms of emotion regulation it seems adaptive to be able to disengage from negative information once it's no longer relevant. To study the link between resilience and flexibility in processing of information it therefore seems relevant to take into account (changes in) the affective valence of the presented information.

A later version of the affective flexibility switching task presented individuals with emotional pictures (Genet, Malooly, & Siemer, 2013; Malooly, Genet, & Siemer, 2013). In this task participants are required to switch between a task for which they indicate the affective valence of the picture (i.e. affective task), and a task for which they indicate the number of people depicted on the picture (i.e. non-affective task). Malooly and colleagues (2013) found that greater emotion regulation effectiveness while watching a sad film clip was related to more efficient switching to the non-affective task when the picture remains negative and related to more efficient switching to the affective task when the picture remains positive. This shows that adaptive emotion regulation may relate to specific cognitive responses depending on the emotional context. Interestingly, a study on rumination, considered a maladaptive response to distress, showed that more efficient switching to non-affective aspects of positive information related to increased rumination, suggesting cognitive flexibility is not adaptive per se (Genet et al., 2013). Similarly, difficulties switching from a neutral to emotional task set has been linked to greater persistence on a stressful and frustrating task (Johnson, 2009a), while more efficient switching towards a neutral task set was also linked to greater persistence (Johnson, 2009b). However, while a decreased ability to switch from a neutral to emotional task set predicted less feelings of frustration during a stressful task it was also related to increased trait anxiety and worry in the longer term (Johnson, 2009b). It's important to note though that in these previous studies the valence of the emotional stimulus was kept neutral on task switch trials and the preceding trial (Johnson, 2009a; 2009b).

These previous findings highlight how the context (e.g. the valence of the picture when individuals have to switch task set) could influence what cognitive response is more or less adaptive. That is, depending on the emotional context more flexibility could be considered adaptive, but inflexibility in switching of attention, depending on the context may not be bad per se. This is in line with the idea of a flexibility-stability balance (Goschke & Bolte, 2014) of cognitive control modes, which reflects that both goal-shielding (i.e. goal maintenance and shielding from distracting stimuli) and flexible set switching have benefits and costs. Although flexibility is generally considered as something adaptive, it can increase distractibility and could promote unstable behavior (Goschke & Bolte, 2014). This suggests that the relationship between cognitive flexibility and resilience, taking into account situational demands, may be complex. That is, both cognitive flexibility (mental set shifting) and cognitive inflexibility (mental set stability) could be considered adaptive depending on the contextual demands.

Previous research investigating flexibility in the processing of affective material and its relation to individual differences in resilience and emotion regulation, seems to consider affective flexibility as a more stable cognitive characteristic. However, it is unclear whether affective flexibility is influenced by mood state and thus whether this ability to flexibly process affective information can vary over time. There is thus need for studies investigating the influence of mood state besides individual differences. Recent research shows that (task-unrelated) positive affect can increase cognitive flexibility, by facilitating task-switching (Yang & Yang, 2014; for a review on positive affect and cognitive flexibility, see Goschke & Bolte, 2014). This previous research measured cognitive flexibility using a task switching paradigm with non-affective information, thus it remains an open question whether positive mood could facilitate affective flexibility, that is, task switching in an affective context, and how this interacts with the affective valence of the information. With theories proposing a link between positive emotions and resilience through effects on attention and cognition (e.g. the broaden-and-build theory, Fredrickson 1998; 2001), the influence of positive emotions on affective flexibility could be a linking factor between the experience of positive emotions and resilience. However, the interplay between positive mood and different emotional contexts, as created by presentation of emotional pictures, on task switching remains to be examined.

In the current experiment we therefore aimed to test the interaction of task switching with emotional context, as created by presentation of emotional pictures, and how this is influenced by both positive mood state and individual differences in resilience. To induce positive mood we used a mood induction involving mental imagery of positive autobiographical memories. This procedure has previously been shown to successfully induce a positive mood (e.g. Grol, Koster, Bruyneel, & De Raedt, 2014; Grol & De Raedt, 2014). To assess individual differences in resilience, we used a self-report questionnaire measure of resilience, in line with previous studies examining the effects of individual differences in resilience (e.g. Genet & Siemer, 2011). We used the Dutch version of the Resilience Scale (RS-nl; Portzky, 2008) as this translation has been validated in a large sample of healthy individuals (Portzky, Wagnild, De Bacquer, & Audenaert, 2010). This questionnaire measures resilience in terms of self-reliance, adaptability, perseverance, and equanimity. In the literature resilience has predominantly been measured with questionnaires and such assessment of resilience taps into an individual's perception of themselves being resilient at this moment in their lives. To measure affective flexibility we used the switching task that was previously used by Genet et al. (2013) and Malooly et al. (2013). This paradigm requires individuals to switch between task sets while being presented with positive and negative pictures. One task requires processing of affective aspects (i.e. identify the valence) of the pictures, and one task requires to process non-affective aspects (i.e. identify the number of persons depicted) of the emotional pictures. This will be the first study to investigate whether this affective flexibility paradigm is sensitive to positive mood induction and whether a relation between resilience and affective flexibility is dependent on the emotional context in which task switching takes place.

It is important to note that several processes contribute to task switching performance and switch costs reflect all executive processes required to deactivate a previous task goal and activate a current task goal. Generally a distinction is made between bottom-up influences (e.g. task-set inertia, task-rule congruency) and top-down influences (e.g. goal setting, inhibition), which can all contribute to more or less flexibility (for review see Meiran, 2010). As the primary goal of this study was to relate individual differences in affective flexibility to mood state and resilience, we did not test which specific processes contributed to task switching. For example, smaller switch costs when switching from the non-affective task set to the affective task set could reflect a combination of top-down processes like adopting an affective processing task set and bottom-up processes like increased saliency of affective information. Similarly, larger switch costs when switching from negative information to positive information could reflect a combination of weaker inhibition of the negative affective characteristics of the stimulus or greater carryover activation of affective information stemming from the previous trial.

The main aim of the current study was to investigate the effect of positive mood and resilience on affective flexibility. Using a task switching paradigm in the context of emotional information allows us to examine effects of positive mood and resilience both on the costs of task set switching, the costs of switches in the affective valence of the presented information, and their interaction. Provided the proposed relationship between the experience of positive emotions and resilience (Fredrickson, 1998; 2001), we expected positive mood and individual differences in resilience to have similar effects on cognitive flexibility in the context of affective information. Therefore, we hypothesized that both positive mood and resilience would be related to increased affective flexibility, more specifically a modulation of positive mood and resilience scores of task set switching costs in the task switching paradigm, in line with previous findings (Genet & Siemer, 2011; Goschke & Bolte, 2014). This predicted relation is visually depicted in figure 1. However, we aimed to further explore how this interacts with the (changing) emotional valence of the presented information. There is an extensive literature reporting that mood disorders (e.g. depression, anxiety) are associated with increased elaboration of mood-congruent negative information and inhibitory impairments for negative information (for reviews see, Gotlib & Joormann, 2010; De Raedt & Koster, 2010). Therefore, it's possible that positive mood and resilience are associated with an increased ability to inhibit negative information, while experiencing difficulties inhibiting mood-congruent positive information. This may be especially so when participants are required to judge the affective aspects of emotional information (e.g. as a mood regulatory strategy). Therefore, we hypothesized that positive mood and resilience are related to relatively less interference of no longer relevant (affective aspects of) negative information when sorting emotional stimuli (in the next trial), while being related to relatively more interference of (affective aspects of) positive information. This would be reflected by an interactive effect of positive mood or resilience with the emotional valence of the presented information in the previous and current trial on task performance. For a visual depiction of this hypothesized effect, see figure 2.

Method

Participants

Eighty participants (64 females) aged between 17 and 46 years (*M* = 21.64, *SD* = 3.70) volunteered to participate in this experiment and were paid for their participation[2]. This

[2] Forty participants were tested during a first phase and 40 participants were tested in a second phase. However, test phase did not have a significant influence on the effect of the mood induction, nor on the average task accuracy and reaction time in the affective flexibility task.

experiment was approved by the local ethical committee of the Faculty of Psychology at Ghent University.

Material and Mood Induction Procedure

Questionnaires. We measured mood state with visual analogue scales (VAS) measuring how happy, sad, aroused, angry, and tense participants were feeling “at this moment”. VAS scales (0 to 10 cm, resulting in a 0-100 scale) were used because of their visual presentation which makes these sensitive to fluctuations in affect (Rossi & Pourtois, 2012). We measured how happy and sad participants were feeling on a scale with the anchor points “neutral” and “as happy/sad as I can imagine”, and we measured arousal on a scale with the anchor points “calm” and “aroused”. Additionally, we measured anger and tenseness on a scale with the anchor points “not at all” and “as angry/tense as I can imagine”.

Along with mood state we also assessed trait affectivity, trait anxiety, and depressive symptoms as these could influence the effectivity of the mood induction procedure. We measured trait affectivity with the 20 item Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988). Participants were asked to rate the degree to which they felt the emotions “*in general*”. Participants gave their ratings on a 5-point Likert scale ranging from 1 “very slightly” to 5 “very much”. Trait anxiety was assessed using the State Trait Anxiety Inventory trait version (STAI-trait; Spielberger, Gorsuch, Lushene, Vagge, & Jacobs, 1983; Van der Ploeg, Defares, & Spielberger, 2000), in which participants were asked to rate how they feel “*in general*” on a 4-point scale ranging from “almost never” to “almost always.” The presence and severity of depressive symptoms was measured using the 21-item Beck Depression Inventory (BDI-II-NL; Beck, Steer, & Brown, 1996; Van der Does, 2002). This questionnaire consists of statements (responses ranging from 0 to 3) and participants are asked to pick out the response that best fits the way the participant has been feeling during the past two weeks.

Finally, resilience was measured using the Dutch version of the Resilience Scale (RS-nl; Portzky, 2008). Participants were asked to rate their agreement with 25 statements on a 4-point scale ranging from "totally disagree" to "totally agree". Two subscales can be calculated, the subscale Personal Competence consists of 17 items and reflects self-confidence, determination, and self-reliance. The subscale Acceptance of Self and Life consists of 8 items and reflects equanimity, adaptability, acceptance of life as it comes, and a balanced perspective of life (Portzky, 2008). Psychometric evaluation of the RS-nl in a large healthy sample has showed that the total scale has good internal consistency, Cronbach's α = 0.85, as does the subscale Personal Competence, α = 0.81, and acceptable internal consistency for the Acceptance of Self and Life subscale, α = 0.68 (Portzky et al., 2010). Additionally, the scale proved to be stable over a period of three months with a test-retest correlation of r = 0.90 (Portzky et al., 2010). The RS-nl has acceptable construct validity, which was shown by comparison to the original Resilience Scale (Wagnild & Young, 1993) given the lack of other validated Dutch resilience scales. The original Resilience Scale has been related to, amongst others, psychological well-being and health promoting activities, while it's inversely correlated to stress, anxiety, depression, and hopelessness (Wagnild, 2009).

