ALWAYS LOOK AT THE BRIGHT SIDE OF LIFE:

PROCESSING POSITIVE INFORMATION IN RELATION TO RESILIENCE AND DEPRESSION

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Aanvankelijk leek het irreëel.
Later onbereikbaar.
Tot voor kort een pelgrimstocht.
Heden een glorieuze ervaring.
Ik moet wel *weerbaar* zijn geworden?

Wat een hoop papier komt uit die printer.
En mijn naam staat daarop.
Staat mijn naam daarop?
Ja hoor, zeer duidelijk zelfs.
Hoe, in hemelsnaam,
hoe is dit werkelijkheid geworden?

Hoe? Om van een ooit ogenschijnlijk irreëel en onbereikbaar doel, over vergelijkingen in de categorie van pelgrimstochten, te eindigen bij een glorieuze ervaring met mijn naam onder, kan ik alleen maar bedenken dat dit werkelijkheid is geworden dankzij jullie die me op deze weg hebben vergezeld. Elk van jullie die een bijdrage heeft geleverd aan deze 4-jarige onderneming, hetzij met academische kennis en wijsheden, hetzij met inspirerende woorden, een aanmoedigende blik of vrolijke daad, wil ik dan ook graag hartelijk bedanken.

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CONTENTS

"If you look the right way, you can see that the whole world is a garden."

Frances Hodgson Burnett, 1911. *The Secret Garden.*

In this dissertation we attempted to contribute to the understanding of how positive emotions and attentional processes may predispose to individuals' resilient responding to daily life events in order to prevent depression.

Depression is a severe and highly common psychiatric illness, at the top of most prevalent psychiatric disorders (Fryers et al., 2004). Up to 14% of the European population will suffer from a depressive disorder at least once during lifetime (Alonso et al., 2004). Furthermore, relapse rate is found to be extremely high with recurrence rates running up to 70-80% (e.g. Kessler, Zhao, Blazer, & Swartz, 1997; Mueller et al., 1999).

Depressive symptomatology primarily consists of negative mood and/or loss of interest or pleasure in (almost) all activities (DSM-IV; American Psychiatric Association, 1994). Next to these, a whole set of cognitive, affective, and somatic symptoms can be co-existent, including self-criticism, indecision, concentration problems, irrational thoughts of worthlessness and guilt, suicidal ideation, thoughts of failure, pessimism, fatigue, loss of energy and sexual desire, sleep and appetite disturbances, and psychomotoric agitation or slowdown (APA, 1994; Beck, Steer, & Brown, 1996). Hence, depression is associated with serious detrimental individual consequences as well as high societal costs (e.g. sick leave, treatment costs).

Despite the availability of a wide range of good pharmacological and psychological interventions that are efficacious at the short term (see Dobson et al., 2008), there is a specific problem in the prevention of *recurrence of depression*. Many patients (21-35%) who are in remission after treatment still have residual symptoms (Judd et al., 2000). Long-term treatment with antidepressants can reduce the risk of recurrence (Paykel, 2001).

Unfortunately, early discontinuation of medication use is high because of several long-term side effects (e.g. Lewis, Marcus, Olfson, Druss, & Pincus, 2004). Indeed, numerous studies indicate that remitted patients, either through spontaneous recovery or through treatment, have a 70-80% risk to develop new depressive episodes (Kessler et al., 1997). Moreover, it has been observed that the risk to develop new depressive episodes increases with the number of previous episodes (Keller, 2003), making depression not only a prevalent psychiatric illness, but also quite a resistant condition to current treatment schemes. Provided this relapse rate, there has been a wealth of research on understanding the cognitive risk factors associated with the development, maintenance, and recurrence of depression. By contrast, research on the *resilience factors* that are associated with adequate and adaptive responding to stress and the protection against depressive responding, is scarce. However, understanding resilience is crucial to understand recurrent depression and its prevention, and therefore this is the focus of the present research.

We start by framing our approach within the current diathesis-stress conceptualization of depression, which is predominantly based on the extensive research on risk factors in depression. Subsequently, the current knowledge obtained in this research combined with ideas from prominent theories in the resilience literature is used to derive specific hypotheses on cognitive mechanisms of psychological resilience and the potential contribution of positive emotions therein. In this present research, we attempted to study resilience within an emotion regulation perspective, looking at interaction effects between *positive emotions, underlying attentional mechanisms* and *resilience* in healthy as well as remitted depressed individuals. We end this general introduction with an overview of the studies addressing the research topics that are incorporated in the present dissertation.

VULNERABILITY TO DEPRESSION

According to Gross (1998), emotion regulation is an essential component of mental health, with problems of regulation most likely underlying different forms of psychopathology, including depression. In a review by Koole (2009), emotion regulation was defined as “the set of processes whereby people seek to redirect the spontaneous flow of their emotions”. In other words, when confronted with stressful or emotional arousing situations, normal emotion regulation should allow us to adaptively cope with these aversive situations by minimizing or down-regulating negative, distressing emotions and maximizing the positive aspects of the situation. Research suggests that the ability to effectively regulate emotions serves as a protective factor against the development of negative outcomes, and is thereby thought to foster resilience (Troy, Wilhelm, Shallcross, & Mauss, 2010). Strategies of emotion regulation are often divided into antecedent-focused strategies - modifying the likelihood of encountering emotional distress - and response-focused strategies - modulating the emotional response to a stressor once it has occurred (Gross, 2002). Strategies such as selective attention and conflict detection to enable situation modification, but also primary and secondary appraisal processes that depend upon enduring values associated with one's own coping potentials are dysfunctional in depression and might contribute to vulnerability to depression (e.g. Dixon, Heppner, Burnett, Anderson, & Wood, 1993).

During the past decades, extensive research has focused on the risk factors associated with depression. Conceptualized from a diathesis-stress view of depression, it has been shown that biological diathesis (genetic risk) in combination with adverse life events can lead to heightened emotional reactivity to stress (Caspi et al., 2003). This enhanced emotional reactivity can be examined at the level of several biological systems, i.e., the hormonal, neurotransmitter, and neural systems level. At the hormonal level, depression has been associated with the enhanced secretion and problematic down regulation of stress hormones such as cortisol. At the level of neurotransmitters, problems at the serotonin transportation and uptake have been reported in the neuroscience literature. At the level of neural systems, there is a wealth of research showing that there is an enhanced amygdala activity upon the encounter of stress, with the amygdala being implicated in the processing of negative emotions. This increased amygdala activity has been linked to impaired cognitive control exerted by specific regions of the prefrontal cortex (R. J. Davidson, Pizzagalli, Nitschke, & Putnam, 2002; Holmes & Pizzagalli, 2008) onto limbic emotion processing, as reflected by lower regulatory activity in the frontal cortices as well as a reduced connectivity between frontal cortex regions and the amygdala during emotion processing in depression. The dysregulation at the biological level corresponds to specific information-processing characteristics that are observed in depression. That is, depressed individuals are unable to swiftly reallocate attention away from negative material to other more positive or task-relevant information (Koster, De Raedt, Goeleven, Franck, & Crombez, 2005; Leyman, De Raedt, Schacht, & Koster, 2007). The inability to exercise cognitive control when confronted with stressful information is reflected in the tendency towards self-reflective rumination in depression. Importantly, after remission of depression both biological and cognitive factors related to this process are still present (e.g. Joormann & Gotlib, 2007; Nolen-Hoeksema, 2000; Vanderhasselt & De Raedt, 2009).

Based on insights from these studies, an integrative cognitive-neurobiological model (De Raedt & Koster, 2010) has been proposed to account for the interplay between biological diathesis and cognitive vulnerability to understand increasing vulnerability after multiple episodes of depression at the level of cognitive processes (i.e., attention) and cognitive content (i.e., negative thinking). Importantly, this work has largely studied biased processing of *negative* material as a potential vulnerability factor for depression. Despite emerging data that depression is associated with impaired processing of *positive* information (for a review, see Scher, Ingram, & Segal, 2005), this aspect of biased information processing has received only scarce attention to date. Provided that cognitive control is crucial in emotion regulation (i.e., attention needs to be redirected from negative to more positive or task-relevant information), it seems plausible to hypothesize that *resilience* depends on such cognitive mechanisms. Indeed, leading theories of resilience propose a key role for cognitive mechanisms.

A THEORETICAL FRAMEWORK FOR RESILIENCE: POSITIVE EMOTIONS AND THE BREADTH OF ATTENTION

Everyone experiences stress at one time or another in life. This can go from major events such as de death of a loved one, to more minor stressors such as financial difficulties and daily hassles. Not surprisingly, exposure to stress is generally associated with a wide range of negative outcomes, including decreased well-being, increased incidence of disease, post-traumatic stress disorder, generalized anxiety disorder, and major depressive disorder (Dohrenwend & Dohrenwend, 1974; Kendler, Karkowski, & Prescott, 1999). However, not all individuals who are exposed to stress develop such negative outcomes. In fact, recent evidence suggests that a considerable number of individuals are resilient to even extreme levels of stress.

Psychological resilience refers to the positive side of individual differences in people's responses to adversity (Rutter, 1987). "Successful adaptation and swift recovery after experiencing adversity during life" currently represents a generally accepted definition of psychological resilience (Rutten et al., 2013). Resilience is thus considered as a dynamic and adaptive process that serves maintaining, or swiftly regaining, homeostasis in conditions of stress (Rutter, 2012). Given that resilience allows individuals to cope well with and overcome adversity, resilience might be important in management, recovery, and relapse prevention of psychiatric disorders (Fava & Tomba, 2009). Indeed, previous studies have shown that high resilience is associated with favorable treatment outcomes in patients with depression (Min, Lee, Lee, Lee, & Chae, 2012) and anxiety (J. Davidson et al., 2012). Recently, the concept of resilience has shifted the focus of intervention from reducing the deficits associated with mental disorders onto building one's positive resources (Connor & Zhang, 2006). Since resilience is not merely characterized by the absence of psychopathology but is the dynamic process that enables the individual to successfully adapt to life adversities (Rutten et al., 2013), underlying mechanisms of resilience need to be elucidated to develop evidence-based interventions that enhance resilience. Among characteristics that promote resilience, evidence suggests that positive emotions are an important source of resilience (Seligman, Steen, Park, & Peterson, 2005).

In what follows, we present an overview of the currently most prominent theory about positive emotions in relation to resilience in the literature, the *broaden-and-build theory* of positive emotions (Fredrickson, 1998, 2001). First, we will present the different proposals of the broaden-and-build theory and describe several empirical studies examining these hypotheses. Then, we will describe how these core principles derived from this theory might be translated and applied to counter pathological processes involved in depression. Subsequently, we will address some of the remaining questions and describe several alternative theoretical accounts concerning the role of positive emotions and underlying working mechanisms for resilience.

The Broaden-and-Build Theory of Positive Emotions

Across the past decade, it has been extensively argued that positive emotions play a crucial role in psychological resilience to stressful events. A prominent theory of positive emotions in the literature, the *broaden-and-build theory* (Fredrickson, 1998, 2001, 2004), presents a successful integration of emotion theory in a resilience framework. The basic assumptions of the theory are that negative and positive emotions have distinct complementary adaptive functions, as well as cognitive and psycho-physiological effects. That is, where negative emotions narrow attention and the behavioral repertoire to cope with specific negative and/or threatening situations, positive emotions *broaden* one's thought-action repertoire. Furthermore, it is assumed that this broadened thought-action repertoire will add up over time and *build* enduring personal psychological, physical, and social resources. Thus, this theory underscores the role of positive emotions in generating long-term resources such as well-being and resilience. In this dissertation, we consider possible mechanisms underlying the broaden-and-build effects.

The broaden hypothesis

A first central hypothesis in the broaden-and-build theory is the broaden hypothesis. It states that, rather than directly fueling specific physical actions, positive emotions are thought to generate a non-specific, broadened cognitive processing style, which may lead to behavioral changes (Fredrickson, 1998). This concept of broadening of cognitive processes, or cognitive scope, has been assessed in a variety of ways, from perception to cognitive categorization.

Cognition. Empirical evidence for the broaden hypothesis can be found in two decades of research on the broadening effects of positive affect on cognition, or more specifically, on *cognitive flexibility* and *creativity*. It is shown that people experiencing positive affect show patterns of thoughts that are notably unusual, flexible and inclusive, creative, integrative, open to information, and efficient (for a review, see Isen, 2000). These effects of a broad and flexible thinking style associated with positive mood have been found across diverse experimental contexts, including intuitive judgments (e.g. Balas, Sweklej, Pochwatko, & Godlewska, 2012), decision making (e.g. Cassotti et al., 2012), creativity (for a review, see Baas, De Dreu, & Nijstad, 2008), stress resilience (Fredrickson & Levenson, 1998), and health (Burton & King, 2009).

Classic research by Isen and colleagues examining the broaden hypothesis of positive mood on cognition provided striking evidence that individuals who experience positive affect can generate more unusual associations to neutral words, used more inclusive categories, and come up with novel problem solving strategies (Ashby, Isen, & Turken, 1999). In an experiment of Isen, Daubman, and Nowicki (1987), participants were induced to feel positive or neutral emotions and then completed Mednicks' Remote Associates Test (Mednick, 1968), which requires participants to generate a concept that relates to three other words that are presented. In this experiment, participants induced to feel positive emotions generated more correct answers than those induced to feel neutral emotions, demonstrating a broadened cognitive scope. Positive emotions also broaden cognition as demonstrated by generating creative and novel uses for everyday objects. When given a problem to solve using a candle, a box of thumbtacks, and a book of matches, Isen and colleagues (1987) found that 75% of the participants who were induced to feel positive emotions were able to solve the problem, compared to 20% of the neutral and 13% of the negative groups. Moreover, positive emotions also appear to influence participants' thoughts about actions in which they would like to engage. Fredrickson and Branigan (2005) reported that compared to those in negative and neutral mood conditions, participants induced to experience positive emotions generated a large and varied list of behaviors in which they wanted to engage. Also, positive emotions widen and expand our interpersonal scope and promote flexible and creative ways of processing social information. For example, in a series of experiments conducted by Johnson and Fredrickson (2005), participants induced to experience positive emotions, compared to those in negative or neutral mood states, showed significant improvement in their ability to recognize people of a different race.

Perception. In line with the effects on higher-level cognition, it is also proposed in the broaden-and-build theory that the valence of affective states interacts with lower-level perceptual encoding in an opposing manner (e.g. Derryberry & Tucker, 1994; Rowe, Hirsh, & Anderson, 2007), with positive affect broadening and negative affect narrowing the scope of attention. Within a broadened *perceptual scope of attention*, individuals experience and attend to a larger distribution of the visual field that includes more features of the surrounding that may have otherwise been excluded. Whereas negative emotions may occur in threatening situations and narrow the attentional scope to facilitate a quick response, positive emotions generally occur in safe contexts and stimulate expansive attention (Fredrickson, 1998, 2001). Studies examining this broaden hypothesis on the attentional level usually utilize global-local processing and selective attention tasks to measure the breadth of the visual attentional scope.

Global-local processing tasks assess the extent to which participants attend global and holistic versus local and detailed features of a composite stimulus. A commonly used global-local task to measure the breadth of attention is the Navon letter task (Navon, 1977) (Yovel, Revelle, & Mineka, 2005). One example of a stimulus used in this task includes a composite visual figure of a large letter (e.g. “T”) that is made up of smaller letters (e.g. “L”). Participants are asked to find the target letter (e.g. “T”) as quickly as possible. In this task, the breadth of the attentional scope is revealed by the difference between local and global reaction times. Some work has found evidence for mood effects on global-local tasks (e.g. Fredrickson & Branigan, 2005; Gasper, 2004; Gasper & Clore, 2002; Huntsinger, Clore, & Bar-Anan, 2010; Johnson, Waugh, & Fredrickson, 2010). For instance, Kimchi and Palmer (1982) found individuals in happy moods to match geometric figures when they are similar in overall shape on a global-local perception task, whereas those in sad moods match figures sharing local elements (Gasper & Clore, 2002). Also, Fredrickson and Branigan (2005) induced temporary states of emotions (amusement, contentment, neutrality, anger, and anxiety) in participants followed by a global-local identification task of hierarchical stimuli (e.g. a set of small triangles arranged in the shape of a square). They found that relative to a neutral affective state, a positive state engendered a tendency to categorize composite visual figures on the basis of their global form as opposed to their local components. Moreover, not only situationally induced but also chronic moods, such as trait happiness and optimism, are associated with attention toward global as opposed to local structures, whereas trait depression and anxiety correlate negatively with global processing (Basso, Schefft, Ris, & Dember, 1996).

Positive emotions have also been found to impact attention on *selective attention tasks*. In a study conducted by Rowe et al. (2007), broadened attention following positive mood induction was assessed with the Eriksen flanker task (Eriksen & Eriksen, 1974). This task is a well-established attentional task, where a centrally presented target is flanked on either side by response-compatible (e.g. NNNNN) or response-incompatible (e.g. NNHNN) stimulus elements. Irrelevant and incompatible flankers interfere with the response to the central target. By presenting flanking stimuli at three different distances (e.g. N N H N N) from the middle target, Rowe et al. (2007) investigated whether positive affect influences visual attention by broadening the scope of attention. Indeed, happy moods were found to impair the ability to selectively respond to a centrally presented target stimulus surrounded by response-incompatible distractor stimuli. This response slowing was also demonstrated for trials with the greatest target/distractor distance. These results suggested that positive emotions expand the breadth of visual selective attention, facilitating inclusion of peripheral information.

In summary, positive emotions seem to broaden cognition and attention in the short term. Evidence shows that when feeling positive emotions, we experience increased breadth and expansion of our attentional scope, thoughts, and problem-solving approaches. In what follows, we explain the second proposal of the broaden-and-build theory, stating that these broadened effects may over time lead to the build effects.

The build hypothesis

In a second hypothesis, the broaden-and-build theory states that the broadened thought-action repertoires of positive emotions are likely to adapt over time. Broadened thought-action repertoires can build a variety of personal physical (e.g. physical skills, health), social (e.g. friendships, social support networks), intellectual (e.g. knowledge, theory of mind, executive control), and psychological (e.g. resilience, optimism, creativity) resources (Fredrickson, 1998, 2001, 2004). Importantly, these personal resources are thought to be durable. Thus, these resources can function as reserves to be used later, to improve coping and problem solving. Hence, the broaden-and-build theory holds as central tenets that positive emotions are important for individuals' trajectories towards growth and well-being, and towards adaptive resilient responding to life's adversities (Fredrickson, 1998).

The "upward spiral effect". It is proposed that positive emotions trigger self-perpetuating positive cycles, referred to as "upward spirals" (Garland et al., 2010). Prospective correlational research indicated that initial positive emotional experiences predict future positive emotional experiences, in part by broadening cognition, positive coping repertoires and social openness (Burns et al., 2008; Fredrickson & Joiner, 2002). Thus, positive emotions tend to accumulate over time leading to more positive emotions in the future (Garland et al., 2010). A variety of prospective and correlational studies provide evidence consistent with the proposition that positive emotions build durable personal resources (e.g. Cohn, Fredrickson, Brown, Mikels, & Conway, 2009; Fredrickson, Tugade, Waugh, & Larkin, 2003; S. L. Gable, Gonzaga, & Strachman, 2006; Stein, Folkman, Trabasso, & Richards, 1997). Moreover, in the last few years, research has begun to show how positive emotions may be key ingredients on the path towards a satisfying and fulfilling life. Strong evidence for such a claim comes from Fredrickson, Cohn, Coffey, Pek, and Finkel (2008) who provided a direct test of this build effect. In their study, adults were randomized to a 7-weeks skills based intervention that was designed to teach participants to generate positive emotions through practicing loving-kindness meditation, compared with a wait list control condition. This loving-kindness meditation involved thinking of a person for whom they felt warm and tender feelings, and then extending these warm feelings to themselves and then to an ever-widening circle of others. Findings indicated that compared to wait-list controls, participants who learned the loving-kindness meditation reported more positive emotions throughout the 7-week intervention, which was associated with improvements in self-acceptance, psychical health, competence, improved relations with others, and sense of purpose in life. Moreover, growth in these resources predicted increases in life satisfaction and fewer depressive symptoms. This study provides evidence for the build effect and the role of positive emotions in the cultivation of well-being. In another study of Cohn et al. (2009), the underlying processes that contribute to well-being were assessed by keeping track of daily emotional experiences of young adults during one month. Results indicated that those who experienced more positive emotions throughout the month showed increases in resilience and life satisfaction. Moreover, the link between positive emotions and life satisfaction was mediated by increases in resilience. These results suggest that experiences of positive emotions help people improve life quality by building resilience.