Mood induction procedure. The procedure to induce mood (MIP) consisted of a procedure using mental imagery. Participants were instructed to vividly imagine a self-provided autobiographical memory to induce either a happy or neutral mood. Participants had to recall a memory of a specific event, that is, an event that took place on a specific day, more than one week ago. All participants first practiced mental imagery from a field perspective (i.e. first person perspective) with a practice task (Holmes, Coughtrey, & Connor, 2008). After this practice task, participants in the neutral MIP group were asked to recall a memory of an event that did not elicit strong negative or positive emotions at that time, while participants in the positive MIP group were instructed to recall a memory of an event which made them feel very happy at that time. Participants were asked to shut their eyes while describing what they remembered in detail. Instructions (based on Holmes, et al., 2008; Watkins & Moberly, 2009) were given to all participants to promote concreteness and imagery from a field perspective (as if they see the situation through their own eyes). Participants imagined the event for 30 seconds after which they were asked a series of questions (based on Watkins & Moberly, 2009), letting them focus on what they could see, hear, and physically feel. Following these questions, participants continued imagining the event for another 30 seconds without describing aloud.

Affective switching task. Affective flexibility was measured using a previously developed task (Genet et al., 2013; Malooley et al., 2013) for which the instructions were translated to Dutch. During the task participants had to make a decision about emotional pictures (positive and negative) according to two different sorting rules, an affective and a non-affective sorting rule. That is, in some trials participants had to make a decision about whether the picture is positive or negative (i.e. affective rule), while in other trials participants had to make a decision based on the number of human beings depicted in the picture (i.e. non-affective rule). Across trials participants had to switch between making a response according to the affective rule or the non-affective rule. Additionally, across trials the emotional valence of the presented picture could remain the same (i.e. remain positive or negative) or change (e.g. change from a negative to a positive picture).

In total there were 16 trial types for which both emotional valence and task set could repeat across trials (e.g. positive affective trial preceded by a positive affective trial), trials for which valence repeats but task set switches (e.g. positive affective trial preceded by a positive non-affective trial), trials for which valence switches but task set repeats (e.g. positive affective trial preceded by a negative affective trial), and trials for which both valence and task set switches (e.g. positive affective trial preceded by a negative non-affective trial). The combination of picture valence and sorting rule (i.e. affective or non-affective) followed a pseudorandom sequence (see Genet et al., 2013; Malooley et al., 2013). The number of trials in the task for each of the 16 trial types ranged between 13-30 trials.[3]

Pictures were selected from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2008). Forty pictures were selected for each of the following four picture types: negative pictures with one or fewer human beings, negative pictures with two or more human beings, positive pictures with one or fewer human beings, and positive pictures with two or more human beings, resulting in a final set of 160 IAPS pictures. Negative and positive pictures differed in valence as expected, $t(158) = 64.06$, $p < .001$ (negative: $M = 2.72$, $SD = 0.53$; positive: $M = 7.38$, $SD = 0.38$), but negative pictures were also more arousing than positive pictures, $t(158) = 5.76$, $p < .001$ (negative: $M = 5.61$, $SD = 0.86$; positive: $M = 4.85$, $SD = 0.82$). In each trial (see Figure 3) participants were first presented with a black screen for 250msec, followed by a fixation cross for 250msec. The fixation cross was then replaced by a picture (1024 x 768 pixels)in the middle of the screen with cues presented left and right of the picture that indicate according to what rule participants have to respond (i.e. sorting according to valence or the number of human beings). This stayed on screen until a response was given. To indicate that participants had to sort the picture according to the non-affective rule, "≤1" and "≥2" were presented left and right of the picture, representing one or fewer human beings, and two or more human beings respectively. For example, if "≤1" was presented left of the picture and "≥2" on the right side of the picture, participants had to press the right key (i.e. letter "M") if the picture depicted two or more human beings. To indicate that participants had to sort the picture according to the affective rule, "+" and "-" were

[3] Previous research (e.g. Malooly et al., 2013) using this task only analysed switch costs for when task set switches (or repeats) but the emotional valence of the picture remains constant across trials. Based on reviewer suggestions we analysed all possible switch costs, that is, switches in task set, emotional valence, or both.

presented left and right of the picture, representing positive valence and negative valence respectively. For example, if the "+" was presented left of the picture and "-" on the right side of the picture, participants had to press the left key (i.e. letter "N") if the picture was positive. Additionally to these cues that indicate according to what rule participants have to respond that trial, the background color of the screen (gray or white) also indicated sorting rule. For example, a gray background could indicate that participants have to make a response to the picture according to the non-affective rule. Thus, in each trial both the cues next to the picture and the background color indicated according to what sorting rule participants had to respond. There were eight different versions of the task, counterbalancing for the combination of background color and sorting rule (e.g. gray indicates non-affective rule), and combination of sorting response and response key (e.g. left key for both "positive valence" and "two or more humans", and right key for both "negative valence" and "one or fewer humans").

Participants were instructed to respond as quickly and accurately as possible by pressing one of two keys on the keyboard to indicate their response. The task consisted of two 10-trial practice blocks in which both sorting rules where practiced separately. This was followed by two 160-trial test blocks, during which the picture type and sorting cue followed the pseudorandom sequence.

Procedure

Participants were randomized to receive either the positive or the neutral MIP. After signing the informed consent form, participants filled out the questionnaires. Next, baseline levels of mood were measured and participants completed the MIP procedure, followed by a mood assessment immediately afterwards. After the MIP, participants performed the affective switching task[4], followed by another mood assessment. At the end of the experiment, participants were debriefed about the study.

[4] We also administered the Ruminative Response Scale (Nolen-Hoeksema & Morrow, 1991; Raes, Hermans, & Eelen, 2003). Additionally, after the affective switching task we administered participants a

Results

Preliminary Analyses

In the affective flexibility task we removed incorrect trials and post-error trials when calculating the reaction time (RT) as these are difficult to classify as being a switch or repeat trial. For this reason accuracy was also calculated considering both incorrect and post-error trials. This resulted in deleting an average of 13.66% of the trials. A univariate ANOVA with MIP group (neutral vs. positive MIP) as between-subject factor revealed no differences in the percentage of deleted trials based on MIP group, $F(1,78) = 0.33$, $p = .567$, $\eta_p^2 < .01$. The influence of outlying reaction times was reduced by using a window of 2.5*SD*s from the mean of each participant (within that trial type). If a RT was outside this window, it was replaced with the value corresponding to 2.5*SD*s below or above the mean, in a similar way to former research using the same task (Genet et al., 2013; Malooy et al., 2013). General switch costs were calculated first, in which a change of sorting rule was considered a switch (i.e. switch from affective to non-affective rule and vice versa). Paired-samples t-test confirmed that the average RT on switch trials ($M = 1430$msec, $SD = 278$) was significantly higher than the average RT on repetition trials ($M = 1280$msec, $SD = 265$), $t(79) = 19.99$, $p < .001$, $d = 0.55$ confirming the presence of switch costs. Similarly, the average accuracy on switch trials ($M = 0.85$, $SD = 0.09$) was significantly lower than the average accuracy on repetition trials ($M = 0.87$, $SD = 0.08$), $t(79) = 4.23$, $p < .001$, $d = 0.23$.

Participant Characteristics

Forty participants were randomized to receive the positive MIP and 40 participants received the neutral MIP. We performed univariate ANOVAs, with MIP group (neutral vs. positive MIP) as between-subject factor to test for pre-existing group differences on PANAS

negative induction task for which we measured the emotional stress response with the VAS scales and for the first 40 participants we also measured the physiological stress response using beat-to-beat heart rate. However, all these measures were not used to test the hypotheses of the current study and will not be reported or published elsewhere.

trait affectivity, log-transformed (because of skewed data) BDI depressive symptoms, STAI trait anxiety, and RS-nl resilience. Significant differences between MIP groups were observed for PANAS trait negative affect, $F(1, 78) = 5.02$, $p = .028$, $\eta_p^2 = .06$, and STAI trait anxiety, $F(1, 78) = 5.03$, $p = .028$, $\eta_p^2 = .06$, with the neutral MIP scoring higher than the positive MIP. A (trend) difference in the opposite direction was observed for PANAS trait positive affect, $F(1, 78) = 3.26$, $p = .075$, $\eta_p^2 = .04$, and the RS-nl Acceptance subscale, $F(1, 78) = 5.72$, $p = .019$, $\eta_p^2 = .07$.

Differences on the scales reflect random group assignment differences. However, the differences in resilience across MIP groups may confound results when examining the effects of positive mood and resilience on affective flexibility. That is, differences in resilience may influence the effects of positive mood on affective flexibility, even when resilience is included in the model. To solve the issue of MIP group differences we excluded the two participants from the neutral MIP group with the lowest score on the RS-nl Acceptance subscale and RS-nl total score, and we excluded the two participants from the positive MIP group with the highest score on the RS-nl Acceptance subscale and RS-nl total score. The final sample that was included in the following analyses therefore consisted of 38 participants in the positive MIP group and 38 participants in the neutral MIP group. The means and standard deviations for the baseline variables are presented in Table 1. Correlations between the baseline variables are reported in Table 2.

A univariate ANOVA with MIP group (neutral vs. positive MIP) as between-subject factor showed no age difference between MIP groups, and gender was evenly distributed across MIP groups as well (see Table 1)[5]. Univariate ANOVAs showed that there was a tendency for MIP groups to differ on PANAS trait negative affect, $F(1, 74) = 3.28$, $p = .074$,

[5] Gender is distributed evenly across conditions, but skewed in the overall sample. However, when controlling for gender in all analyses with task switching the general effects or effects with positive mood or resilience remained similar.

η_p^2 = .04, and STAI trait anxiety, *F*(1, 74) = 3.23, *p* = .077, η_p^2 = .04, but MIP groups did not differ on any of the other scales, all *p* > .10.

Mood Manipulation Check

To investigate the effect of the MIP on the VAS scales happy, sad, arousal, angry, and tense, we calculated a composite negative VAS scale consisting of the average of the sad, angry, and tense scale. Means and standard deviations are presented in Table 3. We performed mixed ANOVAs with time (pre-MIP, post-MIP, post-task) as within-subjects variable, and MIP group (neutral vs. positive MIP) as between-subjects variable on the VAS happy, VAS arousal, and log-transformed VAS negative scale (because of skewed data) separately.

For the VAS happy scale, a significant main effect of time was found, *F*(2, 73) = 35.29, *p* < .001, η_p^2 = .49, and a Time x MIP group interaction, *F*(2, 73) = 13.45, *p* < .001, η_p^2 = .27. Paired t-tests showed that the neutral MIP group did not show a significant change from pre-MIP to post-MIP in happiness, *t*(37) = 0.34, *p* = .736, *d* = 0.03, whereas the positive MIP group did show a significant increase, *t*(37) = 5.67, *p* < .001, *d* = 0.66. Both the neutral and positive MIP group showed a significant decrease in happiness from post-MIP to post-task, *t*(37) = 3.64, *p* = .001, *d* = 0.33 and *t*(37) = 7.77, *p* < .001, *d* = 1.14 respectively. After the MIP the positive MIP reported to be significantly more happy than the neutral MIP group, *t*(74) = 2.47, *p* = .016, *d* = 0.56, while after the affective flexibility task MIP groups no longer significantly differed in happiness ratings, *t*(74) = 0.48, *p* = .479, *d* = 0.16.

For the VAS arousal scale, a significant main effect of time was found, *F*(2, 73) = 12.26, *p* < .001, η_p^2 = .25, and a Time x MIP group interaction, *F*(2, 73) = 10.15, *p* < .001, η_p^2 = .22. Paired t-tests showed that the neutral MIP group did not show a significant change from pre-MIP to post-MIP in arousal, *t*(37) = 0.46, *p* = .649, *d* = 0.06, while the positive MIP group did show a significant increase in arousal, *t*(37) = 4.86, *p* < .001, *d* = 0.74. Similarly, the neutral MIP group did not show a significant change from post-MIP to post-task in arousal,

$t(37) = 0.74$, $p = .467$, $d = 0.13$, while the positive MIP group showed a significant decrease in arousal across the task, $t(37) = 6.09$, $p < .001$, $d = 0.84$. After the MIP the positive MIP reported to be significantly more aroused than the neutral MIP group, $t(74) = 3.30$, $p = .002$, $d = 0.75$, but after the affective flexibility task MIP groups no longer significantly differed in arousal ratings, $t(74) = 0.09$, $p = .928$, $d = 0.02$.

For the composite VAS negative scale, a significant main effect of time was found, $F(2, 73) = 12.54$, $p < .001$, $\eta_p^2 = .26$, but the Time x MIP group interaction was not significant, $F(2, 73) = 2.37$, $p = .100$, $\eta_p^2 = .06$. Paired t-tests, across both MIP groups, showed a general decrease from pre-MIP to post-MIP, $t(75) = 3.58$, $p = .001$, $d = 0.32$, while there was a significant increase from post-MIP to post-task, $t(75) = 4.33$, $p < .001$, $d = 0.44$.

Although the positive MIP was effective in increasing positive mood, these findings suggest the experimental task reduced feelings of happiness and arousal. Previous research on the affective contrast theory (Bacon, Rood, & Washburn, 1914; Manstead, Wagner, & MacDonald, 1983) has shown that effects of mood depend on a contrast with the prior perceived state. In order to get the most accurate measure of positive mood during the affective switching task to examine how this influences performance, we therefore calculated the change in positive mood across the task, from post-MIP to after the task (across both MIP groups).

Positive Mood and Affective Switching Costs

To test the effect of positive mood on affective flexibility, we performed a mixed 2 x 2 x 2 x 2 ANOVA with all different possible trial types (i.e. considering current trial and preceding trial), for accuracy rates and RT separately. Current valence (positive vs. negative), previous valence (positive vs. negative), task set (affective vs. non-affective), and task switch (repetition vs. switch) were entered as within-subjects factors, and the mean-centered change in positive mood across the task as a continuous predictor (i.e. covariate). Means and standard deviations for accuracy and RT data are presented in Table 4. Additional analyses on the task-rule congruency effect and how this is influenced by positive mood and resilience can be found in Supplemental Material (S1) available online.

Accuracy. An arcsine transformation was performed on accuracy data (because of normal distribution of residuals). Significant effects from the mixed ANOVA are summarized in Table 5. Follow-up analyses for general effects, that is, effects not modulated by positive mood, are discussed in Supplemental Material (S1) available online. The mixed ANOVA showed a Current valence x Previous valence x Task set x Δ Positive mood interaction, $F(1,72) = 5.45$, $p = .022$, $\eta_p^2 = .07$. To follow up this Current valence x Previous valence x Task set x Δ Positive mood interaction we calculated the valence switch costs (i.e. switching the valence of the presented stimuli across trials) when the current task set was either the affective or the non-affective task (i.e. regardless of the task set in the previous trial). Correlations of the change in positive mood with these valence switch costs showed that a smaller decrease in positive mood across the task was related to lower costs of switching from a positive trial to a negative affective trial, $r = -.25$, $p = .035$ (see figure 4). On the other hand, a smaller decrease in positive mood was related to greater costs of switching from a positive trial to a negative non-affective trial, $r = .23$, $p = .048$ (see figure 5). That is, individuals who show a smaller decrease in positive mood are better in correctly sorting negative pictures according to the affective rule when this is preceded by a positive trial, while they perform relatively worse when having to sort negative pictures according to the non-affective rule when this is preceded by a positive trial.

Reaction time. RT data were logarithmically transformed because the data was skewed. Significant effects from the mixed ANOVA are summarized in Table 6. Follow-up analyses for effects not modulated by positive mood, are discussed in Supplemental Material (S1) available online. The mixed ANOVA showed a Task switch x Δ Positive mood interaction, $F(1,72) = 5.20$, $p = .026$, $\eta_p^2 = .07$, and a near significant Current valence x Previous valence x Task set x Δ Positive mood interaction, $F(1,72) = 3.72$, $p = .058$, $\eta_p^2 = .05$.

To follow up the task switch x Δ Positive mood interaction, a correlation was calculated between the change in positive mood across the task and task switch costs (regardless of current and previous valence or task set). This showed that the interaction was driven by a relation between a smaller decrease in positive mood across the task and lower switch costs, $r = -.26$, $p = .026$, but this was not specifically driven by effects on either switch or repetition trials (see figure 6).

To follow up the marginally significant Current valence x Previous valence x Task set x Δ Positive mood interaction we calculated the valence switch costs (i.e. switching the valence of the presented stimuli) when the current task set was either the affective or the non-affective task (i.e. regardless of the task set in the previous trial). Correlations between the change in positive mood across the task and these valence switch costs revealed that switching towards a positive affective trial when the previous trial was negative as compared to positive was more efficient (i.e. lower switch costs) with smaller decreases in positive mood across the task, $r = -.28$, $p = .017$ (see also figure 7). This was not specifically driven by a relation with performance on a positive affective trial when the previous trial was either negative or positive.

Resilience and Affective Flexibility

To test the effect of resilience on affective flexibility, we performed a mixed ANOVA with current valence (positive vs. negative), previous valence (positive vs. negative), task set (affective vs. non-affective), and task switch (repetition vs. switch) as within-subjects factors, and the mean-centered RS-nl scale and change in positive mood across the task as continuous predictors (i.e. covariates).

Accuracy. An arcsine transformation was performed on accuracy data. Significant effects from the mixed ANOVA with the RS-nl total score are summarized in Table 7. Results were similar when the RS-nl Personal Competence subscale was included. RS-nl total scores did not modulate performance on the task. A marginally significant Current valence x Previous valence x Task set x Task switch x Δ Positive mood interaction was observed when controlling for mean-centered RS-nl resilience scores. To follow-up this interaction we calculated task switch costs, taking into account the valence of the presented stimulus in the current and previous trial, and current task set. Partial correlations, controlling for mean-centered RS-nl resilience scores, showed a relation between the change in positive mood across the task and task set switch costs when switching from a negative affective trial to a positive non-affective trial, $r = -.25$, $p = .030$ (see figure 8). This shows that when taking into account resilience scores a smaller decrease in positive mood across the task was related to easier switching of task set when the previous trial was negative and the current trial is a positive non-affective trial. That is, reduced costs of switching from attending to affective aspects of negative information to non-affective aspects of positive information.

Results from the mixed ANOVA with the RS-nl Acceptance subscale[6] showed similar interactions with positive mood when controlling for RS-nl Acceptance, but additionally a main effect was observed of the RS-nl acceptance subscale, $F(1,71) = 6.31$, $p = .014$, $\eta_p^2 = .08$, which tended to be modulated by previous valence, $F(1,71) = 3.30$, $p = .074$, $\eta_p^2 = .04$. To follow up this Previous valence x RS-nl acceptance interaction we calculated accuracy for when the previous trial was either positive or negative, regardless of the emotional valence of the current trial, current task set, or whether a switch in task set had occurred. Partial correlations, controlling for the change in positive mood across the task, revealed that higher RS-nl acceptance scores were related to higher accuracy when negative information was

[6] Results are reported after exclusion of two multivariate outliers as indicated by > 3*SD* on the standardized residuals.

presented in the previous trial, $r = .33$, $p = .005$ (see figure 9). A similar, but marginally significant, relation was observed for when positive information was presented in the previous trial, $r = .22$, $p = .063$. That is, higher RS-nl acceptance scores relate to generally better performance on the task, but this is especially pronounced for trials that were preceded by trials in which negative information was presented.

Reaction time. RT data were logarithmically transformed because the data was skewed. Significant effects from the mixed ANOVA with the RS-nl total score are summarized in Table 8. Results were similar when the RS-nl Personal competence subscale was included in the model. RS-nl resilience scores modulated the Current valence x Previous valence x Task switch interaction. To follow up the Current valence x Previous valence x Task switch x RS-nl total interaction we calculated the task switch costs taking into account the current and previous valence of the presented information (regardless of task set). Partial correlations, controlling for the change in positive mood across the task, showed that the interaction was driven by a trend for a negative relation between RS-nl total scores and task switch costs when the current negative trial was preceded by a positive trial, $r = -.22$, $p = .064$ (see figure 10). RS-nl total scores were not significantly related to the other types of task switch costs taking into account the valence of the presented information, all *p*s > .20.

Including the RS-nl Acceptance subscale in the mixed ANOVA[7] showed similar interactions with positive mood when controlling for RS-nl Acceptance, except that the Current valence x Previous valence x Task switch x RS-nl acceptance interaction was not significant, $F(1,71) = 1.19$, $p = .278$, $\eta_p^2 = .02$, but there was a significant Task switch x RS-nl acceptance interaction, $F(1,71) = 5.51$, $p = .022$, $\eta_p^2 = .07$. A partial correlation, controlling for the mean-centered change in positive mood across the task, was then calculated between the RS-nl Acceptance of self and life subscale and task switch costs (regardless of current and

[7] Results are reported after exclusion of two multivariate outliers as indicated by > 3*SD* on the standardized residuals.

previous valence or task set). Higher RS-nl Acceptance of self and life scores were related to lower switch costs, $r = -.27$, $p = .022$, but this was not specifically driven by effects on either switch or repetition trials (see figure 11).

Discussion

Research has long been interested in the way people deal with negative and positive events. Whereas some individuals are more vulnerable to life's challenges, others seem to be resilient and cope well in the face of adversity. Efforts have been made to try to better understand why some people are more resilient than others and the main aim of this study was to further extend this research by investigating possible cognitive mechanisms that underlie psychological resilience. Although resilience has been conceptualized in different ways, an important facet of resilience seems to be flexibility in adapting to a changing environment. Being able to show cognitive flexibility when processing affective material has previously been related to individual differences in self-reported resilience (Genet & Siemer, 2011).

One aim of this study was to extend previous findings (Genet & Siemer, 2011) on the relation between cognitive flexibility in the context of affective information and resilience. However, it remains unclear whether such flexible affective processing is also subject to fluctuations in mood state. Although research has shown that positive affect can facilitate cognitive flexibility by facilitating task-switching (e.g. Yang & Yang, 2014), it is not clear whether this also occurs when affective material is processed. Therefore, we also tested the effect of positive mood on cognitive flexibility in the context of affective information. Moreover, we explored how effects of positive mood on affective flexibility interact with the emotional valence of the presented material.

Our positive mood manipulation was successful in increasing positive mood, the positive MIP group and neutral MIP group showed a significant difference in positive mood ratings after the MIP; however, the groups no longer differed after the experimental task.

Doing a quite difficult experimental task thus seems to have an impact on (positive) mood and it's therefore advised, as we did in the current study, to take mood measurements after a task as well to confirm mood effects last. In order to get an accurate measure of the level of positive mood during the affective switching task, to be able to examine how this influences performance, we used the change in positive mood across the task.

The change in positive mood had a significant influence on performance in terms of accuracy. Positive mood had an influence on the costs of switching the emotional valence of the presented pictures across trials (rather than a change in task set). A smaller decrease in positive mood was related to better performance when having to sort negative pictures according to their affective aspects if this was preceded by positive information. On the other hand, positive mood was related to worse performance when sorting negative pictures according to their non-affective aspects when preceded by positive information. This initially seems counter intuitive as focusing attention on affective aspects of negative information would more likely result in a decrease in positive mood. Nevertheless, it's possible that especially when one is in a positive mood state, the presentation of positive information, as compared to negative information, induces a focus on affective rather than non-affective aspects of information. This is a tentative explanation however, because one would then also expect relatively higher costs of switching from negative versus positive information to sorting positive pictures according to their affective aspects.