The "undo effect". Besides that upward spirals of positive emotions are thought to foster well-being (Fredrickson et al., 2003; Tugade & Fredrickson, 2004), it is also thought that positive emotions may counter chronic negative moods and stress (Fredrickson, Mancuso, Branigan, & Tugade, 2000). Whereas negative emotions prepare the body and mind for specific action (e.g. fight, flight), positive emotions appear to "undo" such preparation, an effect that is presumably linked to the broadened thought-action repertoire that accompanies positive emotions (Garland et al., 2010). Interestingly, individuals who are able to experience positive emotions in stressful situations, benefit in important ways as they are more able to disengage attention away from negative material and engage in emotion regulation. This idea has received empirical support in studies that examined stress reactivity. For instance, Fredrickson and colleagues have tested this "undo effect" of positive emotions in a series of studies that first induced a negative mood state in participants, and then randomly assigned participants to experience positive, neutral or negative emotions. Results revealed that those experiencing mild positive emotions showed significantly faster cardiovascular recovery from negative arousal (Fredrickson et al., 2000). In another study, Tugade and Fredrickson (2004) examined patterns of cardiovascular recovery from negative emotional arousal among low- and high-resilient individuals. First, participants were induced to feel anxiety by giving them a speech preparation task which induced cardiovascular arousal for all participants. Results revealed that high-resilient individuals were more likely to report having experienced positive emotions during the stress induction compared to low-resilient individuals. Moreover, when informed that they would not have to give their speech, high-resilient participants showed faster cardiovascular recovery from negative emotional arousal. These finding suggest that high-resilient individuals benefit from positive emotions in their coping with stress.

In summary, a considerable amount of research has demonstrated that positive emotions can build long-term durable personal resources which in turn trigger further positive emotions, leading to upward spirals of well-being. Moreover, positive emotions may also counter chronic negative moods and stress by fueling resilient coping. Hence, as positive emotions are important for individuals' trajectories towards well-being and adaptive resilient responding to life's adversities, positive emotions and underlying broadening effects may be crucial in preventing recurrence of depression.

The broaden-and-build theory in relation to depression

A body of research showed that positive emotions broaden cognition, attention and behavioral repertoires, and in doing so, build durable personal resources that support coping and flourishing mental health. However, as depression seems to be characterized by a narrowed attentional scope and disrupted down-regulation of stress, the beneficial effects of positive emotions may also help to counter cognitive-emotional mechanisms that underpin emotion-related disorders such as depression.

Narrowed scope of attention. Depression is characterized by both high levels of negative affect and low levels of positive affect (Clark & Watson, 1991), and by cognitive biases towards negatively-valenced stimuli and memories, through which depressed people can more rapidly detect, recall, and elaborate mood-congruent material over mood-incongruent or neutral material (Mathews & MacLeod, 2005). Depressed individuals also tend to remember more negative than positive self-relevant information and elaborate or ruminate on such negative information (Mathews & MacLeod, 2005; Nolen-Hoeksema, 2000). It is thought that such information processing biases further perpetuate and reinforce negative emotions (Garland et al., 2010). Interestingly, negative mood is not only thought to affect the *valence* of individuals' thoughts, but also the *structure* of thinking. That is, negative moods are thought to narrow the scope of attention and cognition (Schmitz, De Rosa, & Anderson, 2009). Narrowed attention and cognition triggered by negative emotions supports the enactment of the specific action urges (e.g. fight, flight) and is often seen as an evolved adaptation that aid survival in circumstances that threaten life, limb, or social safety (Frijda, 1988). However, although all emotions serve adaptive functions under certain circumstances, negative emotions, in particular, can become a source of dysfunction.

One of the post prominent accounts of how mood affects the structure of thinking is the *attentional scope model* (Whitmer & Gotlib, 2012), which posits that mood changes the scope of attentional selection. It is stated that a narrowed attentional scope, caused by high negative or low positive mood, limits the array of thoughts, percepts, and actions that are activated and accessible in working memory or available for selection from long-term memory. Indeed, evidence suggests that participants in whom a negative mood was induced were more likely to exclude fringe exemplars out of a category than were participants in a neutral mood (e.g. Mikulincer, Kedem, & Paz, 1990), showing that negative affect reduces the array of information accessible in long-term memory. Moreover, a narrowed attentional scope leads to a slower rate of conceptual change in working memory, because it increases cognitive resources available to attend to novel information (Whitmer & Gotlib, 2012). This effect of attentional scope on resource allocation means that compared to individuals with a broader attentional scope, individuals with a narrowed attentional scope will encode information at the center of attention more deeply and maintain more robust representations of information in working memory. However, it will also make it more difficult to inhibit, disengage from, or forget that information when demands change, thereby decreasing the ability to flexibly explore a broader array of information, and increasing the likelihood that thoughts will continue to focus on the same topic over time, which is thought to explain ruminative thinking (Whitmer & Gotlib, 2012). Hence, Whitmer and Gotlib (2012) proposed that the pattern of control functioning exhibited by ruminative thinking, which is considered a hallmark feature of depression, reflects a narrowed attentional scope. Interestingly, theories of depression indeed have argued that depressive symptoms are related to a narrowed attentional scope (Basso et al., 1996). Moreover, as depression is also characterized by impaired disengagement from negative information (De Raedt & Koster, 2010; Gotlib & Joormann, 2010), ruminative thinking (Nolen-Hoeksema, 2000), and cognitive inflexibility for neutral (De Lissnyder et al., 2012; Reppermund, Ising, Lucae, & Zihl, 2009), and negative information (De Lissnyder, Derakshan, De Raedt, & Koster, 2011; Deveney & Deldin, 2006; Lo & Allen, 2011; Murphy, Michael, & Sahakian, 2012), it seems plausible that this narrowed attentional scope contributes to these cognitive impairments.

Disrupted down regulation of stress. In stressful situations, the narrowing of attention is associated with a stress response that prepares the body for action. In contrast, positive emotions broaden cognitive processing and will “undo” the stress response causing the body to return to a state of homeostasis (Fredrickson & Levenson, 1998). Thus, positive emotions play a crucial role in the down regulation and the recovery from stress. Importantly, this down regulation of stress is clearly disrupted in depression. Not only does stress increase risk for depression, but depression, in turn, also increase susceptibility to stressful events (Liu & Alloy, 2010). Moreover, when confronted with negative information, depressed individuals have difficulties to disengage from this information (for a review, see Koster, De Lissnyder, Derakshan, & De Raedt, 2011). Indeed, in a recent study, individual differences in disengagement from negative information predicted lower recovery from sad mood in response to the stress induction in depressed patients compared to never depressed controls (Sanchez, Vazquez, Marker, LeMoult, & Joormann, 2013). These results suggest that difficulties in attentional disengagement may contribute to the sustained negative affect that characterizes depressive disorders. Such information processing biases further accrete, creating emotion-related dynamics as downward spirals maintaining negative mood (Garland et al., 2010).

Interestingly, positive emotions may, via their broadening effects on attention and cognition, counter the pernicious effects of depression. Decades of research on affect-related processes have demonstrated that, within momentary experience, positive emotions are incompatible with negative emotions (e.g. Nolen-Hoeksema, 2000). Hence, it is proposed that from the perspective of the broaden-and-build theory, this fundamental incompatibility reflects that the affective system cannot simultaneously be both narrowed and broadened (Garland et al., 2010). Thus, positive mood may have ameliorative effects by undoing the cognitive narrowing provoked by negative emotions, by broadening the attentional scope. Research shows that accessing positive constructs attenuates attentional biases to negative information (N. K. Smith et al., 2006), and that positive emotions facilitate cognitive reappraisal of negative events, which is also thought to be affected in depression (Tugade & Fredrickson, 2004). Thus, positive emotions may counter depressive thinking, by broadening the attentional scope, which may in turn facilitate attentional disengagement from negative stimuli and may facilitate reappraisal of negatively-valenced events. Indeed, in a randomized controlled trial conducted by Fredrickson et al. (2008) more frequent self-generated positive emotions over a course of 7 weeks led to increases in a wide range of personal resources (e.g. increased mindfulness, purpose in life, social support, decreased illness symptoms), which in turn led to reduced depressive symptoms in a non-clinical sample.

In summary, depression is characterized by sustained negative mood which seems associated with a narrowed scope of attention. Because a narrowed scope of attention enhances encoding information at the center of attention, this constricted scope may account for some of the disrupted information processes in depression, such as impaired disengagement from negative information, ruminative thinking, and cognitive inflexibility. Furthermore, this narrowed attentional scope may also account for the disrupted down regulation of stress in depression, as a broadened attentional scope is thought to “undo” the stress response. Interestingly, broaden-and-build effects of positive emotions have shown to reduce depressive symptoms in a non-clinical sample.

Conclusion

From the proliferation of studies examining the different proposals of the broaden-and-build theory (Fredrickson, 1998, 2001), our understanding of the functions of positive emotions has considerably expanded. Positive emotions seem to broaden thought and action repertoires, increase cognitive flexibility, and motivate engagement in novel activities and social relationships. Importantly, positive emotions seem to have lasting consequences as they are thought to build durable personal resources that trigger upward spirals to well-being, and counteract the detrimental effects of stress and adversity. Controversially, negative emotions seem to have opposite effects as they are thought to narrow the cognitive and attentional scope. Moreover, when negative emotions accrete into downwards spirals which focus on negative thoughts and feelings, these vicious cycles can lead to psychopathology, such as depression. As positive emotions - via enhancing the breadth of the cognitive scope - seem to play a crucial role in the down regulation and the recovery from stress, positive emotions and broadened attention may help to counter cognitive-emotional mechanisms that underpin emotion-related disorders such as depression.

Alternative Accounts

Although there is converging evidence, as described in the section above, supporting the different proposals of the broaden-and-build theory (Fredrickson, 1998, 2001), several recent findings and theories challenge these ideas.

Over five decades of research have examined the cognitive consequences of positive affective states, and suggested that positive affect leads to a broadening of cognition (for a review, see Fredrickson, 2001). This idea is widely accepted and supported by many investigators (Fredrickson & Branigan, 2005; Gasper & Clore, 2002; Rowe et al., 2007).

However, several new findings indicate that these theories are incomplete. First, recent theories indicate that the link between affect and information processing styles might be more complex than is proposed by earlier theories, such as the broaden-and-build theory (Fredrickson, 1998, 2001). Second, the above mentioned studies examining the effects of positive affect on emotion regulation, resilience, and well-being explain this association through the ability to broaden cognition and attention. However, little is known about this specific cognitive broadening operation. In what follows, we address some remaining questions, inconsistent results, and propose some other currently promising alternative theories.

The motivational dimension of affect. In most previous work on the attentional and cognitive consequences of affect, research has focused on the valence dimension, that is, whether the affect was positive or negative. However, according to P. A. Gable and Harmon-Jones (2010), another important and relatively neglected dimension of affect is the *motivational dimension*. That is, affect can be associated with a motivation to approach or avoid a stimulus. P. A. Gable and Harmon-Jones (2010) proposed that motivation mediates the relationship between affective states and the breadth of attention and cognition. They state that affective states vary in the degree to which they are associated with approach motivation, which refers to an urge or action tendency to go toward an object. Whereas positive affect low in approach motivational intensity (e.g., joy after watching a funny film) broadens the attentional scope (Fredrickson & Branigan, 2005; P. A. Gable & Harmon-Jones, 2008), positive affect high in approach motivational intensity (e.g., desire while approaching an attractive object or goal) narrows the attentional scope (P. A. Gable & Harmon-Jones, 2008; Harmon-Jones & Gable, 2009). These effects also apply to negative effect, with negative affect high in motivational intensity narrowing, and negative affect low in motivational intensity broadening the focus of perception and cognition. Recently, disgust, a negative affect state that is high in approach motivational intensity, was shown to cause a narrowing of attention relative to neutral affect, whereas sadness caused a broadening of attention (Gable, Poole, & Harmon-Jones, in prep., cited in Harmon-Jones, Gable, & Price, 2013). In addition, high approach-motivated positive affect also improved memory for centrally presented information, whereas low approach-motivated positive affect improved memory for peripherally presented information (P. A. Gable & Harmon-Jones, 2011).

Furthermore, high-approach-motivated positive affect narrowed cognitive categorization, whereas low approach-motivated positive affect broadened cognitive categorization (Price & Harmon-Jones, 2010). These findings indicate that the motivational dimensional model of affect not only applies to perceptual attention, but also to cognition.

With their motivational dimensional model of affect, P. A. Gable and Harmon-Jones (2010) proposed an explanation why past research could convincingly show the link between affect and the scope of attention. They argue that past research on the broadening effects of positive affect have used positive affect that evoked low-intensity approach motivation. For instance, positive mood was induced by handing gifts, showing funny movies, playing happy music or by having participants recall pleasant memories. These manipulations likely evolved low approach motivation, with positive affect not being related to obtaining goals within the experimental context.

However, some recent studies cast doubt on the ideas of the differential effects of low versus high motivational affect on the attentional scope. A recent study (Finucane, Whiteman, & Power, 2010) failed to find effects of low approach motivational positive affect on the efficiency of selective attention, which refers to flanker interference-effects as measured with the Attention Network Task (ANT; Fan, McCandliss, Sommer, Raz, & Posner, 2002). Moreover, Johnson et al. (2010) found that affect increased attentional breadth measured with a global-local task and a covert attentional orienting task if it was accompanied by genuine smiles in participants. However, this effect occurred independently of the positive affect manipulation that consisted of a presentation of funny videos and retrieving positive memories.

Also for negative affect, Harmon-Jones et al. (2013) claim that in most previous research the induced negative states were high in motivational intensity (e.g. fear), explaining the cognitive narrowing effects. Only few past studies examined the effect of negative affect that is low in approach motivation on the cognitive scope. Some work examining the effect of sadness, which is considered low in motivational intensity, indeed suggested that sadness is associated with a broadened cognitive scope (von Hecker & Meiser, 2005). However, this result is not consistent with other studies that did not find sadness to broaden the cognitive scope. Rowe et al. (2007) found that sadness did not produce more attentional broadening than a neutral state. Moreover, Gasper and Clore (2002) even found sadness to narrow the attentional scope. Harmon-Jones et al. (2013) explain these mixed findings by arguing that it may occur that sadness is mixed with other types of negative affect that are higher in motivational intensity. Thus, although the association between affect and the cognitive scope seems dependent on motivational aspects of affect, other factors seem to be at play as well.

Affect as information. Recent work in the *Affect-as-Information* tradition suggests that the link between affect and broad versus narrow information processing styles is more malleable than initially thought. The Affect-as-Information model (Schwarz & Clore, 1988) suggests that affect operates as a source of evaluative information. People use their feelings to interpret their situations in the environment. When people feel positive, they will interpret the environment as benign, while those in a negative mood will interpret the environment as problematic. In relation to information processing styles, it is proposed that affect serves as an informative function that signals the value of whatever processing mode is currently dominant or accessible in a perceiver's mind (Clore & Huntsinger, 2007, 2009; Clore & Palmer, 2009; Huntsinger et al., 2010; Martin, Ward, Achee, & Wyer, 1993). That is, happy moods confer positive value on the dominant mode of processing, thereby promoting its use, whereas sad moods confer negative value on this mode of processing, thereby inhibiting its use (Isbell, 2010). Inspired by this idea, it has been proposed that cues associated with happiness serve as a "go" signal that facilitates the use of currently accessible information, whereas cues associated with sadness serve as a "stop" signal that inhibits the use of this information (Clore & Huntsinger, 2007, 2009; Clore & Palmer, 2009). Thus, in the case of global precedence, positive affect will further accentuate a bias towards global configurations, while negative affect will inhibit global configuration bias. Thus, if the influence of affect depends on the context, the relationship between affect and breadth of attention can be easily changed by altering the currently dominant processing style. Indeed, evidence for this flexible link between affect and attentional breadth is shown in a recent study by Huntsinger (2012). Results showed that when a global focus was primed, people in happy moods displayed a broadened focus, whereas those in negative moods displayed a narrowed focus. In contrast, when a local focus was primed, people in happy moods displayed a narrowed focus, whereas those in negative moods displayed a broadened focus.

In addition, when no focus was made dominant, no link between affect and attentional scope could be found. Thus, the link between affect and attentional focus reflected which focus was active or vanished when no focus was made dominant. These results suggest that the relationship between affect and attentional breadth can easily change according to the currently accessible processing focus.

The idea that mood effects are malleable raises the question why happy moods are overwhelmingly found to be associated with global processing. Huntsinger (2012) proposes that, as Navon (1977) already showed decades ago, people have a default tendency to perceive and rely upon global information rather than local information and that this tendency to adopt a global focus is often reinforced in experimental contexts (Clore & Huntsinger, 2007). Thus, in past research, positive and negative mood could have conferred positive and negative value on the usually dominant global attentional set, leading to a fixed effect of affect on the breadth of attention. Thus, a positive mood reinforced the use of the default global attentional set while a negative mood state, by conferring negative value about this default state, invalidated the global default mode resulting in adopting the opposite attentional focus (Huntsinger, 2012). Although global processing may be the dominant mode most of the time, it is also assumed that both global and local processing modes are constantly active and can be switched easily (Isbell, 2010). Indeed, as shown by Huntsinger (2012), it seems easy to reverse the mood and processing effects by altering the currently global or local processing mode. These results suggest that evaluative information may serve to promote or inhibit reliance on currently accessible processing styles.

In summary, although research over the last five decades has suggested that negative affective states could directly narrow, whereas positive affective states broaden the cognitive scope, recent theories show that this link may be more complex. On the one hand, P. A. Gable and Harmon-Jones (2010) proposed that, regardless of the positive or negative valence of the affective state, affect low in motivational intensity broaden, whereas affects of high motivational narrow the perceptual and cognitive scope. On the other hand, according to the Affect-as-Information model, Huntsinger (2012) proposed that the valence of affect does matter, by giving evaluative information about the currently accessible processing style. Hence, it seems clear that the influence of positive mood on the attentional focus is influenced by additional, insufficiently understood processes that require further study. This seems particularly important as the *broadening function* of positive mood is considered crucial in explaining the association between positive mood and higher-level processes such as creativity (Baas et al., 2008), stress resilience (Fredrickson, 2001), and health (Burton & King, 2009). Hence, the distinction between broad/global versus narrow/local information processing styles seems an important one.

Global/broad versus local/narrow information processing styles. Processing styles are content-free ways of perceiving the environment (Tulving & Schacter, 1990). In global processing, one attends to objects holistically and focusses on the entirety by “zooming out”, whereas in local processing, one attends to objects elementally and focuses on the details by “zooming in” (Navon, 1977). Given inconsistent results and emerging new theories about the relation between affect and global/broad and local/narrow information processing styles, it has become increasingly clear that affect is not the only variable influencing those information processing styles. Forster and Dannenberg (2010a) introduced a comprehensive model, a systems account of the global and local processing model, or GLOMO^{sys} (Forster, Liberman, & Kuschel, 2008) that accounts for a large number of social-psychological phenomena.