Interestingly though, when controlling for average resilience levels, positive mood tended to modulate the costs of switches in emotional valence of the presented information across trials in interaction with switches in task set. More specifically, a smaller decrease in positive mood was related to reduced costs (in terms of accuracy) of switching from affective aspects of negative information to attending to non-affective aspects of positive information (i.e. a double switch). When controlling for average resilience levels it thus seems that greater positive mood makes it easier to switch away from no longer relevant affective aspects of negative information, which could reflect regulatory efforts to sustain a more benign mood.

Positive mood was also related to task switching costs in terms of speed of responding. A smaller decrease in positive mood was related to overall more efficient task switching, regardless of the valence of the presented information. This supports previous research showing that positive affect increases cognitive flexibility, by facilitating task switching (for a review, see Goschke & Bolte, 2014). Positive mood (task irrelevant) is believed to be one factor that can regulate the balance between complementary control modes, cognitive stability versus flexibility, and promotes adaptation to changing task demands and contexts although this can come at a cost in the form of distractibility (Goschke & Bolte, 2014).

In terms of speed of responding, positive mood state also modulated the effects of changes in the affective valence of the presented information across trials (rather than a change in task set). The costs of switching from negative information, as compared to positive information, towards the affective aspects of positive information were lower with a greater increase/smaller decrease in positive mood. Several processes could have contributed to these changes in switching away from (no longer relevant) negative and positive information towards the affective aspects of positive information. It could reflect that with greater positive mood, there are weaker carryover effects and/or stronger inhibition of no longer relevant negative information, while similarly there could be stronger carryover effects and/or weaker inhibition of no longer relevant positive information. However, as carryover effects by previous information should influence performance on any type of following trial, it is more likely a reflection of the ability to inhibit no longer relevant information when you have to focus on the affective aspects of positive information. Similarly, it’s not likely to be caused by bottom-up effects of increased saliency of affective aspects of positive information (in the current trial) because then one should observe general effects of positive mood on performance on (positive) affective trials. An effect of positive mood on the ability to inhibit no longer relevant information when focusing on the affective aspects of positive information could reflect relative difficulties inhibiting mood-congruent information while this becomes relatively easier for mood-incongruent information. This would correspond with existing findings that mood disorders (e.g. depression) are associated with problems inhibiting mood-congruent negative information (e.g. Gotlib & Joormann, 2010). Future studies should try to replicate and extend these findings by further investigating the interactive effects of mood state and 'phasic' effects of presenting affective information on cognitive processing.

A second aim of this study was to extend previous findings on the relation between affective flexibility and self-reported resilience (Genet & Siemer, 2011), taking into account the valence of the presented information. The current study provides this extra information and we find that the link between resilience and affective flexibility is modified by changes in the affective valence of the presented information, suggesting that the link between resilience and flexible processing of emotional information is more complex. In terms of accuracy we observed that the RS-nl acceptance subscale was related to generally better performance on the task which requires cognitive flexibility in the presence of affective information. This subscale, acceptance of self and life, reflects equanimity, adaptability, and acceptance of life as it comes (Portzky, 2008). The influence of RS-nl Acceptance scores on task performance tended to interact with the emotional valence of the picture that was presented in the previous trial, i.e. interact with the emotional valence of the no longer relevant information. Although higher RS-nl acceptance scores were thus related to generally better performance, this influence of Acceptance of self and life levels was especially pronounced in trials that were preceded by the presentation of negative information. Although speculative at this point, it's possible that higher levels of acceptance of self and life, and adaptability, are related to relatively less interference of no longer relevant negative information.

The Acceptance of self and life subscale also had an influence on task performance in terms of speed of responding. Similarly to the effect of a change in positive mood we observed that greater levels of acceptance of self and life were related to overall more efficient task switching, regardless of the valence of the presented information. The results on the relation between resilience and switching of task set in terms of reaction times may however warrant for a more complex take on the link between resilience and affective flexibility. Overall levels of self-reported resilience (i.e. RS-nl total scores) tended to influence the costs of switching task set but this was qualified by the affective valence of the information that was presented. More specifically, we observed a trend for a relation between higher self-reported resilience and more efficient switching of task set when a current negative trial was preceded by presentation of positive information. With higher resilience scores switching task set thus becomes relatively more efficient after positive information was presented and one has to sort negative information. It remains difficult to explain though why more resilient individuals especially benefit from this when one is switching from positive to negative information (and not vice versa). It's possible that especially for resilient individuals the presentation of positive information, as well as task irrelevant positive mood, can facilitate task set switching, with task switching being especially efficient when the affective valence of the presented information also switches. However, this result requires caution provided that the effect was only marginally significant and future research should confirm these findings.

In this study we used a self-report measure of resilience and there is evidence showing that self-reported resilience influences our actual response to daily stressors (Ong, Bergeman, Bisconti, & Wallace, 2006). On the other hand, it's likely that our daily experiences with positive and negative events, and how we responded to those, also shape the development of our subjective feelings of being a resilient person. For future research it would therefore be interesting to examine if differences in affective flexibility can predict individuals' direct responses to distress, which would further support the idea of affective flexibility being a cognitive mechanism underlying (development of) psychological resilience. Additionally, in using a forced switching task (i.e. a cue indicates the task set) we tap into the ability for task switching rather than the tendency to engage in flexible affective processing when appropriate. Further research, for example using a voluntary switching task, could examine whether positive mood and resilience are related to an increased tendency to engage in task switching and how the affective valence of the presented information could influence this.

To summarize, this was the first study to directly test whether cognitive flexibility in the context of affective information (i.e. affective flexibility) is subject to positive mood fluctuations. Our results showed that positive mood was related to an overall reduction in task set switching costs which is in line with previous findings relating positive affect to increased cognitive flexibility by facilitating task switching. In line with this effect of positive mood, we observed that greater levels of Acceptance of self and life also facilitated task set switching in the context of affective information. The relation between resilience and affective flexibility may be more complex though as higher resilience scores tended to relate to more efficient task set switching specifically when sorting negative information which was preceded by positive information. One possible explanation is that especially for resilient individuals the presentation of positive information, as well as task irrelevant positive mood, can facilitate task set switching. Positive mood also influenced the costs that are associated with switching the emotional valence of the presented information across trials (regardless of whether task set had changed). This effect of positive mood could reflect a reduced impact or less interference of no longer relevant negative information and/or more interference of no longer relevant positive information, especially when one has to attend to the affective aspects of positive information. Whereas previous studies on the effects of positive mood on cognitive flexibility have mostly used non-emotional tasks, the results of our study increase our understanding of how mood effects interact with an (changing) emotional context.

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Table 1

Participant characteristics

	Neutral MIP *M* (*SD*) *n* = 38	Positive MIP *M* (*SD*) *n* = 38	Cronbach's Alpha *n* = 76	Difference between MIP groups
Age	21.61 (2.32)	21.71 (4.80)		$F(1, 72) = 0.01$, $p = .911$
Gender	29 females	31 females		χ^2 (1, $N = 76$) = 0.32, $p = .779$
PANAS trait positive	34.31 (5.23)	35.97 (4.73)	.847	$F(1, 74) = 2.12$, $p = .150$
PANAS trait negative	19.11 (6.06)	16.71 (5.45)	.865	$F(1, 74) = 3.28$, $p = .074$
STAI trait	42.24 (9.17)	38.47 (9.10)	.903	$F(1, 74) = 3.23$, $p = .077$
BDI	7.68 (5.29)	6.76 (5.48)	.836	$F(1, 74) = 1.16$, $p = .285$
RS-nl total	76.68 (8.38)	78.77 (6.67)	.819	$F(1, 74) = 1.44$, $p = .234$
RS-nl Personal Competence	53.39 (5.91)	54.27 (4.31)	.751	$F(1, 74) = 0.543$, $p = .463$
RS-nl Acceptance	23.29 (3.43)	24.50 (3.08)	.673	$F(1, 74) = 2.62$, $p = .110$

Table 2

Correlations between baseline variables (n = 76)

	1.	2.	3.	4.	5.	6.	7.
1. PANAS trait positive	-						
2. PANAS trait negative	-.26*	-					
3. STAI trait	-.55***	.70***	-				
4. BDI	-.34**	.55***	.63***	-			
5. RS-nl total	.60***	-.22	-.49***	-.35**	-		
6. RS-nl Personal Competence	.52***	-.14	-.33**	-.27*	.94***	-	
7. RS-nl Acceptance	.58***	-.30**	-.62***	-.40***	.84***	.59***	-

* $p < .05$

** $p < .01$

*** $p < .001$

Table 3

Mood State

	Neutral MIP *M* (*SD*) *n* = 38	Positive MIP *M* (*SD*) *n* = 38
Pre-MIP VAS happy	53.08 (27.08)	48.79 (28.62)
Post-MIP VAS happy	52.24 (27.34)	66.42 (22.49)
Post-task VAS happy	43.16 (28.28)	38.76 (25.52)
Pre-MIP VAS arousal	27.66 (27.61)	25.95 (21.68)
Post-MIP VAS arousal	26.18 (21.58)	45.55 (29.12)
Post-task VAS arousal	23.53 (20.54)	23.08 (22.57)
Pre-MIP VAS negative	10.91 (8.89)	9.43 (8.45)
Post-MIP VAS negative	8.39 (7.13)	7.29 (9.18)
Post-task VAS negative	13.68 (13.93)	13.36 (11.16)

Table 4

Affective flexibility task

Trial type	Accuracy *M* (*SD*)	Reaction Time *M* (*SD*)
Positive affective (preceded by positive affective)	0.88 (0.10)	1119 (261)
Positive affective (preceded by positive non-affective)	0.86 (0.12)	1253 (278)
Positive non-affective (preceded by positive non-affective)	0.94 (0.10)	1168 (279)
Positive non-affective (preceded by positive affective)	0.88 (0.10)	1397 (348)
Positive affective (preceded by negative affective)	0.89 (0.10)	1203 (275)
Positive affective (preceded by negative non-affective)	0.83 (0.13)	1359 (323)
Positive non-affective (preceded by negative non-affective)	0.85 (0.13)	1340 (289)
Positive non-affective (preceded by negative affective)	0.90 (0.10)	1388 (274)
Negative affective (preceded by positive affective)	0.87 (0.10)	1172 (270)
Negative affective (preceded by positive non-affective)	0.88 (0.11)	1427 (300)
Negative non-affective (preceded by positive non-affective)	0.84 (0.12)	1492 (332)

Negative non-affective (preceded by positive affective)	0.80 (0.13)	1599 (355)
Negative affective (preceded by negative affective)	0.92 (0.11)	1216 (300)
Negative affective (preceded by negative non-affective)	0.82 (0.12)	1434 (311)
Negative non-affective (preceded by negative non-affective)	0.80 (0.14)	1469 (368)
Negative non-affective (preceded by negative affective)	0.84 (0.12)	1531 (305)

Table 5

Mixed ANOVA with positive mood on accuracy data

	F (*df*)	*p*	η_p^2
Current valence	42.55 (1,72)	< .001	.37
Previous valence	4.51 (1,72)	.037	.06
Task set	5.03 (1,72)	.028	.07
Task switch	21.49 (1,72)	< .001	.23
Current valence x Previous valence	10.12 (1,72)	.002	.12
Current valence x Task set	94.23 (1,72)	< .001	.57
Current valence x Previous valence x Task set	3.26 (1,72)	.075	.04
Current valence x Previous valence x Task set x Positive mood	5.45 (1,72)	.022	.07
Current valence x Previous valence x Task switch	26.85 (1,72)	< .001	.27
Task set x Task switch	9.71 (1,72)	.003	.12
Current valence x Task set x Task switch	6.01 (1,72)	.017	.08
Previous valence x Task set x Task switch	132.37 (1,72)	< .001	.65

Note: Results are reported after exclusion of two multivariate outliers as indicated by > 3*SD* on the standardized residuals.

Table 6

Mixed ANOVA with positive mood on reaction time data

	F (*df*)	*p*	η_p^2
Current valence	215.38 (1,72)	< .001	.75
Previous valence	42.29 (1,72)	< .001	.37
Task set	132.40 (1,72)	< .001	.65
Task switch	467.30 (1,72)	< .001	.87
Task switch x Positive mood	5.20 (1,72)	.026	.07
Current valence x Previous valence	62.75 (1,72)	< .001	.47
Current valence x Task set	33.35 (1,72)	< .001	.32
Previous valence x Task set	6.05 (1,72)	.016	.08
Current valence x Previous valence x Task set	5.43 (1,72)	.023	.07
Current valence x Previous valence x Task set x Positive mood	3.72 (1,72)	.058	.05
Previous valence x Task switch	19.58 (1,72)	< .001	.21
Current valence x Previous valence x Task switch	7.36 (1,72)	.008	.09
Task set x Task switch	34.41 (1,72)	<.001	.32
Current valence x Task set x Task switch	20.18 (1,72)	<.001	.22
Previous valence x Task set x Task switch	7.25 (1,72)	.009	.09

Current valence x Previous valence x Task set x Task switch	17.12 (1,72)	<.001	.19

Note: Results are reported after exclusion of two multivariate outliers as indicated by > 3*SD* on the standardized residuals.

Table 7

Mixed ANOVA with RS-nl total score on accuracy data

	F (*df*)	*p*	η_p^2
Current valence	42.75 (1,71)	< .001	.38
Previous valence	4.46 (1,71)	.038	.06
Task set	4.96 (1,71)	.029	.07
Task switch	21.21 (1,71)	< .001	.23
Current valence x Previous valence	10.29 (1,71)	.002	.13
Current valence x Task set	93.19 (1,71)	< .001	.57
Current valence x Previous valence x Task set	3.30 (1,71)	.074	.04
Current valence x Previous valence x Task set x Positive mood	5.95 (1,71)	.017	.08
Current valence x Previous valence x Task switch	26.52 (1,71)	< .001	.27
Task set x Task switch	9.66 (1,71)	.003	.12
Current valence x Task set x Task switch	5.92 (1,71)	.018	.08
Previous valence x Task set x Task switch	131.22	< .001	.65
Current valence x Previous valence x Task set x Task switch x Positive mood	3.41 (1,71)	.069	.05

Note: Results are reported after exclusion of two multivariate outliers as indicated by > 3*SD* on the standardized residuals.

Table 8

Mixed ANOVA with RS-nl total score on reaction time data

	F (*df*)	*p*	η_p^2
Current valence	212.38 (1,71)	< .001	.75
Previous valence	42.56 (1,71)	< .001	.38
Task set	130.63 (1,71)	< .001	.65
Task switch	471.89 (1,71)	< .001	.87
Task switch x Positive mood	5.93 (1,71)	.017	.08
Current valence x Previous valence	62.93 (1,71)	< .001	.47
Current valence x Task set	32.93 (1,71)	< .001	.32
Previous valence x Task set	6.01 (1,71)	.017	.08
Current valence x Previous valence x Task set	5.42 (1,71)	.023	.07
Current valence x Previous valence x Task set x Positive mood	3.99 (1,71)	.050	.05
Previous valence x Task switch	19.53 (1,71)	< .001	.22
Current valence x Previous valence x Task switch	7.74 (1,71)	.007	.10
Current valence x Previous valence x Task switch x RS-nl total	4.00 (1,71)	.049	.05
Task set x Task switch	33.92 (1,71)	< .001	.32

Current valence x Task set x Task switch	20.15 (1,71)	< .001	.22
Previous valence x Task set x Task switch	7.15 (1,71)	.009	.09
Current valence x Previous valence x Task set x Task switch	16.92 (1,71)	< .001	.19

Note: Results are reported after exclusion of two multivariate outliers as indicated by > 3*SD* on the standardized residuals.

Figure Captions

Figure 1. Hypothesized relation between greater (change in) positive mood or resilience and lower task set switching costs (i.e. greater affective flexibility).

Figure 2. Hypothesized effect that greater (change in) positive mood or resilience is related to less interference of no longer relevant negative information on performance in the next trial (2A), but related to more interference of no longer relevant positive information on performance in the next trial (2B).

Figure 3. Example of a trial in the affective switching task. Each trial starts with a blank screen for 250msec, followed by a fixation cross presented for 250msec. The picture and trial cues are presented until a response is given.

Figure 4. Correlation between the change in positive mood across the task (not centered) and the costs of switching affective valence of the presented information when switching from a positive trial towards a negative affective trial (untransformed accuracy data).

Figure 5. Correlation between the change in positive mood across the task (not centered) and the costs of switching affective valence of the presented information when switching from a positive trial towards a negative non-affective trial (untransformed accuracy data).

Figure 6. Correlation between the change in positive mood across the task (not centered) and general task switch costs (untransformed RT data).

Figure 7. Correlation between the change in positive mood across the task (not centered) and the costs of switching affective valence of the presented information when switching from a negative trial towards a positive affective trial (untransformed RT data).

Figure 8. Partial correlation, controlling for RS-nl total scores, between the change in positive mood across the task (not centered) and task set switch costs when switching from a negative trial to a positive non-affective trial (untransformed accuracy data).

Figure 9. Partial correlation, controlling for the change in positive mood across the task, between RS-nl Acceptance of self and life subscale (not centered) and accuracy when negative information was presented in the previous trial (untransformed accuracy data).

Figure 10. Partial correlation, controlling for the change in positive mood across the task, between RS-nl total score (not centered) and task switch costs when a negative trial was preceded by a positive trial (untransformed RT data).

Figure 11. Partial correlation, controlling for the change in positive mood across the task, between RS-nl Acceptance of self and life subscale (not centered) and general task switch costs (untransformed RT data).

Figure 1.

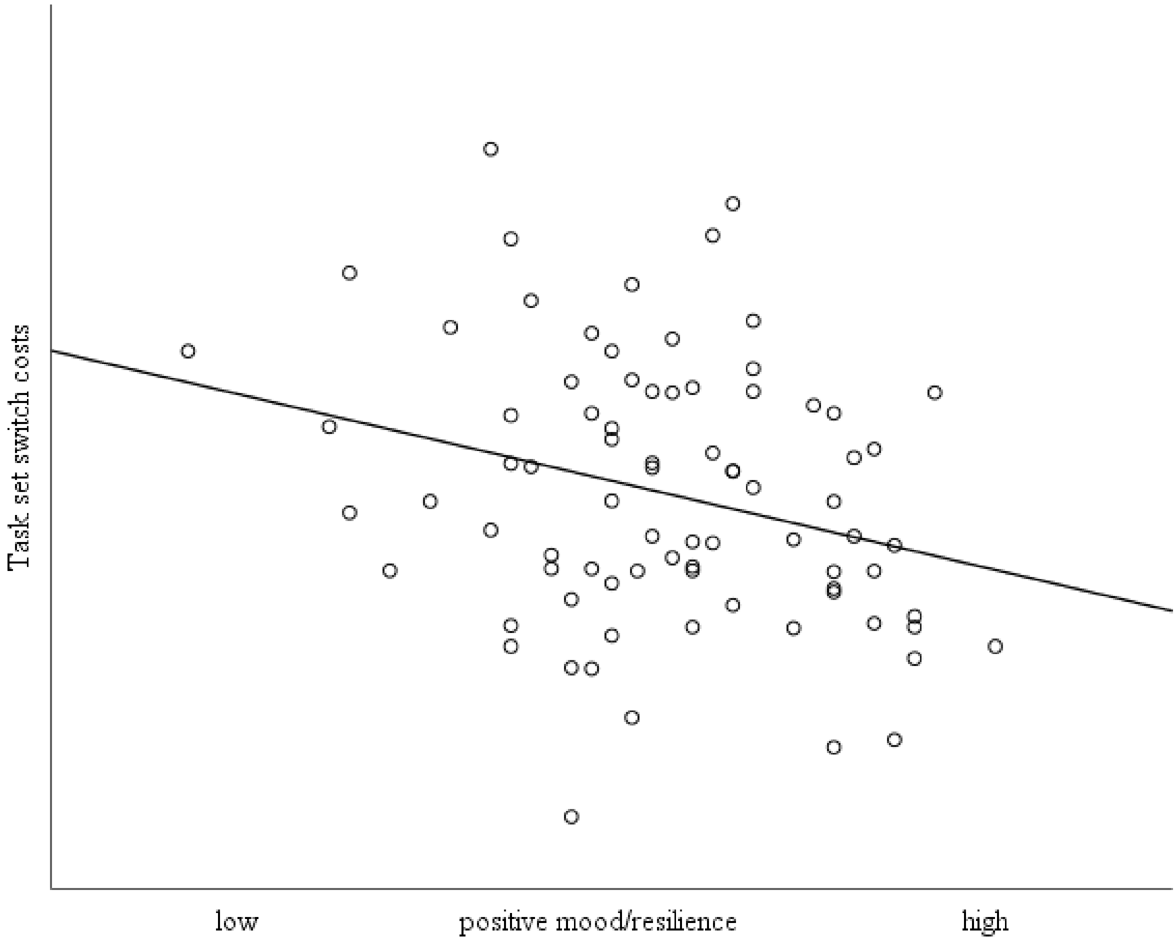


Figure 2.