The GLOMO^{sys} includes predictions about cognitive mechanisms and functionalities of two processing systems: a global system that processes information holistically and a local system that processes the parts. As global versus local processing styles are content-free and can carry over to unrelated tasks, the perceptual scope seems related to the conceptual scope, with global-local perception influencing creativity, similarity focus, and distancing (see Forster & Dannenberg, 2010a). Based on the literature, Forster and Dannenberg (2010a) propose an overview of a variety of psychological variables that can trigger global/local perception. To name a few examples, compared to healthy participants, participants with high chronic levels of autism, obsessionality, or anxiety show enhanced local processing. Also, global processing occurs when people are exposed to unfamiliar as opposed to familiar events or when obstacles are standing in the way of goal pursuit. Even colors can influence global/local processing as the blue color typically enhances global processing in perceptual tasks, whereas for the red condition the opposite is true. Also love, distal events, obstacles, interdependent selves, and promotion focus seem to serve global processing, whereas sex, proximal events, no obstacles, independent selves, and prevention focus are associated with local processing (see Forster & Dannenberg, 2010a).

Although affect does have cognitive, experiential, and motivational components (see Frijda, 1988), and can have an informative value (Schwarz & Clore, 1988), or is implicit (Friedman & Forster, 2010), Forster and Dannenberg (2010a) show that it is unlikely that affect unites all of the above mentioned moderating variables of global/local processing. For example, Forster and Dannenberg (2010a) show that valence or hedonic pleasure cannot explain differences between lust and love, because participants report experiencing these situations as equally pleasant. Also approach versus avoidance and motivational theories can not explain why for example obstacles (related to avoidance, high in motivational intensity) trigger global processing (see Forster & Dannenberg, 2010a).

Making use of the novelty-construal theory (NCT; Forster, Marguc, & Gillebaart, 2010), Forster and Dannenberg (2010a) proposed “novelty”, defined as “not previously experienced” or “lack of familiarity” as the psychological glue that unites all moderators that influence global/local processing. When people explore novel events, the global processing level provides them efficiently with a global meaning, whereas when an event is familiar, the local processing level is useful to learn more about its details. Additionally, Forster and Dannenberg (2010a) propose that the local processing system supports self-regulation in case of threat. Forster and Dannenberg (2010a) explain that people are naturally curious and want to integrate new information into existing knowledge structures, supported by broadened mental categories. In order to understand new, unfamiliar, complex, distant, unclear, or abstract events, it is more efficient to first search the global levels of representation, because they have fewer features than the local levels (Forster, Liberman, & Shapira, 2009). Upon global understanding, the local system takes over to deeper understanding, reflecting a global-to-local sequence (Forster & Dannenberg, 2010a). However, these routines can change when people need to protect themselves from potential danger, making the local system active. When confronted with threatening novel events, people narrow the scope of attention and search for ways to efficiently cope with the threat (see Friedman & Forster, 2010).

Although the GLOMO^{SYS} of Forster and Dannenberg (2010a) provided some of the scaffolding for the global-local information processing research, this theory is still preliminary and raises numerous questions. For example, the authors have been criticized for their conceptualization of novelty. Isbell (2010) raised the question of what triggers individuals to appraise something as novel versus familiar, given that most events possess both novel and familiar features, depending on several situational and individual differences. Moreover, novel events become increasingly more familiar over time. Forster and Dannenberg (2010b) replied to this issue that first people appraise whether an event is new or old stating that it is more the experience or the construal of an event as novel rather than its objective feature that drives the effects. Other researchers believe that novelty could be interpreted as a form of psychological distance, defined in terms of how subjectively distant something feels from one's own direct experience (see P. K. Smith & Ledgerwood, 2010). Thus, it might be untenable to identify one common underlying mechanism that can explain findings across many research paradigms in this global-local processing tradition.

Despite that there are some questions and ambiguities surrounding the GLOMO^{sys}, this model contains some interesting ideas. A first interesting idea in their model is the dichotomous presentation of the two processing systems. Forster and Dannenberg (2010a) claim that the global and local systems represent two systems that are triggered by different variables and involve different process, have different consequences for behavior and information processing, and are based on different functionalities. Thus, when one system is active, the other one should be inactive. Moreover, they state that it is possible to change ways of processing quickly in response to the situational demands. This is, within one system, strength of the activation can be adjusted: one may zoom in or out more strongly or mildly (Forster & Dannenberg, 2010b). This is in line with the idea that within momentary experience, positive emotions are incompatible with negative emotions (e.g. Nolen-Hoeksema, 2000) and that this fundamental incompatibility can be reflected in that the information processing system cannot simultaneously be both narrowed and broadened (Garland et al., 2010). However, if the global and local information processing systems are two separate systems, these systems may also interact. Indeed, the GLOMO^{SYS} suggests that processing can shift from global to local processing, but does not explain how and when this happens.

Furthermore, the GLOMO^{SYS} states that in new situations, people automatically start processing their surroundings more globally, except when this novelty is perceived as threatening. In this case, people start to focus on the threat to eliminate or cope with it, making the local processing system active. Interestingly, as not only anxiety but also depression has been associated with enhanced local processing (Basso et al., 1996), depressive feelings may also inform individuals that their world is unsafe and that their goals are compromised. Hence, it is possible that depressed people may appraise novel events as rather negative and unsafe, resulting in local information processing, potentially contributing to the default local processing mode that is thought to be characteristic for depression.

The GLOMO^{SYS} ideas may also apply to the resilience framework. In a recent study, it is shown that daily obstacles prompt people to step back and to adopt a more global processing style that allows them to look at the “big picture” (Marguc, Forster, & Van Kleef, 2011). The authors explain that obstacles may be perceived as novel events, which may naturally prompt a broad problem-solving mindset to understand and integrate the obstacle into existing knowledge structures. On the basis of the above assumptions, it has been suggested that as people deal with mild obstacles on a daily basis, they may implicitly learn that processing more globally is a promising response to obstacles. Notably, most people have the overall tendency to prioritize global information processing (Navon, 1977). Also, according to the GLOMO^{SYS}, a broad and global processing style is content-free and carries over to other tasks, resulting in routinized global responses to obstacles.

Interestingly, if a global focus helps to adaptively cope with daily obstacles, it might be interesting to experimentally enhance the use of a global processing style in order to influence adaptive coping with obstacles. Indeed, several recent studies have attempted to reveal the causal impact of a broad processing style on emotional resilience by directly manipulating breadth of attention. For example, Hanif et al. (2012). have used a training variant of classic global versus local processing tasks in order to modify attentional breadth. In this training task, participants were presented with hierarchical shape stimuli and were asked to only identify the global shape in the training condition intended to broaden attention, or to only identify the local shape in the training condition intended to narrow attention. These alternative attentional training conditions were found to also differentially modify emotional reactivity to a subsequent stressor. Participants significantly improved their performance on a self-regulation task after the induction of a broad focus of attention in a visual discrimination task, while participants tended to be worse after the narrow attentional focus induction. Thus, these results suggest that attentional breadth training can induce change in emotional resilience. As a global focus seems to have beneficial effects to cope with stress, investigating how this resilient responding can be optimized is a vital avenue for future research, especially to prevent recurrence of depression.

RESEARCH OBJECTIVES OF THE DISSERTATION

In past decades, many empirical and theoretical efforts have been made to gain insight in the vulnerability factors for depression. By contrast, despite the high recurrence of depression, little is known about core psychological mechanisms of resilience to depression. However, the study of psychological resilience to stress is important to understand why some individuals are protected against the development of new depressive episodes. Although previous depressive episodes are overall good predictors of future relapses, there is a large amount of variability across individuals in their ability to become resilient/resistant to depression and stress, which still poses a formidable challenge to current researchers and clinicians working on depression in general, and more specifically with remitted depressed individuals. It is therefore of crucial importance to delineate, from a psychological perspective, what may be the underlying working mechanisms of resilience to depression. Only a more systematic look at cognitive and emotional functions in healthy as well as remitted depressed individuals, as put forward in this dissertation, could help to tackle this challenge and may in the long run assist helping remitted depressed individuals in attaining stable recovery from depression. Moreover, these insights could be used to propose new efficient revalidation strategies in clinical and health psychology aimed at reducing the adverse effects caused by future relapses in a high proportion of these patients. Such research is crucial in understanding the recovery from depression as permanent recovery demands the ability to be resilient to stress, which is impaired with increasing numbers of past depressive episodes.

In this dissertation we use the broaden-and-build theory of positive emotions (Fredrickson, 1998, 2001) as this theory presents a successful integration of emotion theory in a resilience framework. We aim to investigate the core principles derived from this theory and apply these assumptions in depression research to better understand recurrence of depression. As described in the sections above, the basic assumptions of the broaden-and-build theory are that positive emotions, as opposed to negative emotions, broaden one's thought-action repertoire, and, that this broadened thought-action repertoire accretes over time thereby building enduring personal psychological, physical, and social resources. Thus, this theory underscores the role of *positive emotions* and the underlying *broadening mechanism* in generating long-term resources thereby influencing *resilience* and well-being. Using a cognitive-behavioral perspective, two main research lines are proposed here to shed light on key psychological components of resilience in relation to depression.

Research Lines and Chapters

In a *first research line*, we investigate the *effects of positive mood on attentional breadth*. In models of affect and cognition it is held that positive affect broadens the scope of attention (e.g. Ashby et al., 1999; Fredrickson, 1998, 2001). Consistent with this claim, previous research using non-depressed samples has shown that a positive mood induction procedure elicits cognitive effects on attentional breadth as evidenced by impaired selective attention (Rowe et al., 2007). Although many empirical studies seems to support this hypothesis, several recent findings casted doubt on the reliability of this observation and claimed that other variables might interfere with the attentional broadening effect of positive affect. For instance, P. A. Gable and Harmon-Jones (2010) proposed that motivation might mediate the relationship between affective states and the breadth of attention and cognition, in ways that only affect that is low in motivational intensity broadens the attentional scope. Another line of studies in the Affect-as-Information tradition proposed that affect is not directly related to the scope of attention, but serves as an informative function that signals the value of the information processing mode that is currently dominant or accessible in a perceiver's mind (Clore & Huntsinger, 2007, 2009; Clore & Palmer, 2009; Huntsinger et al., 2010; Martin et al., 1993), assuming that the influence of affect might also depend on the context. Hence, it seems clear that the influence of positive mood on the attentional focus is influenced by additional, insufficiently understood processes that require further study. As the hypothesized broadening of attention is a central tenet of theories on positive emotions in explaining why positive affect is associated with enhanced stress resilience (Fredrickson, 1998, 2001), we start with an examination whether positive affect broadens visual attention.

In **Chapter 1**, we set out to systematically examine the first assumption of the broaden-and-build theory whether positive affect broadens visual selective attention in a series of four experiments, using different cognitive-experimental tasks. The rationale of these studies is to induce a positive mood state in participants and examine the effects of this manipulation on the scope of attention. We hypothesize that positive affect will impair selective attention through increasing the scope of attention. In a first experiment, we perform a replication of the Rowe et al. (2007) study using similar mood induction procedures and flanker task. In the second experiment, participants perform the same flanker task in the context of a more ecologically valid mood-induction procedure. We further examine whether the results of previous experiments generalize to other alternative and well-validated measures of selective attention using the ANT (Fan et al., 2002) in a third, and a global-local Navon letter task (Navon, 1977) in a fourth experiment.

In **Chapter 2**, we conduct a replication and extension of the Huntsinger (2012) study which found that affect merely influences whether people do or do not act according to the momentarily dominant tendency to focus broadly or narrowly. Interestingly, as depression seems related to a default narrowed attentional scope (see Whitmer & Gotlib, 2012), positive emotions would, according to this theory, reinforce this narrowed information processing scope, which is thought to have detrimental effects on resilience (Fredrickson et al., 2000). These findings could have important theoretical and practical implications, as training methodologies or intervention strategies that aim to enhance positive affect would only be beneficial in the presence of a broad attentional focus. Hence, to clarify whether positive affect indeed reinforces the dominant focus, we examine the effects of positive affect in comparison with a neutral mood condition. We use a flanker task with different distractor eccentricity conditions to allow a more fine-grained analysis of selective attention.

In a *second research line*, we focus on the second assumption of the broaden-and-build theory which proposes that a broadened scope of attention and cognition builds skills and resources which will serve to enhance the chances to cope successfully when confronted with stress (Fredrickson, 1998, 2001). Hence, a *broad attentional focus* seems crucial for *resilience*. In contrast, a narrowed attentional scope might be detrimental for resilience. According to the attentional scope model (Whitmer & Gotlib, 2012), a narrowed scope of attention is thought to enhance encoding information at the center of attention. Hence, this constricted scope may account for some of the disrupted information processes in depression, such as impaired disengagement from negative information, ruminative thinking, and cognitive inflexibility. As depression seems characterized by a narrowed attentional scope and a disrupted down-regulation of stress, insight in this cognitive broadening mechanism is of crucial importance to understand why some individuals are protected against the development of new episodes. Therefore, in this second research line, we investigate breadth of attention in relation to emotional resilience in healthy and remitted depressed (RMD) samples.

Chapter 3 aims at a comprehensive investigation of attentive processing of neutral and affective information in a sample of RMD individuals compared with never depressed controls (NDC). Although depression is shown to be associated with a narrowed attentional scope (Basso et al., 1996), no such studies have been conducted in a RMD sample. Given that cognitive control deficits are not only present during depression (for a review, see Joormann & D'Avanzato, 2010), but also after remission, we predict that RMD individuals will also be characterized by a narrowed attentional scope which may relate to control impairments such as impaired disengagement and cognitive flexibility. Given the crucial role of attentional breadth in the adaptive responding to stressful information, we predict that RMD will be characterized by a more narrow attentional scope, impaired disengagement from neutral and/or negative information, and impaired flexibility in processing neutral and/or negative information, compared to a NDC sample.

In **Chapter 4**, we aim to study the impact of the breadth of attention in relation to more long-term stress resilience and well-being using a longitudinal prospective design in a student sample. It has been proposed that “upward spirals of positive emotions” may be key for building resilience: the broadened attention and cognition that is triggered by positive emotions, might in turn increase positive emotions because people will be more able to attend to and engage in positive events (Garland et al., 2010). These effects of positive emotions on attentional breadth should accumulate and compound, and over time build resilience. Furthermore, these beneficial effects are also thought to protect psychological health by "undoing" or buffering against the effects of stress (Cohn et al., 2009; Fredrickson et al., 2003; Tugade & Fredrickson, 2004). To examine more long-term effects of positive emotions in relation to the breadth of attention and resilience, we conduct a prospective longitudinal study over a 18 month period. We predict that a broad attentional focus will buffer the detrimental effects of adverse life events, and enhance the effects of positive events on emotional well-being, reflected in lower depressive symptoms, higher resilience, and higher quality of life.

In **Chapter 5**, we aim to replicate and extend previous findings of training procedures designed to induce differential attentional breadth by investigating whether these procedures also serve to alter emotional resilience. According to the GLOMO^{SYS}, a broad and global processing style is content-free and carries over to other tasks, resulting in routinized global responses to obstacles. Interestingly, if a global focus helps to adaptively cope with daily obstacles, experimental manipulation of the attentional processing style could influence adaptive coping. A greater attentional scope may facilitate reallocation of attention to alternative stimuli, and thereby assist with attentional disengagement from aversive stimuli. In order to test the hypothesis that narrow breadth of attention might causally contribute to the biased attentional processing of aversive information known to characterize emotional dysfunction, such as depression, this study exposes participants to training procedures designed to directly manipulate attentional breadth in order to test the prediction that this manipulation will also modify biased attentional responding to aversive information.

We end this dissertation with an integrated overview and general discussion of the main findings. Methodological considerations, theoretical and clinical implications, limitations and guidelines for future research are outlined.

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CHAPTER 1

HAPPY BUT STILL FOCUSED? FAILURES TO FIND EVIDENCE FOR A MOOD INDUCED WIDENING OF VISUAL ATTENTION[1]

ABSTRACT

In models of affect and cognition it is held that positive affect broadens the scope of attention. Consistent with this claim, previous research has indeed suggested that positive affect is associated with impaired selective attention as evidenced by increased interference of spatially distant distractors. However, several recent findings cast doubt on the reliability of this observation. In the present study we examined whether selective attention in a visual flanker and global-local task is influenced by positive mood induction. Across four experiments, positive affect consistently failed to broaden focal attention. The implications of this null-finding for theoretical models of affect and cognition are discussed.

[1] Based on: Bruyneel, L., van Steenbergen, H., Hommel, B., Band, G. P. H., De Raedt R., & Koster, E. H. W. (2013). Happy but still focused: failures to find evidence for a mood-induced widening of visual attention. *Psychological Research, 77,* 320-332. doi: 10.1007/s00426-012-0432-1

INTRODUCTION

In recent years, evidence from several domains in contemporary psychology has suggested that positive mood influences cognition and attention (Ashby, Isen, & Turken, 1999; Fredrickson, 2001). Derryberry and Tucker (1994) argued that emotions represent motivational states that yield specific effects on the attentional scope. Their model combines the notion of Easterbrook (1959) that avoidance-related states, such as anxiety (i.e., tense arousal), narrow the focus of attention with the assumption that approach-related states, such as joy (i.e., elated arousal) broaden the attentional focus, which increases responsiveness to peripheral cues. Extending these earlier approaches, Fredrickson (2001) developed the broaden-and-build theory of positive emotions. According to this theory, positive emotions broaden the perceptual and attentional scope, as well as the scope of mental representations and actions. Research of Fredrickson and Branigan (2005) supporting this model has shown attentional broadening effects of discrete positive states of amusement and contentment using a global-local task to measure the attentional scope. Along similar lines, Gasper and Clore (2002) concluded that positive affective states foster global visual processing. More recently, Rowe, Hirsh, and Anderson (2007) found that positive moods resulted in broadened visual-spatial processing. The idea that positive affect creates attentional and cognitive broadening is widely accepted and supported (Fredrickson & Branigan, 2005; Gasper & Clore, 2002; Rowe et al., 2007).

Despite the often-reported broadening function of positive affect on information-processing (Ashby et al., 1999), positive affect does not always lead to attentional broadening effects. For instance, Gable and Harmon-Jones (2008) found that approach motivation mediates the relationship between positive affect and the broadening of attention. Positive affects vary in the degree to which they are associated with approach motivation which refers to an urge or action tendency to go toward an object. Whereas positive affect low in approach motivational intensity (e.g., joy after watching a funny film) broadens the attentional scope (Fredrickson & Branigan, 2005; Gable & Harmon-Jones, 2008), positive affect high in approach motivational intensity (e.g., desire while approaching an attractive object or goal) narrows the attentional scope (Gable & Harmon-Jones, 2008; Harmon-Jones & Gable, 2009). In studies on positivity and broadening prior to 2005, positive mood was induced by handing gifts, showing funny movies, playing happy music or by having participants recall pleasant memories. These manipulations likely evolved low approach motivation, with positive affect not being related to obtaining goals within the experimental context.