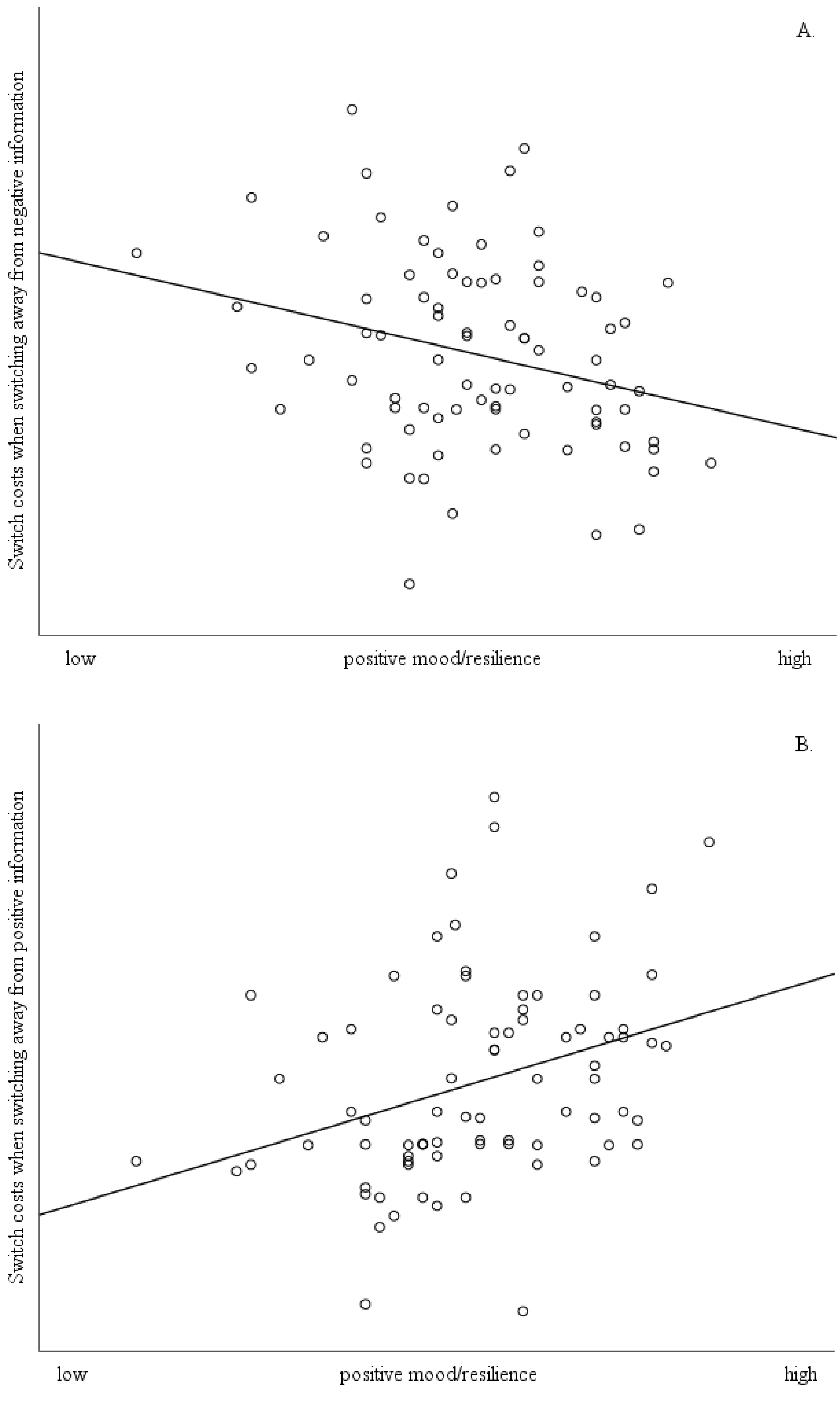

A.
Switch costs when switching away from negative information
low
positive mood/resilience
high
B.
Switch costs when switching away from positive information
low
positive mood/resilience
high

Figure 3.

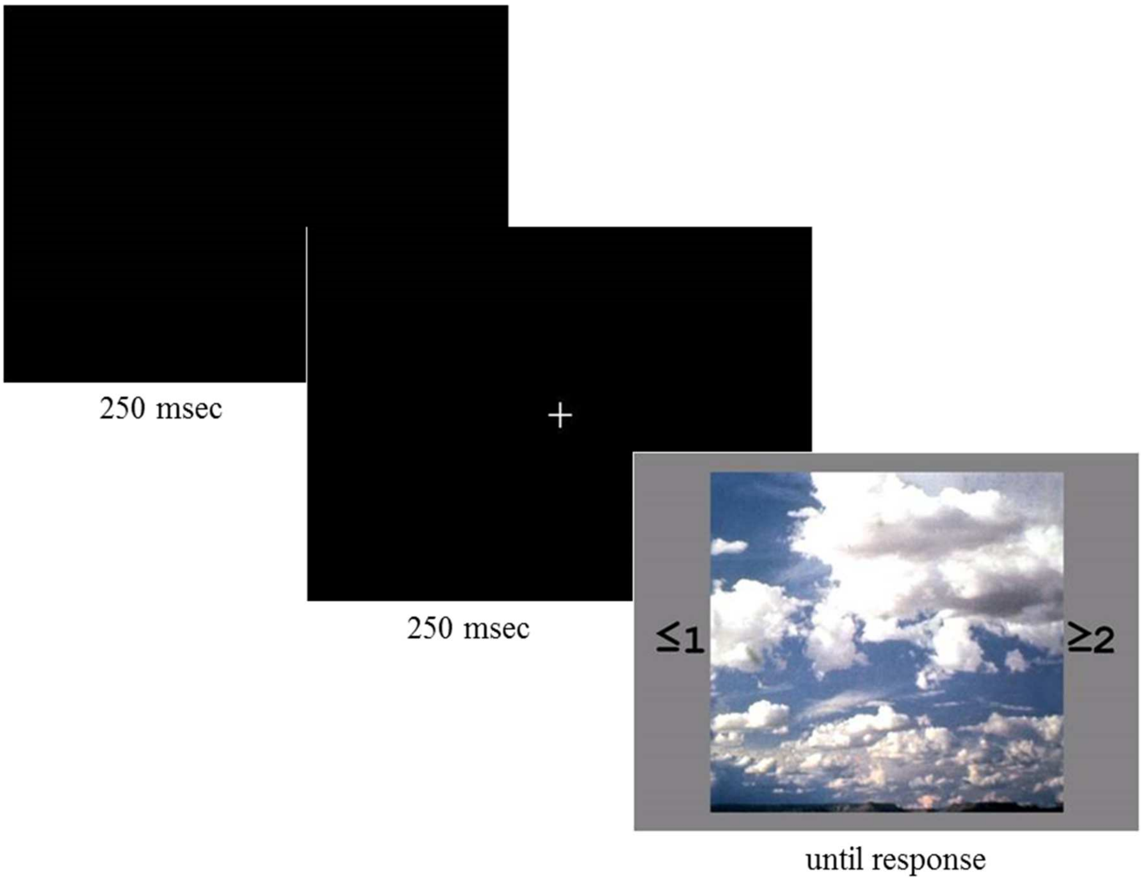
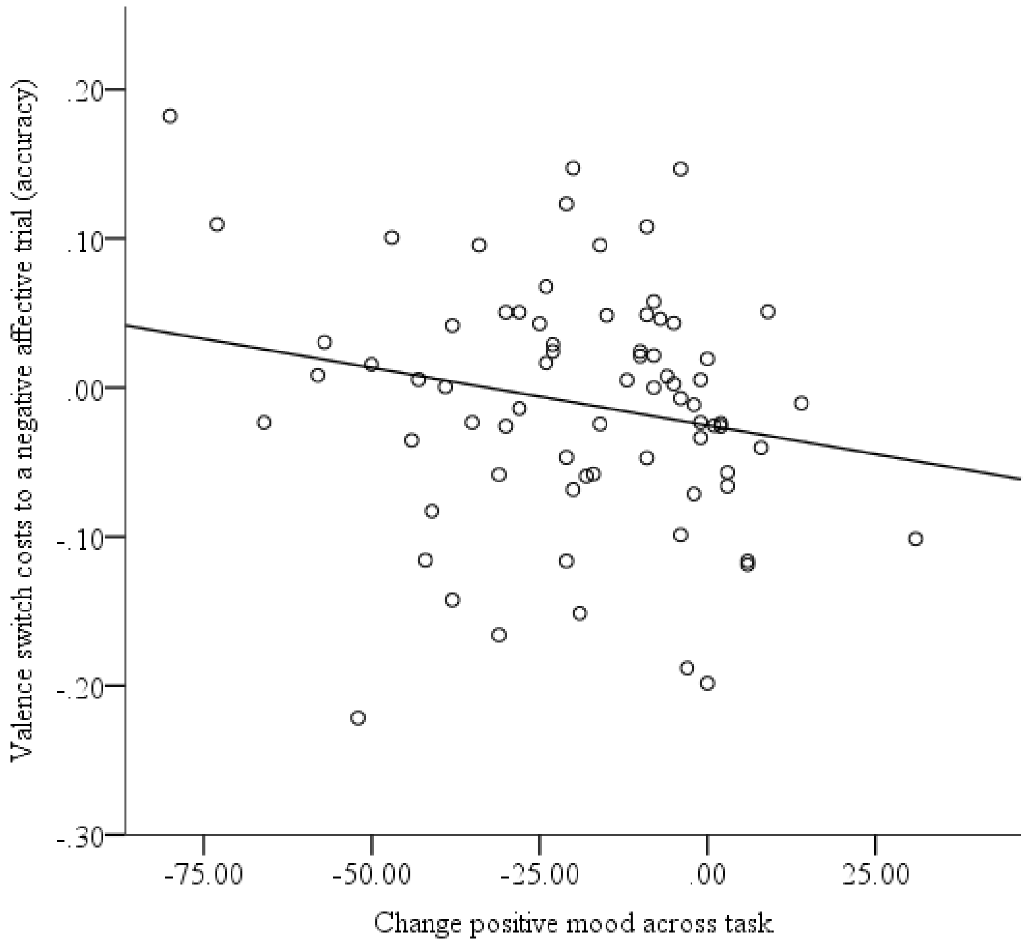


Figure 4.



Valence switch costs to a negative affective trial (accuracy)
.20
.10
.00
-.10
-.20
-.30
-75.00
-50.00
-25.00
.00
25.00
Change positive mood across task

Figure 5.

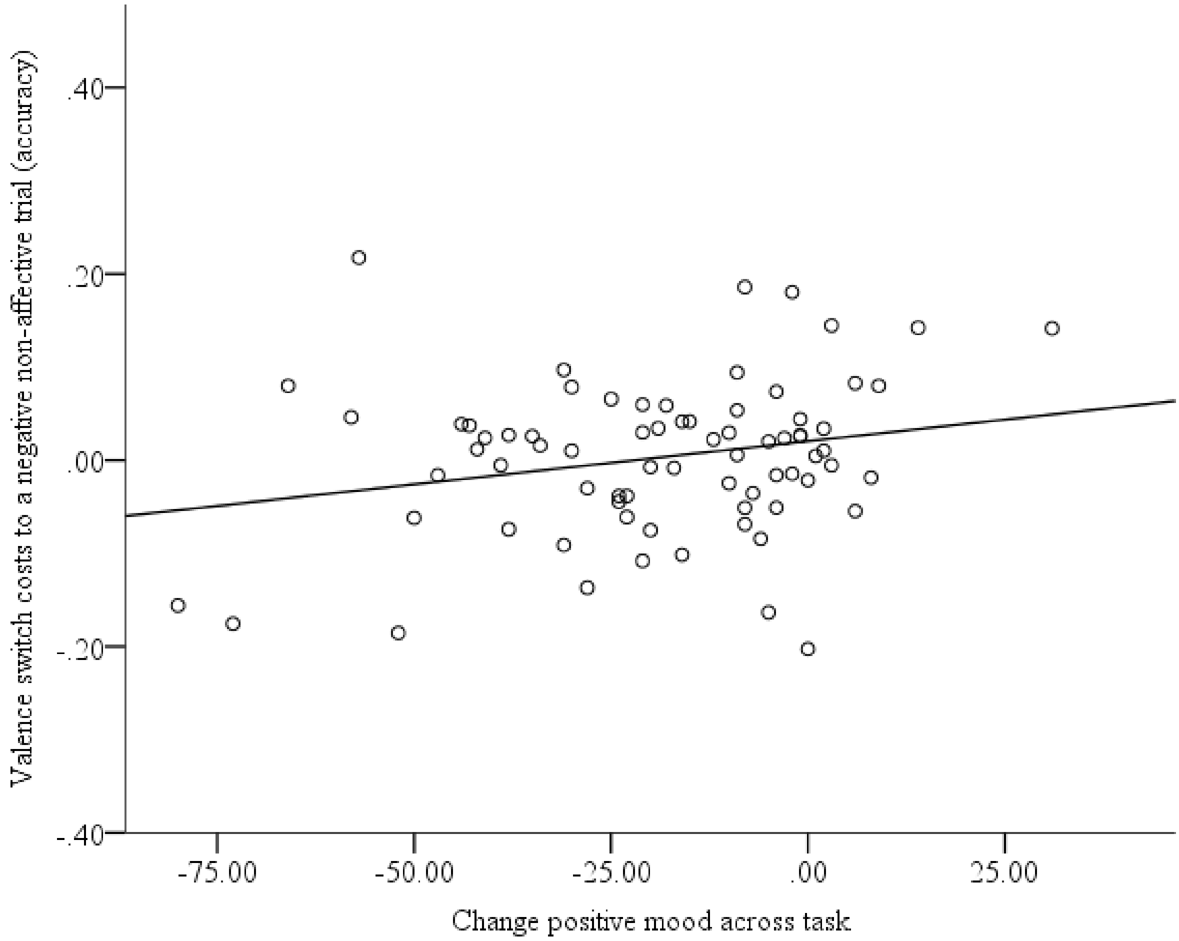

.40
.20
.00
-.20
-.40
Valence switch costs to a negative non-affective trial (accuracy)
-75.00
-50.00
-25.00
.00
25.00
Change positive mood across task

Figure 6.

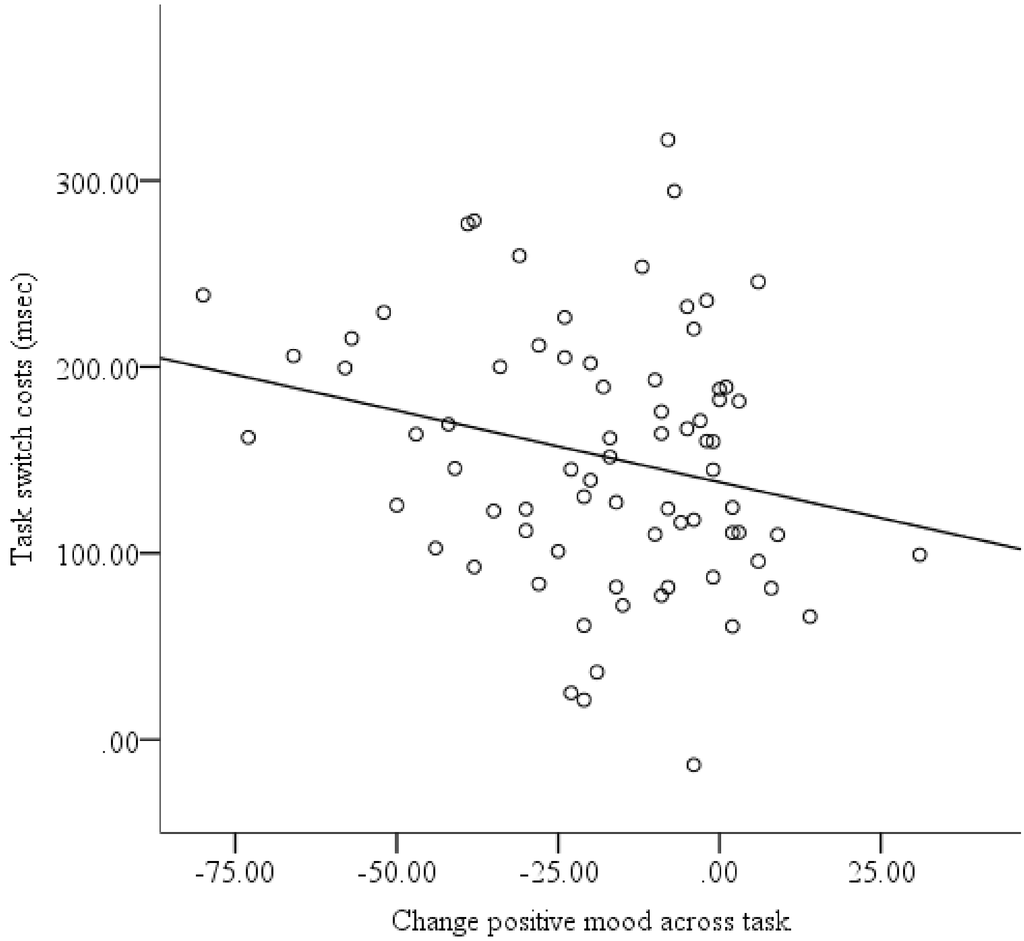

300.00
200.00
100.00
.00
Task switch costs (msec)
-75.00
-50.00
-25.00
.00
25.00
Change positive mood across task

Figure 7.

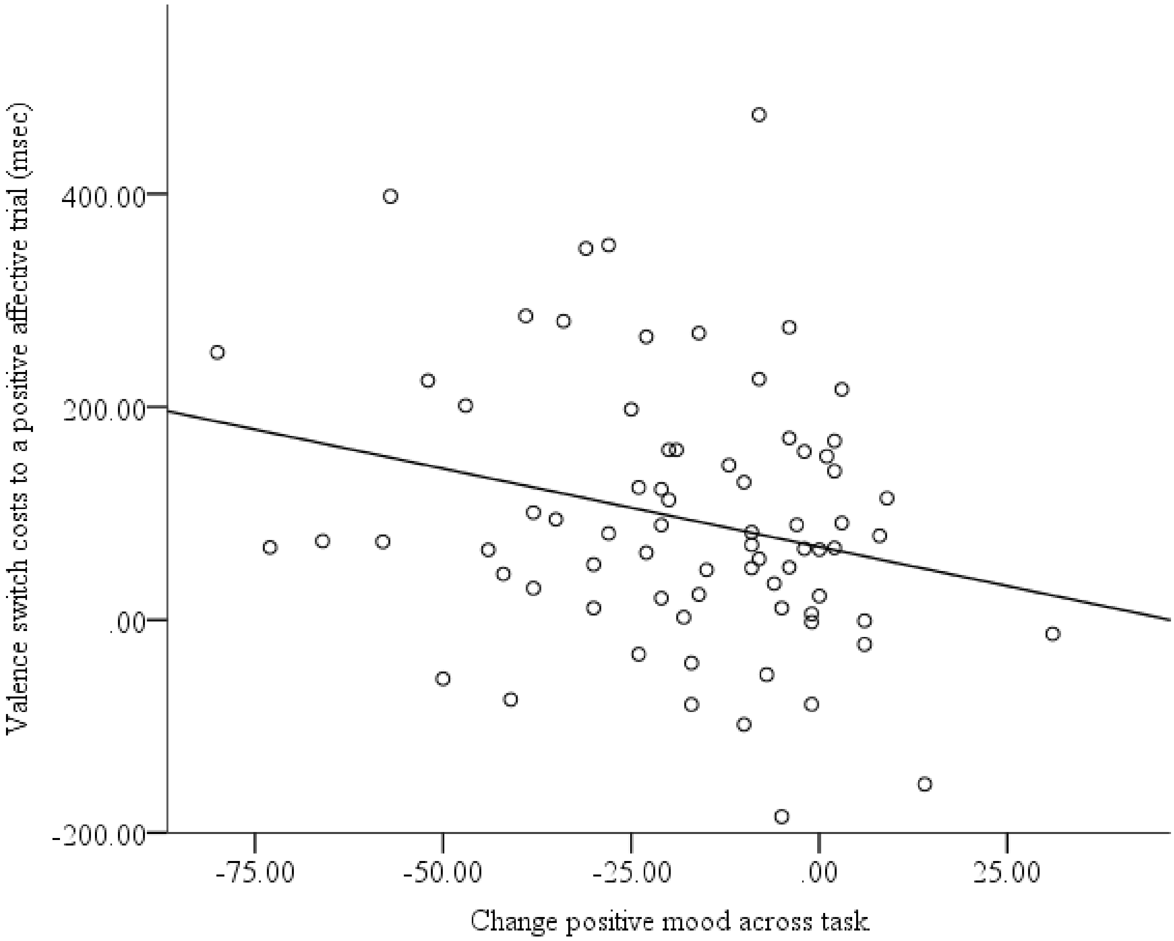

Valence switch costs to a positive affective trial (msec)
400.00
200.00
.00
-200.00
-75.00
-50.00
-25.00
.00
25.00
Change positive mood across task

Figure 8.

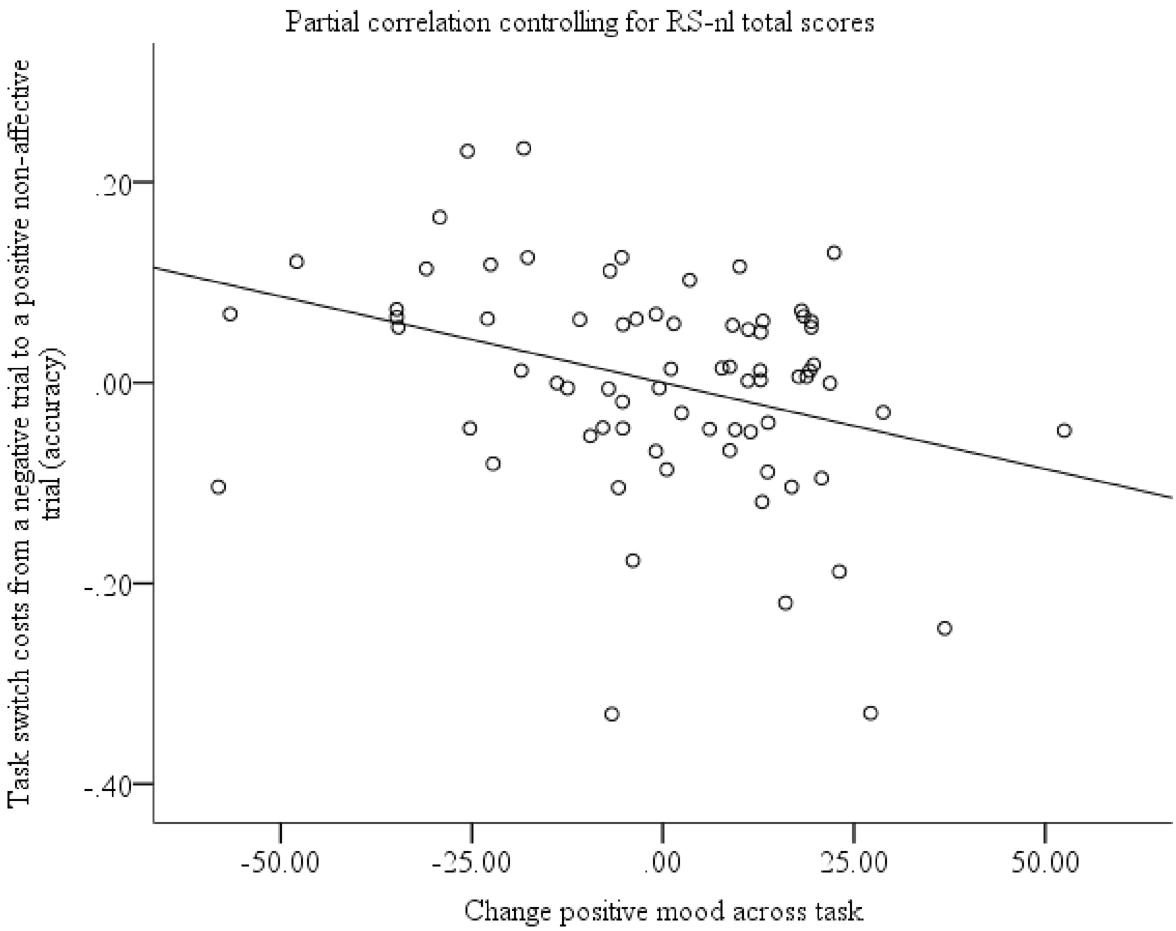

Partial correlation controlling for RS-nl total scores
Task switch costs from a negative trial to a positive non-affective trial (accuracy)
.20
.00
-.20
-.40
-50.00
-25.00
.00
25.00
50.00
Change positive mood across task

Figure 9.