Interestingly, close inspection of the literature reveals that there are mixed findings with regard to the attentional broadening effects, even if the induced mood states were low in approach motivational intensity. On the one hand, attentional broadening effects of positive mood have been convincingly demonstrated. For instance, Rowe et al. (2007) used a modified flanker task to examine attentional broadening in response to positive affect. The flanker task (Eriksen & Eriksen, 1974) is a well-established attentional task, where a centrally presented target is flanked on either side by response-compatible or response-incompatible stimulus elements. Irrelevant and incompatible flankers interfere with the response to the central target. By presenting flanking stimuli at three different distances (near, medium, far) from the middle target, Rowe et al. (2007) investigated whether positive affect influences visual attention by broadening the scope of attention. They found that the effect of spacing on flanker compatibility was influenced by mood. As flanker eccentricity increased, positive mood resulted in a more pronounced slowing relative to negative and neutral mood which means that the effect can be attributed to a widening of the attentional scope. Similar findings have been obtained with other cognitive tasks such as different forms of global-local tasks (Fredrickson & Branigan, 2005; Gable & Harmon-Jones, 2010a). On the other hand, a recent study with a much larger sample size than with Rowe et al. (2007) did not find any differences between positive and neutral mood conditions on flanker interference-effects (Martin & Kerns, 2010). In this study, low approach motivational film clips were used to induce mood states. Another recent study (Finucane, Whiteman, & Power, 2010) failed to find effects of low approach motivational positive affect on the efficiency of selective attention, which refers to flanker interference-effects as measured with the Attention Network Task (ANT; Fan, McCandliss, Sommer, Raz, & Posner, 2002). Finally, Johnson, Waugh, and Fredrickson (2010) found that affect increased attentional breadth measured with a global-local task and a covert attentional orienting task if it was accompanied by genuine smiles in participants. However, this effect occurred independently of the positive affect manipulation that this study also comprised of (presentation of funny videos and retrieving positive memories). Thus, the association between positive affect and attentional broadening seems more complex than most theories hold.

Given the importance of attentional broadening in theories of positive affect and the discrepant findings in this area, we set out to systematically examine whether positive affect broadens visual selective attention. The hypothesized broadening of selective spatial attention is a central tenet of theories on positive emotions in explaining why positive affect is associated with for instance better creative performance (Estrada, Isen, & Young, 1994), facilitation of decision making (Estrada, Isen, & Young, 1997; Isen, 2001), and even enhanced stress resilience (Fredrickson, 2001). In the current study, we set up four experiments with similar experimental within- (Experiment 1, 2 and 3) or between- (Experiment 4) subjects-designs in which we induced positive versus neutral and/or negative mood states. After each mood induction, attentional broadening was examined using a flanker task in Experiment 1 and 2 (Rowe et al., 2007), the ANT (Fan et al., 2002) which contains a broader range of attentional measures in Experiment 3, or the global-local Navon letter task (Navon, 1977) in Experiment 4. In Experiment 1, we performed a replication of the Rowe et al. (2007) experiment with similar mood inductions and flanker task. In Experiment 2, participants performed the same flanker task, but now in the context of a more ecologically valid mood-induction procedure. Finally, we examined whether the results of Experiment 1 and 2 would generalize to an alternative and well-validated measure of spatial orienting using the ANT (Fan et al., 2002) in Experiment 3 and to the global-local Navon letter task (Navon, 1977) in Experiment 4.

EXPERIMENT 1

In Experiment 1, we replicated the study of Rowe et al. (2007). Because we were interested in the effects of positive affect, we used a within-subject design with a positive and neutral mood induction procedure (MIP) followed by a flanker task. In this task, participants are asked to selectively attend to a central target and ignore irrelevant flanking distracters. We expected that the positive compared with the neutral MIP would result in a broadening of attention, as reflected by more pronounced interference effects for distant flankers.

Method

Participants

Thirty-five undergraduate students of Ghent University participated in exchange for course credit. Two participants were excluded from further data-analyses because they responded at chance level on the attention task. Mean age of the remaining 33 participants was 19.27 (*SD* = 2.30). Most participants (88%) were female.

Material

Mood Induction. For the positive MIP, participants listened to Bach's Brandenburg Concerto No. 3 (played by Hubert Laws) while retrieving a positive autobiographical memory. This procedure has been validated in previous mood research (Green, Sedikides, Saltzberg, Wood, & Forzano, 2003; Tellegen, Watson, & Clark, 1999; Wood, Saltzberg, & Goldsamt, 1990). For the neutral MIP participants read in a collection of historical facts about Belgium. Rating scales were administered to check the effectiveness of the MIP (see below). Participants rated their mood on nine-point visual analogue scales (VAS), anchored by end points "1: extremely unpleasant" and "9: extremely pleasant".

Flanker Task. The flanker task was programmed in the E-prime software package (Psychology Software Tools, Inc., 2001). The experiment was run on a laptop computer with a 60 Hz, 15-inch color monitor.

The spaced flanker task was programmed according to the specifications of Rowe et al. (2007). All stimuli were black, presented against a white background. Target stimuli and flankers were the letters N and H. All letters were capitals, presented in 18-point Courier New. On every trial, a fixation arrow (^) was presented in the middle of the screen. Imperative stimuli consisted of 5 letters, a target letter (N or H) flanked on both sides by the same pair of two identical letters (NN or HH). Spacing between the letters was manipulated, divided equally between near, medium, and far distances (0, 1 or 2 letter width). Responses were made by pressing one of two keys (target N: "s", target H: "h") with the left and right finger on an AZERTY keyboard.

Procedure

Participants were tested individually in a sound-attenuated lab at Ghent University. All participants were informed about the procedure and gave their written informed consent.

The experiment was conducted in one session. The participants performed the task after both MIPs. The order of MIPs was counterbalanced between participants. Participants rated their mood at three time points throughout the experiment. The first time point was before the MIP and flanker task. The remaining time points were immediately after the neutral and positive MIP. For the positive MIP, participants were instructed to listen to the music and generate a positive autobiographical memory for a period of 5 minutes. They were told to bring the experience as vividly as possible to mind and recall associated feelings just as they had experienced at that time. For the neutral MIP, participants had to read in a book with facts about Belgium for a period of 5 minutes.

After both MIPs, participants performed the flanker task. Participants were given 36 practice trials on the first out of two task blocks. Each task block consisted of 96 randomly presented trials, presented at varying intertrial intervals (500, 700 and 800 ms). Participants were instructed to identify the central letter as quickly as possible without sacrificing accuracy by pressing the corresponding key.

The sequence of events on a test trial consisted of a 1000 ms fixation arrow. Then a cue of 5 letters appeared for a 1000 ms or until a key press was made. Participants were seated at approximately 60 cm viewing distance from the computer screen to perform the flanker task. This distance was controlled by using a chin rest.

Results

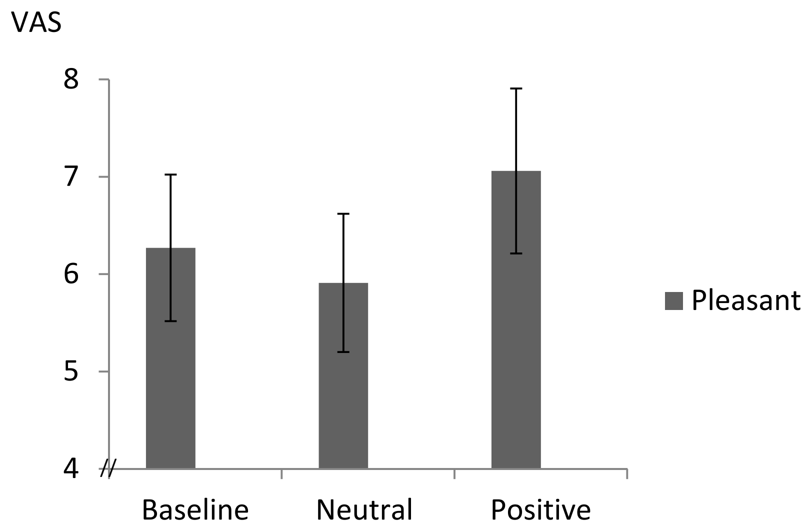
Data Preparation

Results from two participants were excluded from the analyses because of an excessive number of errors (> 50%). Trials with errors (< 9%) and outliers with reaction times (RT) deviating more than 2.5 standard deviations (SDs) from the group mean RT (< 1%) were analysed separately.

Mood Induction

Scores on the VAS showed that participants reported the expected change in mood following MIP (Figure 1). Mood ratings were submitted to separate one-way ANOVAs with three levels of the mood induction factor (i.e., pre-induction, post neutral MIP, post positive MIP). Valence ratings differed significantly depending on induction phase, $F(2, 30) = 27.19$, $p < .001$, $\eta_p^2 = .64$. The mood did not change significantly relative to pre-induction after neutral MIP, $t(32) = 1.53$, $p = .13$. The positive MIP resulted in significantly increased positive affect relative to pre-induction, $t(32) = 4.07$, $p < .001$, and neutral MIP, $t(32) = 6.80$, $p < .001$. Equal results were obtained when the order of the MIPs was included as an additional factor in the ANOVA.

Figure 1. Mood ratings (Means ± SD) on a visual analogue scale (VAS) from 1 extremely unpleasant to 9 extremely pleasant for Experiment 1.



Attentional Breadth

RT data were submitted to a 2 (mood: neutral, positive) x 2 (compatibility: compatible, incompatible) x 3 (spacing: near, medium, far) repeated measures analysis of variance (ANOVA). A highly reliable main effect of flanker compatibility, $F(1, 32) = 130.16$, $p < .001$, $\eta_p^2 = .80$, revealed that responses were faster in compatible trials ($M = 507$, $SD = 120$) than in incompatible trials ($M = 540$, $SD = 126$). There was also a main effect of spacing, $F(2, 31) = 62.67$, $p < .001$, $\eta_p^2 = .80$, with near flankers producing significantly slower responses ($M = 545$, $SD = 121$) than flankers at medium ($M = 517$, $SD = 126$), $F(1, 32) = 79.76$, $p < .001$,

η_p^2 = .71, and far distances (*M* = 509, *SD* = 122), *F*(1, 32) = 115.48, *p* < .001, η_p^2 = 0.78. The effect of spacing interacted with flanker compatibility, *F*(2, 31) = 18.45, *p* < .001, η_p^2 = .54, such that compatibility effects (incompatible minus compatible) were reduced with greater flanker distance. Near versus medium spacing revealed a 57.6% reduction in the effect of flanker compatibility, *F*(1, 32) = 33.04, *p* < .001, η_p^2 = .51. Finally, there was no significant difference between medium and far spacing for the effect of flanker compatibility, *F* < 1.

In contrast with the hypothesized influence of positive affect on visual selective attention, there was no main effect of mood, *F*(1, 32) = 1.15, *p* = .29, η_p^2 = .04. Furthermore, the positive MIP did not result in greater flanker interference relative to the neutral MIP, *F*(1, 32) < 1 (see Table 1). The three-way interaction revealed that the effect of spacing on flanker compatibility was not influenced by mood, *F*(2, 31) = 1.29, *p* = .29, η_p^2 = .08. Furthermore, no correlation was found between the amount of mood change and the amount of interference effect change, *r* = .05, *p* = .80. See table 1 for means and SDs.

Proportion error rates were submitted to a 2 (mood: neutral, positive) x 2 (compatibility: compatible, incompatible) x 3 (spacing: near, medium, far) repeated measures analysis of variance (ANOVA). A highly reliable main effect of flanker compatibility, *F*(1, 32) = 129.10, *p* < .001, η_p^2 = .81, revealed that responses were typically more accurate in compatible trials (*M* = .04, *SD* = .02) than in incompatible trials (*M* = .11, *SD* = .02). There was a main effect of spacing, *F*(2, 31) = 9.60, *p* < .001, η_p^2 = .39, with near flankers producing a significantly higher error rate (*M* = .10, *SD* = .03) than flankers at far distance (*M* = .06, *SD* = .03), *t*(32) = 3.78, *p* = .001. There was no significant difference between error rates of near and medium spaced trials (*M* = .09, *SD* = .04), *t*(32) = .42, *p* > .05. The effect of spacing interacted with flanker compatibility, *F*(2, 31) = 8.90, *p* < .001, η_p^2 = 0.37, such that error rates of compatibility effects (incompatible minus compatible) were reduced with greater flanker distance (see Table 1). Furthermore, there were no effects of mood on error rates. First, there was no main effect of mood, *F*(1, 32) = 1.73, *p* = .20, η_p^2 = .05. Furthermore, there was no interaction effect with compatibility nor spacing, both *F*(1, 32) < 1. The three-way interaction revealed that error rates of the effect of spacing on flanker compatibility was not influenced by mood, *F*(2, 31) < 1.

Table 1. Mean reaction times and error rates for flanker conditions and compatibility effects (*N* = 33) in Experiment 1.

	Positive			Neutral		
	M	SD	ER: M	M	SD	ER:M
Compatible trials RTs (ms)						
Spacing Near	516	134	.04	519	127	.04
Spacing Medium	501	125	.04	510	143	.04
Spacing Far	491	111	.05	505	137	.03
Incompatible trials RTs (ms)						
Spacing Near	568	117	.16	575	119	.14
Spacing Medium	525	130	.15	532	119	.14
Spacing Far	519	118	.09	523	134	.08
Compatibility Effect RTs (ms)						
Spacing Near	52	32	.12	56	41	.11
Spacing Medium	26	34	.11	21	46	.09
Spacing Far	28	21	.05	17	30	.05

Note: ER = proportion error rates

Discussion

The results of Experiment 1 show that a positive MIP did not impair the ability to focus attention on a target and thus failed to increase the processing of spatially distant flanking distracters. It is important to mention that we found the expected effects of the MIP on the mood ratings. Furthermore, we replicated all the basic flankers effects reported by Rowe et al. (2007): highly significant main effects of compatibility, spacing, and an interaction effect. However, there was no higher-order interaction between mood, compatibility, and spacing. Furthermore, the correlation between the amount of mood change and the amount of interference effect change was not significant, which strengthens our null-finding. Finally, error rates were not influenced by mood.

Some aspects of this first experiment deserve consideration. A few methodological differences with the study of Rowe et al. (2007) should be noted. First, they controlled for both gender (an equal number of males and females) and time of testing (in between participants' peak and off-peak time of day). Gender differences have been found in selective attention (Merritt et al., 2007) as well as in the effects of mood manipulations (Westermann, Spies, Stahl, & Hesse, 1996) and attention is particularly vulnerable to time of day effects (Valdez et al., 2005). It is possible that such minor differences could affect the outcome of the task, supporting that the broadening of attention occurs under some very restricted conditions. Second, in the study of Rowe et al. (2007), the mood manipulation continued for a period of 10 minutes. Although in the current study the mood manipulation was briefer (5 minutes in total), we obtained similar results on the manipulation checks. Finally, in the study of Rowe et al. (2007) the music component softly continued as participants performed the experimental task in the positive condition. However, there was no music component in the neutral condition. Because the difference in the presence of music between conditions could blur the broadening effects of positive mood (Olivers & Nieuwenhuis, 2005), we decided not to play the relevant music during the testing period.

As this is a null-finding we sought to further examine potential attentional broadening effects of positive affect. Although mood ratings differed significantly depending on induction phase with similar magnitude as reported in the study by Rowe et al. (2007), mean values indicated that participants were in a slightly positive mood after the neutral MIP. Therefore, we decided to run an experiment with a more ecologically valid and presumably stronger MIP that was still low in approach motivation.

EXPERIMENT 2

Because of our failure to replicate the findings of the broadening effect of positive affect on visual selective attention in Experiment 1, we decided to use a similar design, yet using a more involving and naturalistic MIP to elicit stronger positive mood. To maximize chances to find a modulation of attentional breadth by positive affect, we first induced stress by manipulating a personal concern that was highly goal-relevant for the participants and could evoke high-intensity approach motivation, which is thought to narrow attentional breadth (Chajut & Algom, 2003; Gable & Harmon-Jones, 2010a). The second MIP elicited positive affect through personally relevant positive feedback which is related to positive mood that is low in approach motivation (Fredrickson, 2001; Gable & Harmon-Jones, 2010a).

Method

Participants

Thirty-eight undergraduate students from Ghent University participated in a two hour multipart experiment in exchange for money (16 Euros). As we sought to elicit positive mood through personally relevant feedback (see below), we recruited psychology students from the 1st and 2nd grade who were interested in studying clinical psychology in the 3rd grade. Mean age of the participants was 20.14 (*SD* = 4.22). Most participants (82%) were female.

Material

Mood Induction Procedure (MIP). For the MIP, we used a performance task that contained uncontrollable and socially evaluative threatening elements that induced stress (Dickerson & Kemeny, 2004) to heighten the importance of feedback. This performance task consisted of a diagnostic interview which had to be performed by the participant with an actor having a background in clinical psychology. The participants were told that they had to use appropriate interviewing skills and that their performance was captured on video for possible use, after critical evaluation, in clinical psychology courses.

For the positive MIP, participants were given false positive feedback about their performance on the verbal interaction task. It has been shown that this procedure reliably results in moderate to large affective reactions (Nummenmaa & Niemi, 2004). All participants were told that they did very well, and that the actor, as a client, could feel at ease with the participant as a clinical psychologist. They were told that they created an open atmosphere that was stimulating to talk about problems. Finally, they were told that, given their excellent performance, it seemed that they would become a good clinical psychologist.

Mood Measure. The participants were given VASs consisting of a 100 mm horizontal line, on which they were asked to rate how tense (not tense at all – very tense) and how relaxed (not relaxed at all – very relaxed) they felt at the present moment.

Flanker Task. The flanker task was identical to Experiment 1. The task was run on a Windows XP computer with a 75 Hz, 17-inch colour monitor.

Procedure

The research protocol was approved by the local ethical committee. Written consent was obtained from the participants. The experiment was part of a larger study on the relation between information processing, and negative and positive mood. Participants were tested individually in a sound-attenuated lab at Ghent University. The lab was divided into three separate rooms; one for the attention tasks, one for the interview, and a third one for the positive MIP.

The experiment consisted of two separate parts. In the first part, unrelated to the present experiment, participants performed two attention tasks. After these tasks, participants were allowed to rest for several minutes. At the end of the resting phase, participants completed their first VAS. Then, an experimenter came in and brought them to another room for the interview. This room contained two chairs with a big camera pointing towards one chair and strong lights. Participants completed a second consent form in which they approved that their performance on the interview would be captured on tape and could be used in courses. Then they performed the interview for approximately two minutes. The actor did not provide any feedback, even if participants asked for it. After the interview, participants completed a second VAS immediately followed by the flanker task. After this task, participants were told to relax for a while. After several minutes, the experimenter provided standardized positive feedback about the interview. After this positive MIP they completed a third VAS, immediately followed by the same flanker task.

After the experiment, all participants were fully debriefed and asked if they were aware of the purpose of the MIP. Some of the participants reported to be aware, but all said that they were stressed by the interview and relieved after the positive MIP.

Results

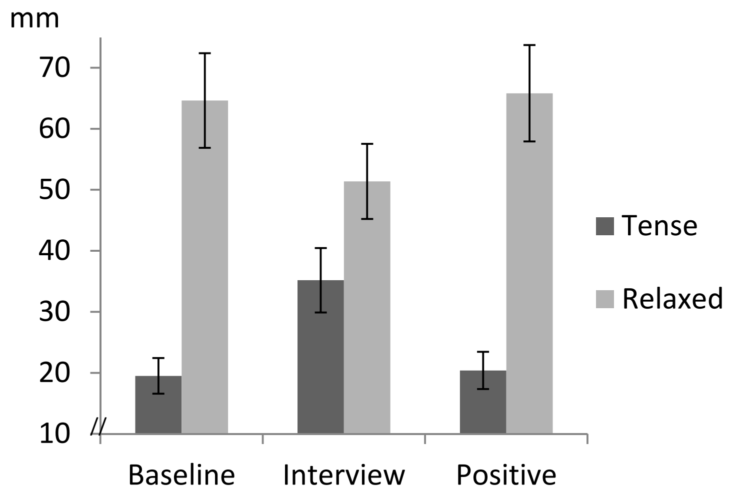
Data Preparation

Trials with errors (< 10%) and outliers with RTs deviating more than 2.5 SDs from the mean RT (< 1%), were analyzed separately.