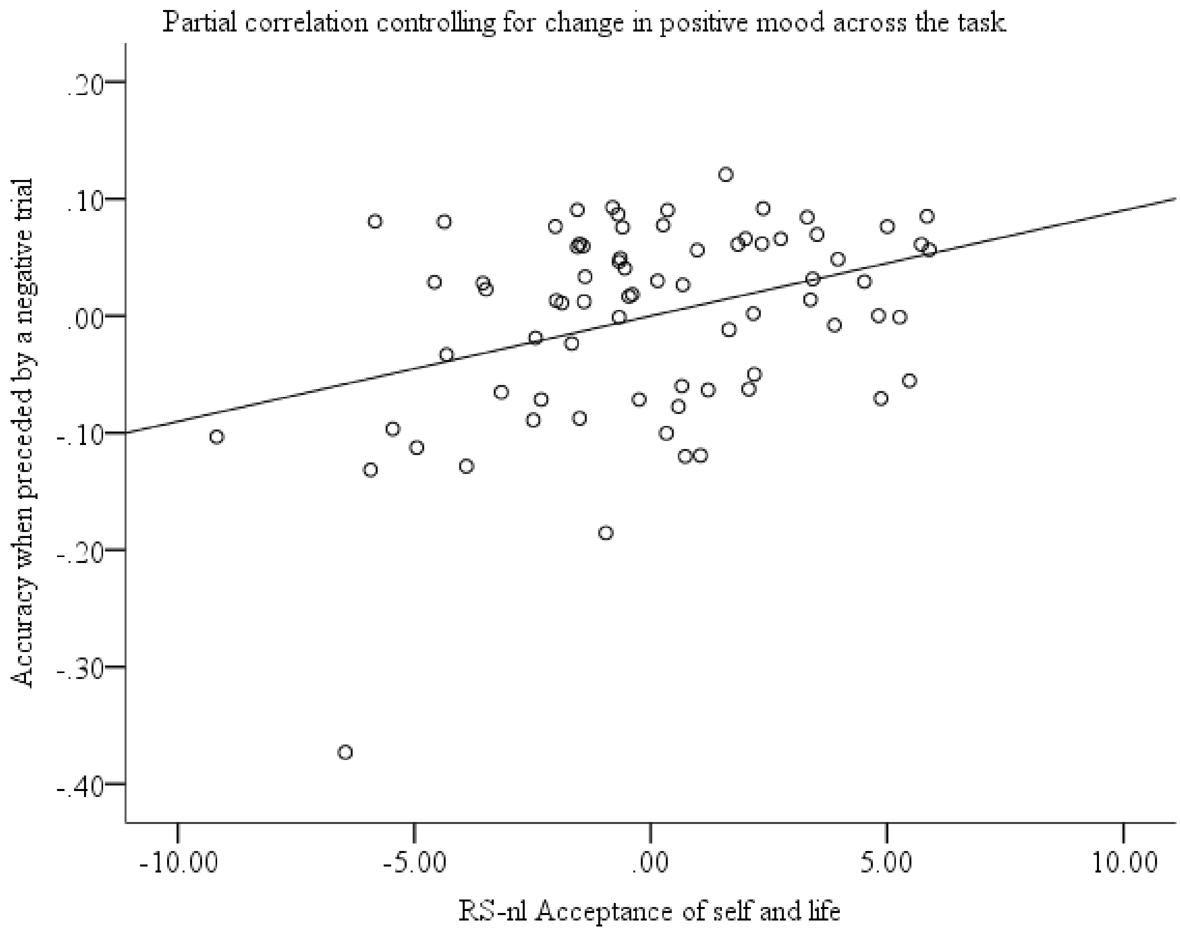

Partial correlation controlling for change in positive mood across the task
Accuracy when preceded by a negative trial
.20
.10
.00
-.10
-.20
-.30
-.40
-10.00
-5.00
.00
5.00
10.00
RS-nl Acceptance of self and life

Figure 10.

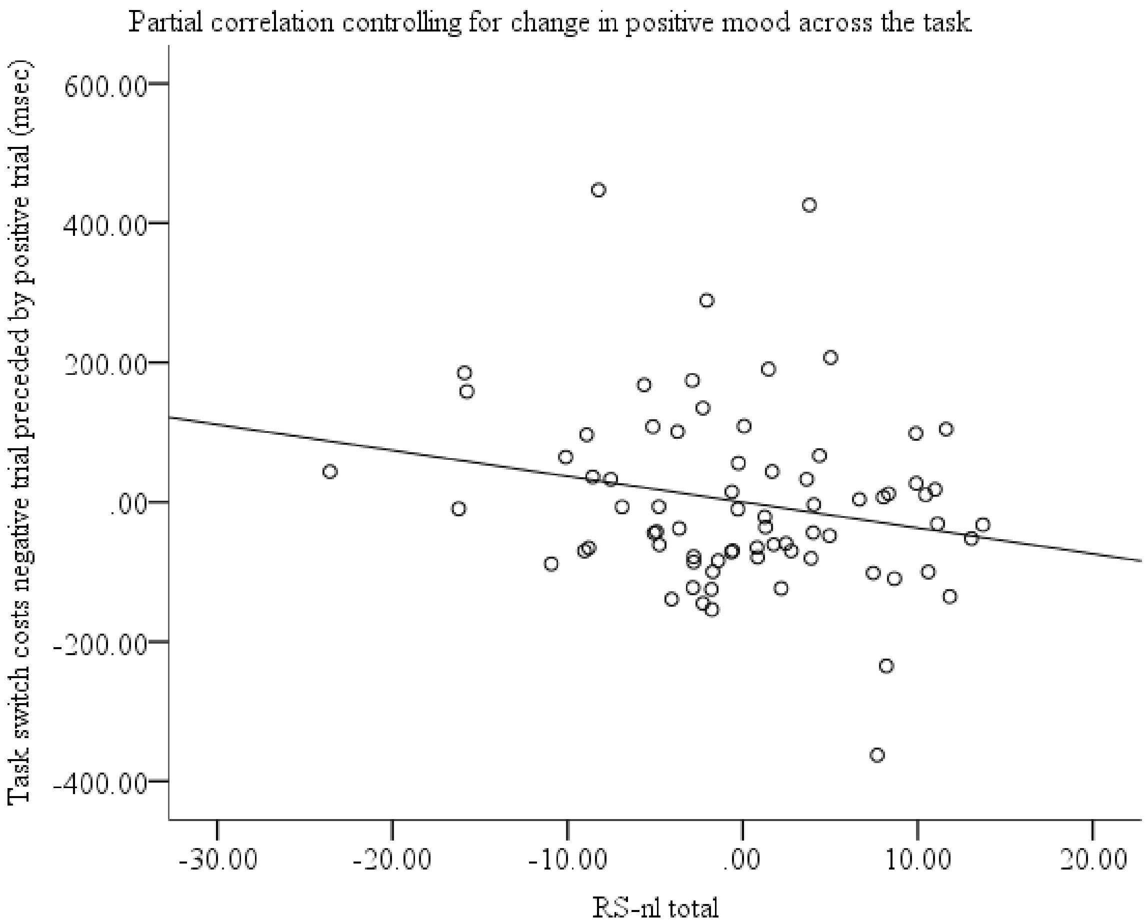
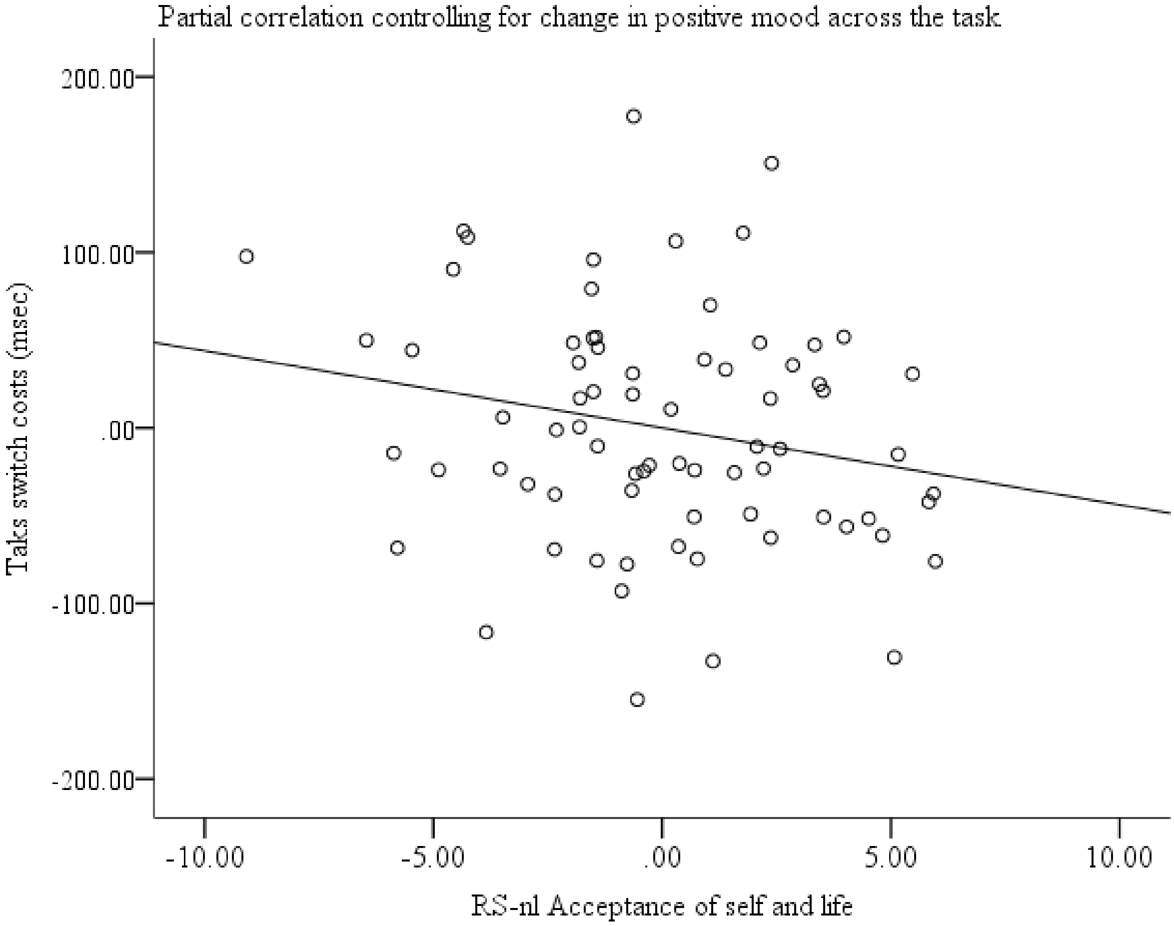

Partial correlation controlling for change in positive mood across the task
Task switch costs negative trial preceded by positive trial (msec)
600.00
400.00
200.00
.00
-200.00
-400.00
-30.00
-20.00
-10.00
.00
10.00
20.00
RS-nl total

Figure 11.


Partial correlation controlling for change in positive mood across the task
Taks switch costs (msec)
200.00
100.00
.00
-100.00
-200.00
-10.00
-5.00
.00
5.00
10.00
RS-nl Acceptance of self and life