Mood Induction

Scores on the VASs showed that participants started with a positive mood and that they followed the expected change in mood considering the sequence of negative and positive MIPs respectively (see Figure 2). Mood valence scores were submitted to separate one-way ANOVAs with three levels of the mood induction factor (i.e., pre-induction, post interview, post positive MIP). Valence ratings for both variables tension and relaxation differed significantly depending on induction phase, $F(2, 36) = 15.73$, $p < .001$, $\eta_p^2 = .47$ and $F(2, 36) = 15.80$, $p < .001$, $\eta_p^2 = .47$, respectively. The initial baseline mood changed significantly after the interview for mood rating scores on tension, $t(37) = 5.14$, $p < 0.01$, and relaxation, $t(37) = 4.92$, $p < 0.01$. The positive MIP resulted in significantly increased positive affect relative to the preceding interview for scores on tension, $t(37) = 4.47$, $p < .001$, and relaxation, $t(37) = 5.68$, $p < .001$.

Figure 2. Mood ratings (Means ± SD) on two visual analogue scales on a 100 mm horizontal line from 0 (not tense/relaxed at all) to 100 (very tense/relaxed) for Experiment 2.



Attentional Breadth

RT data were submitted to a 2 (mood: negative, positive) x 2 (compatibility: compatible, incompatible) x 3 (spacing: near, medium, far) repeated measures ANOVA. A highly significant main effect of flanker compatibility, $F(1, 37) = 171.63$, $p < .001$, $\eta_p^2 = .82$, revealed that responses were faster in compatible trials ($M = 450$, $SD = 45$) than in incompatible trials ($M = 484$, $SD = 43$) trials. There was also a main effect of spacing, $F(2, 36)$

= 87.24, $p < .001$, $\eta_p^2 = .83$, with near flankers producing significantly slower responses (*M* = 490, *SD* = 48) than flankers at medium (*M* = 461, *SD* = 43), $F(1, 37) = 111.79$, $p < .001$, $\eta_p^2 = .75$, and far distances (*M* = 450, *SD* = 43), $F(1, 37) = 177.24$, $p < .001$, $\eta_p^2 = .83$. The effect of spacing interacted with flanker compatibility, $F(2, 36) = 14.41$, $p < .001$, $\eta_p^2 = .45$, such that compatibility effects were reduced with greater flanker distance. Near versus medium spacing revealed a 30% reduction in the effect of flanker compatibility, $F(1, 37) = 6.56$, $p < .02$, $\eta_p^2 = .15$. Moreover, there was another 25% reduction in the compatibility effect in medium versus far distance, $F(1, 37) = 9.83$, $p < .01$, $\eta_p^2 = .21$ (see Table 2).

There was a main effect of mood with RTs on the flanker task being higher in the negative (*M* = 477, *SD* = 52) compared to the positive condition (*M* = 458, *SD* = 37), $F(1, 37) = 27.00$, $p < .001$, $\eta_p^2 = .42$. Probably, this effect was due to the fixed order of the interview and positive MIP with practice effects from the first to the second administration of the flanker task. There was no interaction between mood and compatibility, $F(1, 37) < 1$. Most importantly, there was no significant three-way interaction between spacing, flanker compatibility, and mood, $F(2, 36) = 1.59$, $p = .29$, $\eta_p^2 = .08$. Furthermore, the correlation between the amount of mood change and the amount of interference effect change was not significant, $r = .23$, $p = .50$. See table 2 for means and SDs.

Proportion error rates were submitted to a 2 (mood: neutral, positive) x 2 (compatibility: compatible, incompatible) x 3 (spacing: near, medium, far) repeated measures analysis of variance (ANOVA). A highly reliable main effect of flanker compatibility, $F(1, 37) = 90.93$, $p < .001$, $\eta_p^2 = .71$, revealed that responses were typically more accurate in compatible trials (*M* = .04, *SD* = .03) than in incompatible trials (*M* = .12, *SD* = .03). There was a main effect of spacing, $F(2, 36) = 28.28$, $p < .001$, $\eta_p^2 = .61$, with near flankers producing a significantly higher error rate (*M* = .13, *SD* = .04) than flankers at medium (*M* = .06, *SD* = .03), $t(37) = 6.99$, $p < .001$, and far distance (*M* = .06, *SD* = .03), $t(37) = 6.88$, $p < .001$. The effect of spacing interacted with flanker compatibility, $F(2, 36) = 4.59$, $p = .02$, $\eta_p^2 = 0.20$, such that error rates of compatibility effects (incompatible minus compatible) were reduced with greater flanker distance (see Table 2). Furthermore, there were no effects of mood on error rates. First, there was no main effect of mood, $F(1, 37) < 1$. Furthermore, there was no interaction effect with compatibility, $F(1, 37) = 1.21$, $p = .28$, nor spacing, $F(1, 37) < 1$. The three-way interaction revealed that error rates of the effect of spacing on flanker compatibility was not influenced by mood, $F(2, 36) = 1.04$, $p = .36$.

Table 2. Mean reaction times and error rates for flanker conditions and compatibility effects ($N = 38$) in Experiment 2.

	Positive			Neutral		
	M	SD	ER: M	M	SD	ER:M
Compatible trials RTs (ms)						
Spacing Near	457	44	.07	477	64	.06
Spacing Medium	436	42	.04	454	51	.02
Spacing Far	431	39	.03	449	51	.04
Incompatible trials RTs (ms)						
Spacing Near	506	41	.19	520	62	.19
Spacing Medium	468	39	.08	487	53	.10
Spacing Far	448	41	.08	475	52	.09
Compatibility Effect RTs (ms)						
Spacing Near	49	43	.11	57	63	.12
Spacing Medium	32	41	.04	33	52	.08
Spacing Far	17	40	.05	26	52	.06

Note: ER = proportion error rates

Discussion

In Experiment 2 we replicated the null-finding of Experiment 1 with a more ecologically valid MIP. Scores on the VASs showed that participants started with a positive mood and that they followed the expected change in mood considering the sequence of negative and positive MIPs respectively. After the positive MIP, ratings of positive affect returned to the positive baseline levels. Moreover, the main effects of the flanker task again attested to the validity of the task. That is, we observed all standard effects: an overall compatibility effect with slower responding to incompatible compared with compatible trials, a main effect of spacing with reaction times reducing with increased spacing, and an interaction effect between compatibility and spacing such that compatibility effects were reduced with greater flanker distance. Furthermore, the correlation between the amount of mood change and the amount of interference effect change was not significant, which strengthens our null-finding. Finally, error rates were not affected by the MIPs.

Some aspects of this second experiment deserve consideration. First, response times in Experiment 2 were about 50 ms shorter than in Experiment 1. This might be due to a larger size and higher refresh rate of the computer screen in Experiment 2. Second, a main effect of mood was found on RTs where responding was faster after positive MIP than after the interview. This is likely due to order effects with the second presentation of the flanker task after the positive MIP. One could argue that this response facilitation could have obscured attentional broadening effects during positive MIP. However, there was no interaction between mood and compatibility, which argues against this idea. It still remains possible that the second flanker task session might be the one with more focused attention and this might have ran counter to an effect of the broadening of attention by positive mood.

EXPERIMENT 3

One limitation of Experiment 1 and 2 was that we investigated selective visual attention by means of just one specific measure of spatial attention: the flanker task. In Experiment 3, we therefore sought for the inclusion of a broader range of attentional measures, so to increase our odds to find any impact of affect on visual attention. Human attention has been subdivided into at least three functionally and neuro-anatomically separate networks (Fan et al., 2002; Posner & Petersen, 1990). These networks have been claimed to drive three different types of attention, namely alerting, orienting, and selective attention. These types of attention might be differentially sensitive to mood manipulations, which is why we considered all three types in Experiment 3. To do so, we combined a mood manipulation with the ANT – the task that has been suggested to assess the three types of attentional networks (Fan et al., 2002).

Although the hypothesized role of positive mood on spatial attention has usually been measured in selective attention tasks – which according to Fan et al. (2002) would tap into the selective attentional network – the orienting network might be modulated in similar ways. Some findings indeed suggest an affective influence on the ability to overtly attend to the spatial location of a stimulus. In the ANT this can be measured by comparing RTs to stimuli at spatially cued versus uncued positions. Consistent with the hypothesized role of positive affect in cognitive flexibility, it has been shown that positive mood improves the rapid covert orienting of attention (Compton, Wirtz, Pajoumand, Claus, & Heller, 2004; Johnson et al., 2010). However, given that these positive affect modulations have only been observed in some trials (Compton et al., 2004) or under specific smiling conditions (Johnson et al., 2010), whereas other studies have failed to find such an association (Finucane et al., 2010; Moriya & Tanno, 2009), further investigation of this issue is required.

The third, alerting function of attention refers to the ability to prepare and sustain alertness to process relevant signals. Task-related alertness can be measured in the ANT by comparing RTs to stimuli that are temporally forewarned versus not forewarned by a cue stimulus. Some studies have shown an association between negative affect and improved alertness efficiency, which is consistent with a norepinephrine modulation of sustained attention in negative affect (cf. Compton et al., 2004). Interestingly, improved alertness seems to be specific to negative mood states with moderate to high activation levels, given that modulation has been observed for self-reported negative affect (a general dimension of sujective distress, see Compton et al., 2004; Watson & Tellegen, 1985) and induced state anxiety (Pacheco-Unguetti, Acosta, Callejas, & Lupianez, 2010), but not for low-activation negative moods (i.e. sadness; Finucane et al., 2010). Moreover, these effects are not thought to be related to reduced positive affect (Compton et al., 2004), suggesting that improved alertness would be observed following negative mood induction only, but not following positive mood induction. This hypothesis was tested in Experiment 3.

To summarize, in Experiment 3 we examined whether the null-findings of Experiment 1 and 2 generalized to an alternative and well-validated measure of spatial orienting. Whereas the mixed results of previous studies might well predict null-results regarding mood effect on orienting and selective attention, a somewhat more consistent picture emerges from studies investigating the alerting function: alertness might be improved by negative mood, but not by positive mood inductions. In order to test these predictions, we measured the efficiency of the three attentional networks with the well-validated ANT (Fan et al., 2002), after having manipulated participants' mood using a mood induction procedure that includes a negative, neutral, and positive condition.

Method

Participants

Twenty-five students from Leiden University participated in three sessions of a 45-minutes experiment in exchange for money (12 euros) or course credit. Two participants were excluded from further data-analyses: one person made more than 20% errors on average, the other person reported to be unable to get in a negative mood. Mean age of the participants was 21.24 years (*SD* = 3.79). Most participants (74%) were female.

Material

Mood Induction. Film fragments were combined with the instruction to get in a particular mood using Velten statements. This combination of procedures has been reported to be an effective method for the induction of mood states (Westermann et al., 1996). Following a 3-minute film fragment of movie clips (cf. van Wouwe, Band, & Ridderinkhof, 2011) from The Little Mermaid (happy condition) and The Lion King (sad condition), or a Falling Sticks movie (neutral condition; Rottenberg, Ray, & Gross, 2007), 16 translated Velten mood induction statements adapted from an earlier validated set (Jennings, McGinnis, Lovejoy, & Stirling, 2000) were presented on the computer monitor for at least 20 seconds each. From the Velten task on, background music from the movie fragments (with the vocals removed) was played softly throughout the experimental session via headphones. In order to check the induction manipulation, participants were to rate their mood on a 9 x 9 valence x arousal grid (Russell, Weiss, & Mendelsohn, 1989) by placing a single checkmark somewhere in the grid. The valence score is taken as the number of the square checked, with squares numbered along the horizontal dimension (unpleasant feelings – pleasant feelings), counting from 1 to 9, starting at the left. The arousal score is taken as the number of the square checked, with squares numbered along the vertical dimension (sleepiness – high arousal), counting from 1 to 9 starting at the bottom. Ratings were given on a grid occasionally presented on the monitor during the experiment.

Attentional Network Test (ANT). A standard adult version of the ANT implemented in E-prime was run on a computer with a 60 Hz, 15-inch color monitor (see Fan et al., 2002, for details). The ANT combines the standard arrow flanker task with a cued RT task. In the ANT, participants have to decide as quickly and accurately as possible whether an arrow flanked on both sides by two distracting arrows is pointing left or right using an index finger response on the buttons “z” or “/” of a QWERTY keyboard. On any trial, the set of arrows can be presented either above or below fixation point. Before the presentation of the arrows, a cue may be used to direct the attention of the participants. Three different types of cue are used, as well as a no-cue condition. Alerting is defined as the ability to make use of a temporally informative cue and is evaluated by comparing RTs of the no-cue condition to RTs of the double cue condition (a cue above and below fixation at the two possible target locations). Orienting is the ability to make use of a spatially informative cue above and beyond a temporally informative cue. Orienting is evaluated by comparing RTs of the center cue condition (where the cue is presented at fixation) to RTs of the condition with the single spatially informative cue that appears where the target arrow will appear. Finally, selective attention (the ability to ignore incompatible distractors) has been evaluated by comparing RTs of trials in which the distracter arrows are incompatible with RTs of trials in which the target arrow and the distracter arrows are compatible.

Procedure

The research protocol was approved by the local ethical committee. Written consent was obtained from all participants. Participants were tested individually in a lab booth at Leiden University during three sessions at the same time of day, separated by at least one week (M = 9 days). Before the first session, instructions about the mood rating procedure and how to perform the task were given. Each session started with a baseline mood rating, and was followed by a short practice block of 24 ANT trials. Then the MIP started (positive, negative, or neutral condition; order balanced across subjects), and was followed by three blocks of 96 ANT trials separated by self-paced breaks. During the experiment, seven mood ratings were obtained at the following time points: at the beginning of the experiment (baseline), following the practice trials, halfway and at the end of the MIP, and after each task block.

Results

Data Preparation

Following standard practice (Fan et al., 2002), behavioral efficiency scores were calculated for each attentional network separately. The compatibility effect measuring the breadth of attention was calculated by subtracting the mean correct RT of all compatible flanking conditions, summed across cue types, from the mean RT of incompatible flanking conditions. The orienting effect was calculated by subtracting the mean RT of the spatial cue conditions from the mean RT of the center cue. The alerting effect was calculated by subtracting the mean RT of the double-cue conditions from the mean RT of the no-cue conditions.

Mood Induction

Baseline grid scores indicated that participants started the sessions in a slightly positive and aroused mood. Valence ratings showed that the MIP successfully induced the expected change in mood (Figure 3). A 3 (mood: negative, neutral, positive) x 7 (time point) repeated measures ANOVA yielded an interaction between mood and time point for valence, $F(12, 264) = 22.12$, $p < .001$, $\eta_p^2 = .50$, but not for arousal, $F(12, 264) = 1.53$, $p > .10$, $\eta_p^2 = .07$. Follow-up tests including the average mood ratings before and after the task blocks (i.e., time points 3 to 6, Table 3) showed a monotonic function for valence: scores for the negative condition were lower than for the neutral condition, $t(22) = 6.80$, $p < .001$ which, in turn, were lower than those for the positive condition, $t(22) = 6.78$, $p < .001$.

Figure 3. Mood ratings (Means ± SD) on VASs for Experiment 3: Mood ratings on a 9 x 9 valence x arousal grid.

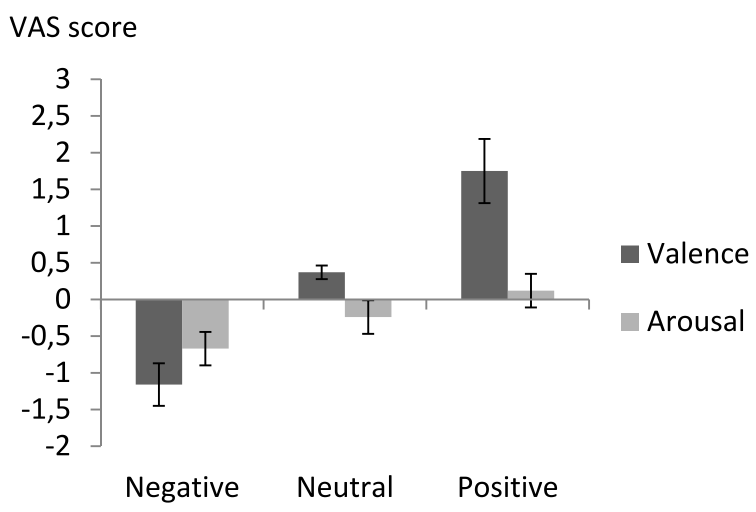


Table 3. Mood ratings in Experiment 3.

Dimension	Induction Condition	Time point						
		Baseline	1	2	3	4	5	6
Pleasure	Negative	0.83	0.83	-1.22	-1.65	-1.26	-1.04	-0.70
	Neutral	0.83	0.78	-0.17	0.30	0.26	0.30	0.61
	Positive	0.39	0.57	2.17	2.26	1.83	1.74	1.17
Arousal	Negative	0.48	0.87	0.70	-0.61	-0.48	-0.70	-0.91
	Neutral	0.57	0.91	0.78	-0.09	-0.26	-0.35	-0.26
	Positive	1.00	0.96	1.43	0.96	0.26	-0.43	-0.30

Note: Seven mood ratings were obtained at the following time points: at the beginning of the experiment (baseline), following the practice trials (1), halfway (2) and at the end of the MIP (3), and after each task block (4 -6).

Selective attention, Orienting, and Alertness

In order to test effects of mood on RTs, ANT difference scores of the three attentional networks were submitted to a univariate repeated measures ANOVA (see Table 4). Although the ANT produced a reliable main effect score for selective attention, $F(1, 22) = 275.29$, $p < .001$, $\eta_p^2 = .92$, there was no evidence of mood modulating this effect, $F(2, 44) = 0.08$, $p > .90$, $\eta_p^2 = .004$. Similarly, an ANOVA including all levels of compatibility (i.e., compatible, neutral, and incompatible flankers) as factor did not reveal any modulatory effect of mood, $F(4, 88) = .189$, $p > .90$, $\eta_p^2 = .01$. The ANT also produced a robust orienting effect, $F(1, 22) = 215.55$, $p < .001$, $\eta_p^2 = .91$, without any influence of mood on this measure, $F(2, 44) = 1.55$, $p > .20$, $\eta_p^2 = .07$.

However, analyses of the alerting effect, $F(1, 22) = 110.52$, $p < .001$, $\eta_p^2 = .83$, revealed a trend towards a mood modulation, $F(2, 44) = 2.84$, $p = .069$, $\eta_p^2 = .12$. Follow-up tests showed that there was a significant increase of alertness for the negative in comparison to the neutral condition, $t(22) = 2.82$, $p = .01$. This suggests that increased alerting is driven by negative affect. Note that this effect is not fully specific to negative emotions as in the overall analysis, the effect of positive, neutral, and negative mood on the alerting effect did not reach significance with positive affect having similar but non significant effects on alerting. See table 4 for means and SDs.

Analyses on proportion error rates (see Table 4) revealed a main effect for selective attention, $F(2, 21) = 1.87$, $p = .18$, with typically higher error rates in incongruent trials ($M = .08$, $SD = .06$) compared to congruent ($M = .01$, $SD = .01$) and neutral trials ($M = .01$, $SD = .01$). There was no evidence of mood modulating this effect, $F(4, 19) < 1$. Furthermore, mood did not influence error rates in the orienting effect, $F(2, 21) = 1.51$, $p > .23$, and in the alerting effect, $F(2, 21) = 1.41$, $p = .27$.

Table 4. Mean reaction times for cue and flanker conditions and ANT scores in Experiment 3 (*N* = 23).

	Negative			Neutral			Positive		
	M	SD	ER: M	M	SD	ER:M	M	SD	ER: M
Cue condition RTs (ms)									
No cue	540	44	.03	523	51	.03	532	62	.03
Center cue	503	45	.04	492	47	.03	488	59	.04
Double cue	490	45	.05	489	45	.03	484	61	.03
Spatial cue	452	46	.03	449	44	.02	444	59	.03
Flanker condition RTs (ms)									
Congruent	473	44	.01	465	45	.01	462	56	.01
Incongruent	556	51	.08	548	54	.07	547	73	.08
Neutral	465	37	.01	460	41	.01	456	50	.01
ANT efficiency scores (ms)									
Attentional breadth	83	26	.07	83	32	.06	85	31	.07
Orienting	52	22	.01	44	19	.01	44	21	.02
Alerting	51	23	.02	40	24	.01	48	26	.01

Note: ER = proportion error rates

Discussion

We successfully replicated the finding of Experiment 1 and 2: no effect of positive mood on selective attention was observed in the ANT, even though the MIP was successful.

Moreover, attentional orienting, another measure of spatial attention, was also not affected by participants' affective state. These findings corroborate our finding that spatial attention is not generally modulated by positive mood. On the other hand, temporal alertness was sensitive to mood changes. Confirming previous studies, alerting efficiency was found to be improved in negative mood but not in positive mood (in comparison to the neutral condition). This finding is not only consistent with earlier observations (Compton et al., 2004; Pacheco-Unguetti et al., 2010), but it also reinforces the conclusion that the null-effects regarding spatial attention are reliable and cannot be attributed to reduced sensitivity of the attentional measures to mood effects.

EXPERIMENT 4

A tentative explanation for differences between studies on mood-induced attentional broadening might be the task-relevance of peripheral spatial information. Whereas the flankers were truly task-irrelevant in Experiment 1, 2 and 3, the nominally irrelevant information is more integrated with the task-relevant information in other tasks, such as global-local tasks. In such tasks, relevant local information is a structural part of the irrelevant global information. Accordingly, it might be easier to ignore irrelevant information in tasks like the flanker task, thus working against potential mood effects. Some work has found evidence for mood effects on the global-local task (e.g. Fredrickson & Branigan, 2005; Gasper, 2004; Gasper & Clore, 2002; Huntsinger, Clore, & Bar-Anan, 2010; Johnson et al., 2010). For instance, Kimchi and Palmer (1982) found individuals in happy moods to match geometric figures when they are similar in overall shape on a global-local perception task, whereas those in sad moods match figures sharing local elements (Gasper & Clore, 2002).

In order to test whether the null-findings of Experiment 1, 2 and 3 would generalize to an alternative measure of attentional breadth, we examined the effects of positive mood on a global-local Navon letter task (Navon, 1977) in Experiment 4. In line with previous research, we selected a global-local letter task based on Navon (1977) that is extensively used and has shown that affective and motivational states influence performance on this task, with positive affect low in approach motivation being associated with a global preference (Gable & Harmon-Jones, 2010b).

Method

Participants

Sixty-six undergraduate students (56 females, 10 males) aged between 17 and 30 years (*M* = 18.76, *SD* = 2.40) from Ghent University volunteered to participate in this study in partial fulfillment of undergraduate course requirements. Participants were randomly assigned to either a positive or neutral mood induction condition.

Material

Mood induction. The MIP consisted of an imagery procedure where participants were instructed to vividly imagine either a self-provided neutral- or happy-inducing autobiographical memory. Participants first practiced the use of mental imagery by completing an imagery practice task of cutting a lemon (Holmes, Coughtrey, & Connor, 2008). Following this practice task, participants in the positive MIP condition were instructed to recall a memory of an event that happened on a specific day, more than one week ago, which made them feel very happy at that time, while participants in the neutral MIP condition were instructed to recall a memory of a specific event that did not elicit strong negative or positive emotions at that time. All participants were asked to shut their eyes and to describe aloud what they remembered in detail. Participants were given instructions (Watkins & Moberly, 2009; based on Holmes et al., 2008) to promote concreteness (e.g. “Focus on how the event happened and imagine in your mind as vividly and concretely as possible a ‘movie’ of how the event unfolded”), and to promote field perspective imagery (e.g. “See it through your own eyes, from your own perspective”). Participants imagined the event for 30 seconds after which they were asked a series of questions (based on Watkins & Moberly, 2009), asking them to focus on what they could see, hear, and feel (e.g. “What can you see?”, “What physical or bodily sensations do you feel?”). Following these questions, participants were instructed to continue imagining the event for another 30 seconds without speaking up aloud. In order to strengthen the induction of the desired mood, music was played during imagining the autobiographical memory and continued playing throughout the task. To induce positive mood we used Mike Oldfield’s “Music of the spheres” (track 2, 3, 5, and 6). To induce neutral mood we used Chopin’s “Waltzes Nos. 11 and 12”, which have been successfully used to induce neutral mood in previous studies (Heene, De Raedt, Buysse,

& Van Oost, 2007; Startup & Davey, 2001). In order to check the induction manipulation, positive and negative mood were assessed before and after the MIP with the Positive and Negative Affectivity Schedule (PANAS; Watson, Clark, & Tellegen, 1988). Participants were asked to rate the extent to which they felt a number of emotions at the present moment. Ratings were made on a 5-point Likert scale, ranging from 1 (very slightly or not at all) to 5 (extremely). The PANAS consists of 10 items in the Positive Activation (PA) subscale (active, alert, attentive, determined, enthusiastic, excited, inspired, interested, proud, strong) and 10 items in the Negative Activation (NA) subscale (afraid, ashamed, distressed, guilty, hostile, irritable, jittery, nervous, scared, upset).

Global-local Navon letter task. Participants completed a global-local Navon letter Task (Navon, 1977) to measure attentional breadth. The task was programmed using the E-PRIME 2 software package. All participants were seated at a distance of 30 cm from a 19” CRT-computer screen, using a chin rest to ensure correct positioning. Black stimuli were presented against a white background. On every trial, a black fixation cross was presented in the middle of the screen for 500 ms. Then, a target was presented in the middle of the screen and consisted of 1 of 8 global-local Navon figures (Navon, 1977). Participants were instructed to identify the target as fast and correct as possible. There were two targets, the letter T and the letter H. On each trial, one of these letters was presented, either as a local shape (e.g. the global letter L made up of little T’s) or as a global shape (e.g. the global letter H made up of little K’s). On each trial, participants had to indicate whether the target presented was a T or an H. Thus, a local trial is a trial in which the target was a local feature, whereas a global trial is a trial where the target was a global feature. The test phase contained 32 trials. All figures were written in upper-case letters in 18-point Times New Roman font. Global letters were either T’s composed of local F’s or L’s, or global H’s composed of local F’s or L’s. Participants were instructed to identify the T or H in the figure as fast and correct as possible. 50% of the trials were figures with a global target, 50% with a local target. The target remained on the screen until a response was made. Responses were made by pressing one of two keys on a standard AZERTY keyboard. The ITI was 3000 ms. Attentional breadth was assessed with the difference score between RTs on global versus local trials.

Procedure

The research protocol was approved by the local ethical committee. Written informed consent was obtained from all participants. Participants were randomized to receive either the positive or the neutral MIP. After informed consent, baseline levels of mood were measured with the PANAS. Following this, participants completed the positive or neutral MIP depending on condition and mood was measured again immediately afterwards. After the second mood rating, participants performed the experimental global-local Navon letter task which consisted of a practice phase of 8 trials followed by a test phase of 32 trials.

Results

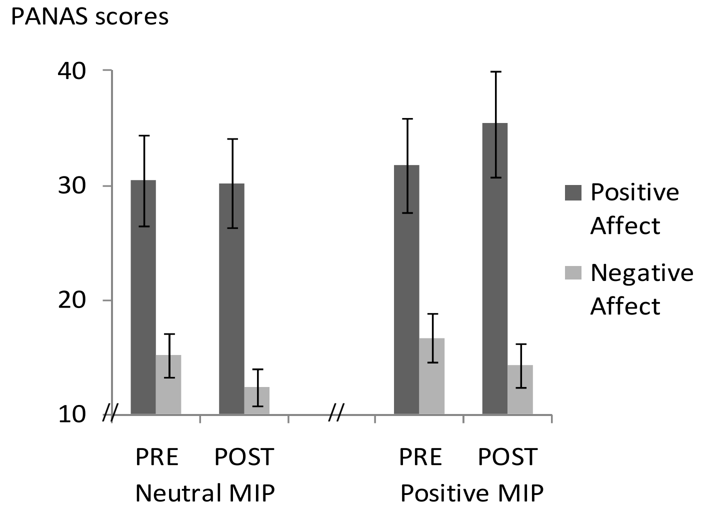
Data preparation

Results from one participant were excluded from the analyses because of general RTs deviating more than 2.5 SDs from the group mean. For RT data, trials with errors were discarded from analyses (< 3%). Furthermore, for each participant trials with RTs deviating more than 2.5 SDs from the participant's mean RT for that trial type were excluded (< 3%).

Mood induction

Scores on the PANAS showed that participants reported the expected change in mood following MIP (Figure 4). A 2 (mood induction condition: neutral, positive) x 2 (time: pre, post) repeated measures ANOVA yielded an interaction between mood condition and time point for positive affect, $F(1, 63) = 11.67$, $p < .001$, $\eta_p^2 = .16$, but not for negative affect, $F < 1$. The initial baseline positive affect score increased significantly after the positive MIP, $t(31) = 4.21$, $p < .001$, but not after the neutral MIP, $t(31) < 1$.

Figure 4. Means and SDs for positive and negative affect scores of the PANAS in Experiment 4 for the neutral and positive mood induction condition.



Attentional breadth

RT data were submitted to a 2 (trial type: global, local) x 2 (mood induction condition: positive, neutral) repeated measures ANOVA. A significant main effect of trial type, $F(1, 63) = 13.53$, $p < .001$, $\eta_p^2 = .18$, revealed that responses were faster on global trials ($M = 756$, $SD = 140$) than on local trials ($M = 816$, $SD = 134$) trials, which is typically found in this task (Gable & Harmon-Jones, 2012). There was a trend towards an interaction between mood condition and RTs on global versus local trials, $F(1, 63) = 3.68$, $p = .060$, $\eta_p^2 = .06$, though in the opposite direction. That is, global preference, as indexed by the difference score between local and global trials, tended to be higher in the neutral condition, indicating that participants in the neutral condition displayed a broader attentional scope compared to participants in the positive mood condition. There was no main effect of mood condition, $F < 1$. Means and SDs can be found in Table 5.

Proportion error rates were submitted to a 2 (trial type: global, local) x 2 (mood induction condition: positive, neutral) repeated measures ANOVA. Results revealed no mood effects on error rates. There were no main effects of trial type nor mood induction condition, both *F*s < 1. Also, no interaction between mood induction condition and trial type was found, $F(1, 63) = 1.58$, $p > .05$.

Table 5. Mean reaction times for global-local conditions in the global-local Navon letter task for the neutral and positive mood induction condition in Experiment 4 (*N* = 65).

	Positive			Neutral		
	M	SD	ER: M	M	SD	ER: M
Global trials RTs (ms)	779	162	.03	733	111	.03
Local trials RTs (ms)	807	149	.04	825	119	.02
Global preference (ms)	29	117	.03	92	145	.03

Note: ER = proportion error rates

Discussion

In Experiment 4, we examined whether positive mood would broaden focal attention in a global-local Navon letter task, another commonly used measure of attentional breadth. Surprisingly, results indicated that a positive mood state did not result in a heightened preference for global information, but in contrast, tended to induce a lowered global preference compared with the neutral mood induction condition. One possible explanation could be that a more positive mood state facilitates cognitive flexibility to switch from one trial type to another, rather than inducing a broader attentional scope. Furthermore, it is also possible that the positive mood induction procedure, which consisted of imaging a positive autobiographical memory, elicited positive affect that was high in approach motivational intensity which can decrease global attentional focus (Gable & Harmon-Jones, 2008).

GENERAL DISCUSSION

In a series of four experiments using different paradigms and mood induction procedures, performed in two different labs, we could not find any evidence for an attentional broadening effect, caused by positive mood. These results are important for future theorizing on the role of mood on attentional processes. Although some work has found evidence for attentional broadening by positive mood states (Rowe et al., 2007), more recent papers are now suggesting that these effects cannot always be observed but are restricted to certain conditions. Although recent studies have provided qualified conclusions regarding initially reported effects of mood on the global-local task (i.e. Gasper & Clore, 2002; Fredrickson & Branigan, 2005; qualified by Gasper, 2004; Huntsinger et al., 2010; Johnson et al., 2010), no such qualifications have been reported so far for the effect of positive mood on the flanker task, as described by Rowe et al. (2007). Here we have demonstrated for the first time, that mood does not consistently influence flanker task performance, even with a task identical to that used by Rowe et al. (2007). Selective attention was also not found to be modulated in the ANT, which is consistent with earlier findings (Finucane et al., 2010; Moriya & Tanno, 2009). Moreover, positive affect tended to result in a narrowed attentional focus as measured with the global-local Navon letter task, compared with a neutral mood condition.

As these are essentially null-findings of the hypothesized attentional broadening function of positive mood, it is important to consider the reliability of the present findings. There are several features of the present experiments that attest to this issue. First, the null-finding generalized across various MIPs, one comparable to that used by Rowe et al. (2007) and three other well-established and often-employed MIPs. Each of the MIPs was successful as indicated by changes in mood ratings. Second, all four of the present experiments showed reliable basic effects and the first two experiments were able to reproduce the known modulation of the flanker effects through spacing. Finally, the null-findings obtained in Experiment 1 and 2 generalized to another well-validated measure of selective attention, the ANT. Moreover, in Experiment 4, positive mood as elicited after imaging a positive autobiographical memory tended to narrow the attentional scope.

Another important issue to consider is statistical power. Although the sample sizes of the individual experiments were comparable to those reported in previous work, they were not large. If we assume an effect size of $d = .2$ (a small effect according to the conventions of Cohen, 1988), the power to detect an interaction of mood and flanker interference was .49 in Experiment 1, .50 in Experiment 2, .42 in Experiment 3 and .36 in Experiment 4. The corresponding power when a medium effect is assumed ($d = .5$) amounts to .99, 1.00, and .99, .98 respectively. Thus, it remains possible that our study lacked statistical power to capture the effect of positive mood on selective attention.

Thus, taken together, the present null-finding of the attentional broadening effect of positive mood appears reliable and it is important to consider the theoretical implications of this finding for empirical research and theoretical models of the relationship between positive affect and attention. First, it is becoming increasingly clear that the effects of positive mood on attention are dependent on several mediating processes. One of these processes is motivational salience of positive information as only positive information low in approach motivation seems to broaden the attentional scope (Gable & Harmon-Jones, 2008, 2010a). This might explain the result of Experiment 4 where positive mood tended to induce a narrowed attentional scope. However, given that in Experiment 1, 2 and 3, the MIPs were low in approach motivation, other factors seem to be at play as well.

Furthermore, in Experiment 4 we examined whether differences between studies on mood-induced attentional broadening could be due to task-relevance of peripheral spatial information. Whereas in Experiment 1, 2 and 3, the flankers were truly task-irrelevant, the nominally irrelevant information is more integrated with the task-relevant information in the global-local Navon letter task as used in Experiment 4. However, our results indicated that the positive mood condition tended to display a more narrowed attentional focus compared to the neutral mood condition. Therefore, it is possible that our positive MIP that consisted imaging a positive autobiographical memory could have elicited a positive mood state that is high in approach motivation and thus constricts the attentional focus. Future research should therefore not only consider whether mood is high or low in approach motivation, but also take into account the importance of applying a broad versus narrow attentional window for the task at hand.

At a theoretical level, the present findings are not in line with theories predicting that positive affect is associated with a broadening of attention (Fredrickson, 1998). On the one hand, our present findings do not rule out that positive affect can serve an important role in broadening attention in principle (e.g. Fredrickson & Branigan, 2005; Gable & Harmon-Jones, 2010a). On the other hand, however, it seems clear that the influence of positive mood on attention is mediated by additional, insufficiently understood processes that require further study. This seems particularly important as the broadening function of positive mood is considered crucial in explaining the association between positive mood and higher-level processes such as creativity (Baas, De Dreu, & Nijstad, 2008), stress resilience (Fredrickson, 2001), and health (Burton & King, 2009).

There are several limitations of our study that deserve some consideration. First, most of the MIPs used here are known to have only a brief effect on affect. It is therefore possible that mood induction was effective during parts of the task only and that this explains why positive mood failed to influence visual attention. However, the same mood-induction techniques were used in most of the studies that reported reliable effects of positive mood induction on attention. Moreover, we have used different MIPs in an attempt to create situations with ecologically valid strong positive affect. Thus, despite the possibility of short-term effects of positive mood, the discrepant findings between the current and previous studies require an explanation.

In sum, in four experiments we consistently failed to replicate previous findings suggesting that positive affect broadens spatial attention. These null-findings suggest a not-yet-understood, mediating role of additional factors and, thus, call for further research on the interaction between positive affect and visual attention.

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CHAPTER 2

A FLEXIBLE IMPACT OF POSITIVE MOOD ON ATTENTIONAL SCOPE[1]

ABSTRACT

Although a large literature claimed a straightforward impact of affect on the visual attentional scope, current theorizing in emotion science suggests that this link is more flexible than initially thought. Inspired by the Affect-as-Information model, research by Huntsinger (2012) convincingly showed that affect merely influences whether people do or do not act according to the momentarily dominant tendency to focus broadly or narrowly. To clarify whether positive affect indeed reinforces the dominant focus, in the current study we examined the effects of positive affect in comparison with a neutral mood condition. Selective attention was measured using a flanker task with different distractor eccentricity conditions to allow a more fine-grained analysis of selective attention. The expected interaction between the primed perceptual focus and mood was found in the flanker condition with the highest flanker eccentricity supporting the idea that affect flexibly determines the attentional scope in interaction with the currently accessible attentional orientation. However, the interaction between perceptual priming and mood condition was not found in flanker conditions with lower flanker eccentricity. In the most difficult condition without spacing between the flankers, positive mood was related to the commonly found broadening effect on selective attention. These results indicate that positive mood can regulate perception by providing experiential feedback about the value of the currently accessible processing focus rather than directly leading to a broadened attentional scope, but that other moderating variables may also play a role.

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INTRODUCTION

In the last five decades, theorists extensively argued that emotions have potent interactions with cognition, shaping thoughts and actions (for reviews, see Dolan, 2002; Pessoa, 2008; Phelps, 2006). Positive emotions have been linked to a more creative and generative mindset, and have been hypothesized to broaden one's thought-action repertoire, increasing the flexibility of cognition and its scope (Ashby, Isen, & Turken, 1999; Fredrickson, 2004; Rowe, Hirsh, & Anderson, 2007). By contrast, negative states are thought to induce a more fixed and narrow mindset (Derryberry & Tucker, 1994; Easterbrook, 1959). This distinction between flexible/broad versus rigid/narrow thinking styles associated with positive and negative states, has been found across diverse experimental contexts, including intuitive judgments (e.g. Balas, Sweklej, Pochwatko, & Godlewska, 2012), decision making (e.g. Cassotti et al., 2012), creativity (for a review, see Baas, De Dreu, & Nijstad, 2008), stress resilience (Fredrickson & Levenson, 1998), and health (Burton & King, 2009).

Besides the influence on higher conceptual levels of processing, affective states are also claimed to influence processes at the perceptual level (Fenske & Eastwood, 2003; Gable & Harmon-Jones, 2008; Gasper & Clore, 2002; Rowe et al., 2007). Mood may also influence the allocation of visuospatial attention to the external environment, shaping the initial process of perceptual encoding. In line with the effects on higher-level cognition, it has been hypothesized that the valence of affective states also interacts with lower-level perceptual encoding in an opposing manner (e.g. Derryberry & Tucker, 1994; Rowe et al., 2007) with positive affect broadening and negative affect narrowing attention. Positive versus negative mood is associated with greater global or holistic processing (i.e., seeing the forest before the trees) versus local processing (i.e., seeing the trees before the forest) (e.g. Basso, Schefft, Ris, & Dember, 1996; Gasper & Clore, 2002). A range of studies have been consistent with these hypotheses. For example, Fredrickson and Branigan (2005) found that positive emotions broaden the scope of attention by showing global bias. In their study, temporary states of emotions (amusement, contentment, neutrality, anger and anxiety) were induced by showing movies followed by the identification of hierarchical stimuli (e.g. a set of small triangles arranged in the shape of a square). They found that relative to a neutral affective state, a positive state engendered a tendency to categorize composite visual figures on the basis of their global form as opposed to their local components. Relatedly, Rowe et al. (2007)

found that happy moods impaired the ability to selectively respond to a centrally presented target stimulus surrounded by response-incompatible distractor stimuli. This suggests that positive emotions expand the breadth of visual selective attention. In contrast to the broadening effect of positive emotions, studies also showed that negative emotions narrow the attentional scope. For example, Basso et al. (1996) found that positive mood and optimism were directly associated with a global bias and inversely related to a local bias. A converse pattern of findings was obtained with depression and trait anxiety.

Although a large literature claimed a direct impact of mood states on the visual attentional scope, recently there are indications that this relationship is more complex than initially thought. It is argued that, rather than a genuine change in the scope of perceptual encoding, these extensively published behavioral results that are confirming the relationship between positive emotions and the breadth of attention may originate in higher-level cognitive biases, where moods may increase or decrease access to what is in mind during the task at hand. This idea comes from the Affect-as-Information model which states that affect serves as an informative function that signals the value of whatever mode of processing is currently dominant or accessible in a perceiver’s mind (Clore & Huntsinger, 2007, 2009; Clore & Palmer, 2009; Huntsinger, Clore, & Bar-Anan, 2010; Martin, Ward, Achee, & Wyer, 1993). From this perspective, happy moods confer positive value on the dominant mode of processing, thereby promoting its use, whereas sad moods confer negative value on this mode of processing, thereby inhibiting its use. Inspired by this idea, it has been proposed that cues associated with happiness serve as a “go” signal that facilitates the use of currently accessible information, whereas cues associated with sadness serve as a “stop” signal that inhibits the use of this information (Clore & Huntsinger, 2007, 2009; Clore & Palmer, 2009). Thus, in the case of global precedence, positive affect will further accentuate a bias towards global configurations, while negative affect will inhibit global configuration bias. Thus, if the influence of affect depends on the context, the relationship between affect and breadth of attention can be easily changed by altering the currently dominant processing style.

Evidence for this flexible link between affect and attentional breadth is shown in a recent study by Huntsinger (2012). In this study, participants first completed a perceptual priming manipulation in which a global or local focus was primed using a variant of the global-local Navon letter task (Navon, 1977). In this task, participants are presented with typical Navon stimuli, which consist of a global letter that is made up of smaller letters (e.g. a global H, made of small F's). In the commonly used Navon letter task, participants have to identify target letters which can either be the global or local configuration. To prime perceptual focus in the Huntsinger (2012) study, participants in the global-priming condition were only presented with global-letter targets, whereas participants in the local-priming condition were only presented with local-letter targets. In addition, he included a condition in which no focus was made dominant (or both perceptual orientations were primed equally). After the perceptual priming task, participants underwent a positive or negative mood induction after which they completed a flanker task as a measure of selective attention. Results showed that when a global focus was primed, people in happy moods displayed a broadened focus, whereas those in negative moods displayed a narrowed focus. In contrast, when a local focus was primed, people in happy moods displayed a narrowed focus, whereas those in negative moods displayed a broadened focus. In addition, when no focus was made dominant, no link between affect and attentional scope could be found. Thus, the link between affect and attentional focus reflected which focus was active. Furthermore, it was found that this link between affect and attentional focus vanished when no focus was made dominant. These results suggest that the relationship between affect and attentional breadth is not fixed but flexible and can easily be changed by altering the currently accessible processing focus.

Furthermore, Huntsinger (2012) proposes an explanation why a large literature associated happy moods with a broadened attentional focus. He noted that, as Navon (1977) already demonstrated decades ago, people have a default tendency to perceive and rely upon global information rather than local information and that this tendency to adopt a global focus is often reinforced in experimental contexts (Clore & Huntsinger, 2007). Thus, in past research, positive and negative mood could have conferred positive and negative value on the usually dominant global attentional set, leading to a fixed effect of affect on the breadth of attention. Thus, a positive mood reinforced the use of the default global attentional set while a negative mood state, by conferring negative value about this default state, invalidated the global default mode resulting in adopting the opposite attentional focus (Huntsinger, 2012). Although global processing may be the dominant mode most of the time, it is also assumed that both global and local processing modes are constantly active and can be switched easily (Isbell, 2010). Thus, it should be easy to reverse the mood and processing effects by altering the currently global or local processing mode.

These findings are highly important for theories on affect and attention. However, an important limitation of the Huntsinger (2012) study was the lack of a neutral mood control condition. This condition is necessary to determine whether global-local priming manipulation would also affect attentional breadth in the absence of happy and sad moods or whether the effects are only occurring for happy or sad mood. Past research is not conclusive on whether the effects of mood on attentional breadth are driven by positive mood enhancing the breadth of attention, negative mood narrowing the focus of attention, or both mood states causing opposite effects. In some studies, negative mood led to a narrowing of attention compared with positive and neutral moods, which did not cause differential effects on attentional breadth (e.g. Gasper & Clore, 2002). In contrast, other researchers found that positive mood led to broadened attention compared with negative and neutral moods, but these latter two conditions did not differ (e.g. Rowe et al., 2007).

The current study aimed to replicate and extend the findings of Huntsinger (2012). First, in the current study, we examined the specific effects of a positive mood in comparison with a neutral mood condition. If positive mood indeed reinforces the dominant perceptual focus, the effect should also be found when compared with a neutral mood condition. According to the Affect-as-Information model, neutral mood states do not provide experiential information about the value of the attentional set that is active at the moment. Thus, a neutral mood state would not reinforce, but also not inhibit the currently active processing mode. If positive mood states indeed confer positive value that reinforces the dominant processing mode while neutral moods do not affect the dominant mode, we predict that after global or local priming induction, positive as compared with neutral mood states would alter selective attention differently. That is, after a global focus induction, a positive mood would result in a more broadened attentional focus compared with a neutral mood. In contrast, after local perceptual priming, positive mood would result in a more narrowed attentional focus compared with neutral mood.

Second, as selective attention is associated with the inhibitory filtering of task-irrelevant stimuli (Friedman & Miyake, 2004), increased/decreased attentional breadth would be reflected in an increased/decreased capacity to inhibit processing of spatially adjacent irrelevant information. Similar as (Huntsinger (2012)), we measured selective attention using a flanker task (Eriksen & Eriksen, 1974). This paradigm is well suited for testing how well attention is restricted to a particular object or location. In flanker tasks, participants are instructed to make judgments about a target stimulus and to ignore other stimuli that flank the target. Despite instructions to ignore the flankers, response times to the target are typically found to vary with the type of flanker. Reaction times are significantly shorter with compatible flankers than with incompatible flankers. This pattern of results is referred to as the flanker compatibility effect (FCE). Also, the magnitude of the FCE has been shown to depend on differences between targets and flankers in their relative physical characteristics such as spatial proximity (Rowe et al., 2007). That is, as flanker eccentricity increases, flanker compatibility effects typically decrease. Thus, a broadened attentional focus should enhance perceptual encoding of irrelevant flankers, thereby impairing performance, whereas a narrowed attentional focus would diminish such encoding, improving performance. However, in the Huntsinger (2012) study, using a flanker task with two different flanker distance conditions, flanker distance did not qualify the results, whereas Rowe et al. (2007) did show differential effects of flanker distance, using a flanker task with three flanker distance conditions. Therefore, the present study systematically manipulated flanker eccentricity to allow a more fine-grained analysis of the influence of the perceptual focus and mood state on selective attention by examining selective attention with a flanker task including close, medium and far spacing between the stimuli (cfr. Rowe et al., 2007).

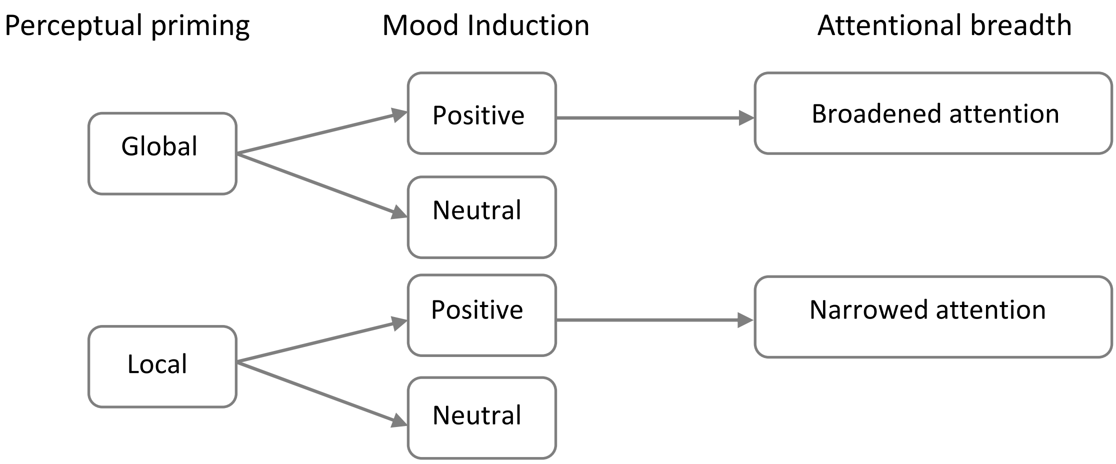
Hence, in our replication and extension study of Huntsinger (2012) we expected that when a global focus was primed, a positive compared with a neutral mood state would result in more pronounced interference effects, especially in flanker conditions with higher flanker eccentricity. In contrast, when a local focus was primed, we expected that positive mood would result in a narrowed attentional scope, reflected in lower interference effects, especially in flanker conditions with higher flanker eccentricity.

METHOD

Participants

Seventy undergraduate students completed the experiment in exchange for monetary reward. One participant was excluded because of responding on chance level on the flanker task. Another two participants were excluded because their mean reaction time (RT) on the flanker task deviated more than 2.5 SDs from the group mean. Mean age of the remaining 67 participants was 21.70 (*SD* = 2.50). Most participants (60) were female. There was random assignment to the four experimental conditions: global perceptual priming followed by neutral mood induction, global perceptual priming followed by positive mood induction, local perceptual priming followed by neutral mood induction, and local perceptual priming followed by positive mood induction. An overview of all experimental conditions is presented in Figure 1.

Figure 1. Overview of the research design, hypotheses, and experimental conditions (*N* = 67).



Materials

Global-local priming. Similar to Huntsinger (2012), a variant of the global-local Navon letter task (Navon, 1977) was used to prime perceptual focus. This task was programmed using the E-prime 2 software package (Psychology Software Tools, Inc., 2001). All participants were seated at a distance of 30 cm from a 19" CRT-computer screen, using a chin rest to ensure correct positioning. Black stimuli were presented against a white background. On every trial, a black fixation cross was presented in the middle of the screen for 500 ms. Then, a global-local Navon stimulus (Navon, 1977) was presented in the middle of the screen. This stimulus consisted of a large letter composed of smaller letters (five closely spaced local letters on each vertical or horizontal line of the global letter). There were two targets, the letter T and the letter H. On each trial, one of these letters was presented, either as a local shape in the local-priming condition (e.g. the global letter L made up of little T's) or as a global shape in the global-priming condition (e.g. the global letter H made up of little K's). On each trial, participants had to indicate whether the target presented was a T or an H. All figures were written in upper-case letters in 18-point Times New Roman font. Global letters were either T's composed of local F's or L's, or global H's composed of local F's or L's. Participants were instructed to identify the T of H in the figure as fast and correct as possible. Responses were made by pressing one of two keys on a standard AZERTY keyboard. The intertrial interval was 300 ms. In the global-priming condition, all 80 trials had global-letter targets, whereas in the local-priming condition all 80 trials had local-letter targets. See Figure 2 for stimulus examples.

Figure 2. Stimulus examples of the global-local priming task in the (a) local priming and (b) global priming condition.

```
(a)   T T T T T     (b)   F F F F F
      T                       F
      T T T T T               F
      T                       F
      T                       F
```

Mood manipulation. Mood was manipulated via 2-minute film clips. Participants in the positive mood condition watched a film clip of a laughing baby sitting in a couch, a popular amusement clip on you tube. Participants in the neutral mood group watched a 2-minute screen saver clip showing abstract shapes. This neutral film clip has shown to elicit neutral emotions (Gross & Levenson, 1995). As mood manipulation check, before and after the mood induction procedure (MIP), participants indicated how happy, sad and aroused they felt on 3 visual analogue scales (VASs). These VASs consisted of 100 mm horizontal lines that anchored from 'neutral' at the left (0 mm) to 'as happy/sad/aroused as I can imagine' at the right (100 mm). They were instructed to mark the position on the lines that reflected how they felt at the current moment.

Flanker task. The flanker task (Rowe et al., 2007) was used to measure attentional breadth. The flanker task was programmed in the E-prime 2 software package (Psychology Software Tools, Inc., 2001). The experiment was run on a desktop computer with a 60 Hz, 19-inch colour monitor. The spaced flanker task was programmed according to the specifications of Rowe et al. (2007). All stimuli were black, presented against a white background. Target stimuli and flankers were the letters N and H. All letters were capitals, presented in 18-point Courier New. On every trial, a fixation arrow (^) was presented in the middle of the screen. Imperative stimuli consisted of 5 letters, a target letter (N or H) flanked on both sides by the same pair of two identical letters (NN or HH). Spacing between the letters was manipulated, divided equally between near, medium, and far distances (0, 1 or 2 letter width). Responses were made by pressing one of two keys (target N: "s," target H: "h") with the left and right finger on an AZERTY keyboard. After reading the task instructions, participants completed one block of 108 randomly presented trials. The intertrial interval varied between 500, 600, 700 and 800 ms.

Self-report measurements. Because attentional breadth is not only thought to be influenced by the current mood state, but also by more dispositional or chronic mood characteristics (Basso et al., 1996), participants completed self-report questionnaires to ensure that any between-group differences in attentional breadth as measured with the flanker task were not due to pre-existing differences trait characteristics. We therefore assessed depression scores with the Beck Depression Inventory (BDI-II; Beck, Steer, & Brown, 1996), and positive and negative affect with the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988).

Procedure

At the beginning of the experiment, informed consent was explained and acquired. Then, participants performed the global-local focus priming task, to induce either a local or global attentional set. After the attentional priming task, participants rated their current mood state on three VASs. Then, participants watched one of two 2-minute film clips and were asked to watch the film clip in its entirety. Immediately after the MIP, participants rated their mood again with the same VASs. Following this manipulation check, they performed the flanker task. Finally, participants completed self-report questionnaires concerning depression, and positive and negative affect.

RESULTS

Participant characteristics

Table 1 presents mean scores and standard deviations (SDs) on all questionnaires for participants assigned to each of the priming and mood conditions. Mean age and gender ratio did not differ between conditions, $F < 1$, $\chi^2 < 1$, respectively. Depression scores (BDI-II) did not differ between the two priming conditions, $F < 1$, nor between the two mood conditions, $F(1, 63) = 1.86$, $p = .178$, $\eta_p^2 = .03$, nor between the four experimental groups (2 (perceptual priming: global, local) x 2 (mood induction: neutral, positive), $F < 1$. Furthermore, trait negative affect scores (PANAS) did not differ between the two priming conditions, nor between the two mood conditions, both *F*s < 1, and nor between the four experimental groups, $F < 1$. Trait positive affect scores (PANAS) did not differ between the two priming conditions, nor between the two mood conditions, both $F < 1$, but tended to differ between the four experimental groups, $F(1, 63) = 2.92$, $p = .092$, $\eta_p^2 = .04$. In order to control for pre-existing differences in trait positive affect between the experimental conditions, this variable was added as a covariate in further analyses.

Table 1. Participant characteristics. Means (M) and standard deviations (SD) for all questionnaire data for global and local perceptual priming and positive and neutral mood conditions (*N* = 67).

Priming condition	Global		Local	
Mood condition	Neutral	Positive	Neutral	Positive
N	16	18	17	16
Gender, F/M	15/1	15/3	15/2	15/1
Age, M (SD)	21.94 (3.34)	22.33 (2.59)	21.65 (2.09)	20.81 (1.68)
BDI, M (SD)	6.13 (6.44)	4.50 (5.32)	7.18 (6.99)	4.88 (4.46)
PA trait *, M (SD)	34.56 (6.81)	33.06 (5.12)	32.88 (7.03)	36.31 (4.21)
NA trait, M (SD)	17.25 (5.93)	14.72 (5.18)	17.24 (5.97)	17.19 (4.04)

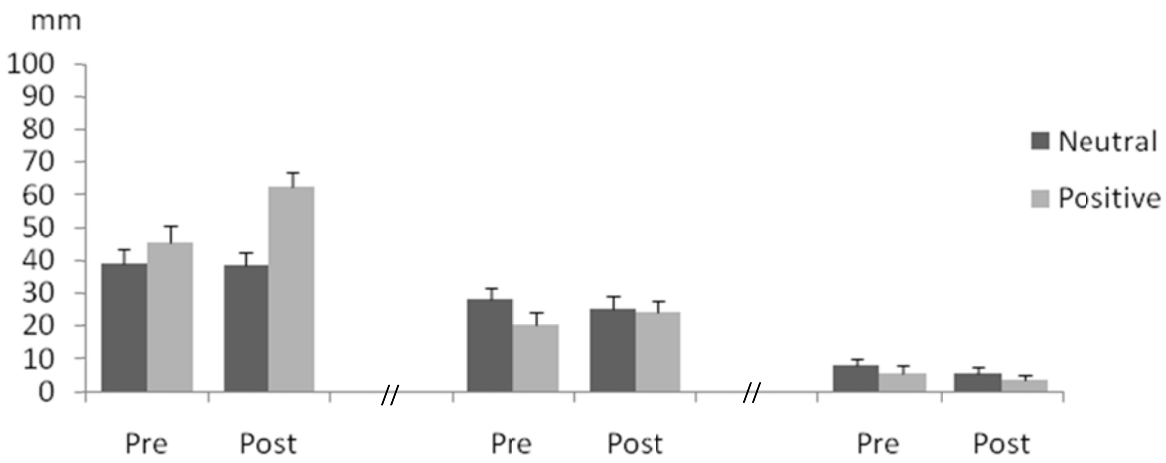
Note. BDI = Beck Depression Inventory-II (Beck et al., 1996); PA trait & NA = Positive And Negative Affect Schedule (Watson et al., 1988). *Perceptual priming x mood condition, $F(1, 63) = 2.92$, $p = .092$, $\eta_p^2 = .04$.

Mood manipulation

Before and after the MIP, participants rated their mood state on a happy, arousal, and sad VAS. Because perceptual priming might influence affect (Srinivasan & Hanif, 2010), we submitted scores of the three VASs before the MIP to separate univariate ANOVAs with perceptual priming (global, local) as between factor. Results revealed no differences between the perceptual priming conditions for happy, arousal, both $F < 1$, nor sad mood, $F(1, 65) = 2.72$, $p = .104$, $\eta_p^2 = .04$, before the MIP. Furthermore, mood groups did not differ on the happy, $t(65) = 1.10$, $p = .271$, arousal, $t(65) = 1.72$, $p = .090$, and sad, $t(65) = 1.13$, $p = .264$, VASs before MIPs. To check whether the mood inductions were effective, data of the three VASs were submitted to three separate 2 (time: pre, post MIP) x 2 (mood manipulation condition: neutral, positive) mixed ANOVAs, with trait positive affect as covariate. As expected, the interaction between time and mood manipulation condition showed that scores on the happy VAS significantly depended on MIP, $F(1, 64) = 41.67$, $p < .001$, $\eta_p^2 = .39$, revealing that participants in the positive mood manipulation condition displayed more happy feelings ($M = 62.82$, $SD = 21.42$) after the MIP compared to participants in the neutral condition ($M = 38.24$, $SD = 27.28$), $t(65) = 4.11$, $p < .001$. Results of the arousal VAS showed a marginally significant interaction between time and mood condition, $F(1, 64) = 3.32$, $p =$

.073, η_p^2= .05. Further analysis showed that arousal ratings after MIP did not differ between mood conditions, $F < 1$. Results of the sad VAS showed a main effect of time, $F(1, 64) = 7.48$, $p = .008$, η_p^2= .11, revealing that sad mood was higher before (M = 7.18, SD = 14.58) compared with after (M = 5.49, SD = 11.70) MIPs. No other effects were significant. See Figure 3 for mean scores and SDs on the happy, arousal, and sad VASs for both mood manipulation conditions.

Figure 3. Mean scores and SDs on the happy, arousal, and sad visual analogue scales (VASs) on a 100 mm horizontal line (ranging from ‘0 = neutral’ to ‘100 = as happy/aroused/sad as I can imagine’) before (Pre) and after (Post) neutral and positive mood manipulation conditions (MIP). Error bars indicate + 1 standard error of the mean.



Effects of perceptual priming and mood on attentional breadth

For RT data, trials with errors were discarded from analyses (< 14%). Furthermore, for each participant trials with RTs deviating more than 2.5 SDs from the participant’s mean RT for that trial type were excluded (< 2%). There were no significant main or interactive effects of mood and prime on overall RTs or error rates on the flanker task. To simplify analyses, a Flanker Compatibility Effect score (FCE) was created (incompatible RT – compatible RT). A higher FCE score reflects a higher impact of the to-be-ignored flankers, and thus a broadened attentional focus. Mean RTs and SDs can be found in Table 2.

RT data were submitted to a 3 (FCE with 3 distances: FCE close, FCE medium, FCE far) x 2 (perceptual priming: global, local) x 2 (mood induction: neutral, positive) mixed ANCOVA, with trait positive affect as covariate. Results revealed a significant main effect of spacing, $F(2, 61) = 5.01$, $p = .010$, $\eta_p^2 = .14$, with higher FCE scores in close trials ($M = 46.77$, $SD = 30.86$) than in medium ($M = 28.77$, $SD = 28.20$) or far trials ($M = 21.36$, $SD = 24.82$). Furthermore, a significant interaction effect between FCEs with different distances and mood induction, $F(2, 61) = 3.76$, $p = .029$, $\eta_p^2 = .11$, was found. Crucially, the three-way interaction effect between FCE at different distances, perceptual priming and mood induction was significant, $F(2, 61) = 3.33$, $p = .043$, $\eta_p^2 = .10$ (Figure 4). To clarify these interaction effects, separate analyses with the FCEs for each of the three distances were conducted.

Results for the *close distance* revealed a main effect of mood induction, $F(1, 62) = 4.30$, $p = .042$, $\eta_p^2 = .07$, with participants in the positive mood condition showing a higher FCE ($M = 54.44$, $SD = 32.23$) compared with the neutral mood condition ($M = 38.83$, $SD = 29.25$). However, the expected interaction between perceptual priming and mood induction was not significant, $F(1, 62) < 1$.

Results for the FCE at *medium distance* revealed no main effect of perceptual priming condition, $F(1, 62) = 1.24$, $p = .270$, $\eta_p^2 = .02$, nor main affect of mood condition, $F(1, 62) = 2.49$, $p = .119$, $\eta_p^2 = .04$. The expected interaction between priming and mood condition was not significant, $F(1, 62) < 1$.

Finally, results for the FCE at *far distance* revealed no main effect of priming condition, $F(1, 62) = 1.77$, $p = .188$, $\eta_p^2 = .03$, nor main effect of mood condition, $F(1, 62) < 1$. The expected interaction between perceptual priming and mood condition was significant, $F(1, 62) = 6.68$, $p = .012$, $\eta_p^2 = .10$, revealing that effects of mood condition on FCE with far distances between the letters, depended on perceptual priming condition. In line with the hypothesis, after global perceptual priming, participants in the positive mood condition revealed a higher FCE ($M = 32.21$, $SD = 25.59$) compared to the neutral mood condition ($M = 16.82$, $SD = 35.63$). After the local perceptual priming, this pattern was reversed, with participants in the positive mood condition showing a smaller FCE ($M = 12.03$, $SD = 17.03$) compared with participants in the neutral mood condition ($M = 22.91$, $SD = 11.90$).

Figure 4. Flanker Compatibility Effects (FCE) (ms) for three flanker eccentricity conditions (close, medium, far) in the flanker task as a function of mood conditions when a global or local perceptual focus was primed. Error bars indicate + 1 standard error of the mean.

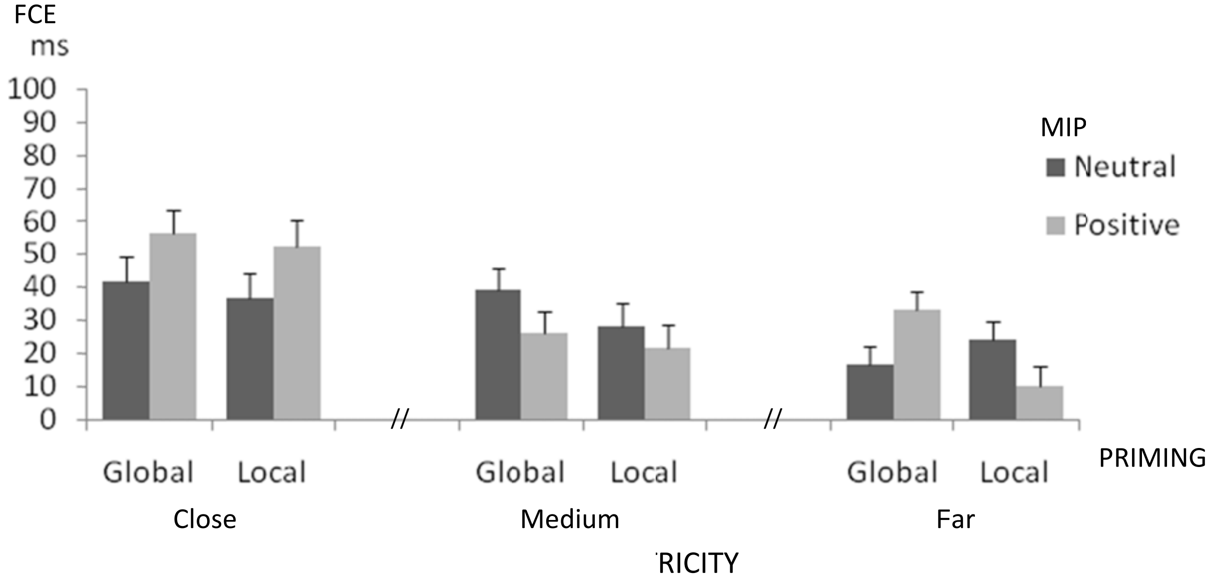


Table 2. Mean reaction times (M), standard deviations (SD), and Flanker Compatibility Effects (FCE) (ms) for the three flanker eccentricity conditions (close, medium, far) in the flanker task as a function of mood conditions when a global or local perceptual focus was primed.

Priming condition	Global		Local	
Mood condition	Neutral	Positive	Neutral	Positive
	M (SD)	M (SD)	M (SD)	M (SD)
Close				
Compatible	441 (36)	442 (42)	424 (40)	426 (43)
Incompatible	483 (53)	499 (40)	461 (45)	478 (56)
Medium				
Compatible	414 (30)	425 (40)	402 (43)	426 (42)
Incompatible	454 (50)	451 (39)	432 (43)	447 (52)
Far				
Compatible	414 (39)	425 (41)	406 (45)	421 (43)
Incompatible	430 (37)	457 (43)	429 (49)	433 (43)
FCE				
Close	42 (34)	57 (28)	36 (25)	52 (34)
Medium	40 (30)	26 (29	29 (23)	20 (29)
Far	17 (36)	32 (26)	23 (12)	12 (17)

DISCUSSION

Inspired by the Affect-as-information model which suggests that affect serves an informative function that signals the value of the currently available processing mode, Huntsinger (2012) showed that the link between affect and attentional focus reflects the focus that is momentarily dominant. In this research, the momentary dominance of either a broad or narrow orientation was manipulated. He showed that when a global focus was made dominant, a positive mood resulted in a broadened attentional focus while a negative mood resulted in a narrowed focus. Moreover, this pattern reversed when a local focus was primed: a positive mood then resulted in a narrowed focus while a negative mood resulted in a broader focus. Also, when no focus was made dominant, the link between affect and attentional breadth vanished (Huntsinger, 2012). Thus, these results provide evidence that positive and negative affect confer positive or negative value on the dominant perceptual orientation to focus broadly or narrowly.

However, it was not clear whether these findings could be explained by both positive or negative mood conditions, or whether the effects were only driven by one of the mood conditions. If positive affect indeed reinforces the momentarily accessible focus, this effect should also be present when compared with a neutral focus. A neutral mood should confer neutral value to the dominant processing mode, thus not reinforcing nor inhibiting it. Hence, the current study aimed to clarify the specific effects of positive affect in function of the perceptual scope on selective attention by comparing a positive with a neutral mood condition. Furthermore, selective attention was measured using a flanker task with different distractor eccentricity conditions to allow a more fine-grained analysis of selective attention. We hypothesized that a broadened attentional focus would be reflected in higher flanker compatibility effects, especially in conditions with higher flanker eccentricity, compared with a narrowed attentional focus.

The results of the current study indeed replicated and extended the findings of Huntsinger (2012). The expected interaction between the primed perceptual focus and mood condition was found in the flanker condition with the highest flanker eccentricity. When a global perceptual focus was primed, participants in a positive mood displayed a broadened attentional focus, as reflected by higher flanker compatibility effects, compared with participants in a neutral mood. In contrast, when a local focus was primed, participants in the positive mood condition exhibited a narrowed attentional focus, as reflected by lower flanker compatibility effects, compared with participants in the neutral mood condition.

However, the interaction between priming and mood condition was not found in flanker conditions with lower flanker eccentricity. Surprisingly, current mood seemed to have an influence on the flanker compatibility effect in the flanker condition with the smallest eccentricity, regardless of perceptual priming. In this condition, participants in a positive mood showed a higher flanker compatibility effect compared with participants in the neutral mood condition, indicating a broadened scope in happy participants. There were no effects of mood or priming for the flanker condition with medium flanker eccentricity. These results suggest that other moderating variables may interact with the flexible link between affect and attention. For instance, since the condition with the closest flanker eccentricity seems more difficult than the further ones (main effect of distance between flankers), it is possible that this condition is too difficult to benefit from the primed perceptual focus. It could also be that although a local focus was primed, this spatial focus was still too broad to be beneficial for the selective attention task obscuring interaction effects with perceptual priming condition.

Nevertheless, the present findings lend support for the idea that affect does not have a direct and static influence on attentional scope but determines the attentional scope in interaction with other factors such as the dominant accessible focus. The finding that positive affect acts as a go signal is in line with the idea of affect-as-input where positive affect acts as positive feedback signals to maintain the current focus. It is interesting that compared with the basic idea that affect directly influences attentional scope, there now emerges data showing that attentional scope is determined by other variables. Recently, it has been proposed (Forster & Dannenberg, 2010; Isbell, 2010) that affect is not the "psychological glue" that unites all of the moderating variables of global-local processing. For instance, the influential theory about the role of motivation (approach vs. withdrawal) proposes that affective states with the same valence can have opposite effects on information processing. Gable and Harmon-Jones (2008, 2010a, 2010b) showed that positive as well as negative affect that is low in motivational intensity broadens, whereas affect high in motivational intensity narrows cognitive processes.

In the current study we were able to replicate and extend the specific effects of positive affect by comparing a positive with a neutral mood condition clarifying that the findings obtained by Huntsinger (2012) are not only driven by the negative mood condition. One could argue that although a valid mood induction procedure to induce a neutral mood state was used (Gross & Levenson, 1995), a neutral mood induction can also be perceived as negative as it aims to change people's default positive baseline mood in to a more neutral mood state. Research has shown that this drop from a positive baseline mood to a more neutral mood state is indeed not always experienced as a neutral mood, but rather as negative (Storbeck & Clore, 2008, 2011). However, our mood manipulation check revealed that after the neutral MIP participants felt as happy as compared with their baseline levels.

In summary, the current results are in line with the idea that positive affect can regulate perception by providing experiential feedback about the value of the currently accessible processing focus rather than directly leading to a broadened attentional scope. However, it is clear that these effects are limited to specific conditions and that other moderating variables seem to play a role as well.

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CHAPTER 3

FLEXIBILITY IN GENERAL AND EMOTION PROCESSING IN REMITTED DEPRESSION[1]

ABSTRACT

In positive psychology research, the broaden-and-build theory of positive emotions proposes that positive emotions serve resilience via crucial broad and flexible behavioral and attentional mechanisms. There is extensive research identifying these attentional broadening and flexibility processes that are thought to facilitate the adequate and adaptive responding to stress in healthy individuals. Given the high relapse rate in depression, research in remitted depressed individuals (RMD) is highly important to gain insight on vulnerability as well as resilience-related factors. The current study provides a comprehensive investigation of specific components of attention that might protect against depressive responding. Based on the available literature, we hypothesized that RMD individuals, in comparison with never depressed controls (NDC), would be characterized by (a) reduced attentional breadth; (b) impaired disengagement from focal negative information; (c) impaired general and affective flexibility. However, results showed no robust group differences between RMD and NDC individuals in each of these processes.

[1] Bruyneel, L., Koster, E. H. W., Grol, M., & De Raedt, R. (2013). Flexibility in general and emotion processing in remitted depression. *Unpublished manuscript.*

INTRODUCTION

Depression is a highly invalidating mental disorder that poses a major challenge for mental health services. Population estimates indicate that major depression has a life-time prevalence of 15-30% (Kessler et al., 2003). A particular problem in depression is that, despite a wide range of available pharmacological and psychological treatments that have substantial immediate therapeutic effects on depressive symptoms, there is often only partial remission and relapse rates are high (Beshai, Dobson, Bockting, & Quigley, 2011; Kessler et al., 2003; Solomon et al., 2000; Vittengl, Clark, Dunn, & Jarrett, 2007). The observation of high relapse rates is not only an important clinical finding but also has theoretical relevance because it suggests that individuals who develop major depression are characterized by stable risk factors that are not remediated by treatment (Nierenberg, Petersen, & Alpert, 2003; Reppermund, Ising, Lucae, & Zihl, 2009). Moreover, it has been proposed that the occurrence of depression has a “scarring” effect that sensitizes the individual for new depressive episodes (Hammen, 1991; Wichers, Geschwind, van Os, & Peeters, 2010). In both cases, research in remitted depressed individuals (RMD) is highly important to gain insight on the vulnerability factors for depression to understand the large amount of variability across individuals in their ability to become resilient to depression (Just, Abramson, & Alloy, 2001).

In recent years, cognitive theories have emphasized the role of impaired attentional processes as risk factor for depression. Early theories have suggested that depression is characterized by general attention deficits (Beck, 2008; Williams, Watts, MacLeod, & Mathews, 1988). However, more recent theories have further specified different aspects of impaired attentional processes that may play different functional roles in the pathophysiology of depression (for reviews see De Raedt & Koster, 2010; Gotlib & Joormann, 2010; Mathews & MacLeod, 2005). A broad distinction can be made into attentional processes that are related to the *breadth* of attention and the *orientation* of attention (Derryberry & Tucker, 1994). The breadth of attention refers to the idea that the perceptual scope of attention can be adjusted. An often used metaphor regarding this latter approach is that visual attention operates like a zoom lens on a camera, which can constrict to focus more on the detailed information, with high resolving power, or alternately focus on a large region of space, with lower resolving power (Eriksen & Stjames, 1986). The orienting approach views attention in terms of a flexible mechanism whose direction can be adjusted by disengaging from a current location, moving to a new location, and engaging in the new location (Posner & Petersen, 1990). Theories of depression have argued that depressive symptoms can indeed be related to both conceptualizations as this mood disorder is thought to be associated with a narrowed attentional scope (Whitmer & Gotlib, 2012) as well as with impaired disengagement from negative information (De Raedt & Koster, 2010; Gotlib & Joormann, 2010). De Raedt and Koster (2010) specifically proposed that these attentional impairments can act as risk factor for new episodes in RMD individuals. Furthermore, Siegle, Ingram, and Matt (2002) proposed in their affective interference hypothesis that depression is characterized by enhanced processing of negative information which can lead to performance benefits when negative information is task-relevant but can lead to interference when emotion is task-irrelevant. As a common denominator, many of these theories share the idea that depression is characterized by attentional inflexibility when processing negative information (De Lissnyder, Derakshan, De Raedt, & Koster, 2011; Deveney & Deldin, 2006; Lo & Allen, 2011; Murphy, Michael, & Sahakian, 2012) or information in general (De Lissnyder et al., 2012; Reppermund et al., 2009).

The current study aims at a comprehensive investigation of these attentional processes in relation to risk as well as resilience factors for depression in a RMD sample. For this purpose, the broaden-and-build theory (Fredrickson, 1998, 2001) is used to guide our specific hypotheses. Within most RMD research there is an emphasis on identifying the risk factors for new depressive episodes. However, there is extensive research identifying potential resilience factors in non-depressed individuals that have also been linked to attentional processes in their own right. Therefore, to investigate whether there are important differences in resilience factors in a RMD sample, we specifically aimed to examine components of attention that are related to resilience.

In the literature, the prominent broaden-and-build theory of positive emotions (Fredrickson, 1998, 2001) is used as a framework for understanding psychological resilience. This theory suggests as a first hypothesis that positive emotions (e.g. enjoyment/happiness/interest/anticipation) *broaden* one's attention thereby encouraging novel, varied, and exploratory thoughts and actions. This is in contrast to negative emotions, which prompt a narrow range of possible responses or urges. Secondly, the theory states that over time, this broadened behavioral repertoire *builds* skills and resources, making people more resilient when confronted with stress. Given the high recurrence of depression, insight in this cognitive broadening mechanism could be of crucial important to understand why some individuals are protected against the development of new episodes.

Indeed, a large literature has documented that mood can change the scope of attentional selection. In general, theories about the influences of mood on attention converge on findings of extensive research in this area showing that individuals under stress tend to reduce their use of peripherally relevant information. Already decades ago, Easterbrook (1959) proposed in his tunneling hypothesis that negative states - particularly high arousal states like anxiety – narrow the scope of attention, making people miss the forest for the trees (for a review, see Derryberry & Tucker, 1994). This "tunneling" hypothesis has been confirmed and replicated by numerous other investigators (e.g. Bundesen, 1990; Cohen, 1980). A few decades later, Derryberry and Tucker (1994) proposed that happy moods, as opposed to sad moods, are thought to broaden the scope of attention. Studies have used global-local visual processing paradigms to assess biases in attentional focus (Basso, Schefft, Ris, & Dember, 1996; Derryberry & Reed, 2002; Gasper & Clore, 2002). For example, on a global-local perception task (Kimchi & Palmer, 1982), individuals in happy moods have been found to match geometric figures when they are similar in global shape, whereas those in sad moods match figures sharing local elements (Gasper & Clore, 2002). Similarly, Derryberry and Reed (1998) found that when individuals could lose points, trait anxiety was associated to quickly noticing local details. Not only situationally induced but also chronic moods, such as trait happiness and optimism, are associated with attention towards global as opposed to local structures, whereas trait depression and anxiety correlate negatively with global processing (Basso et al., 1996). Hence, dispositional attentional breadth might also be seen as a vulnerability/resilience factor in depression. Recently, Whitmer and Gotlib (2012) proposed in their attentional scope model of rumination that the pattern of control functioning exhibited by ruminative thinking - a hallmark feature of depression – reflects a narrowed attentional scope. Given that cognitive control deficits are not only present during depression, but also after remission (for a review, see Joormann & D'Avanzato, 2010), we predict that RMD individuals will show a more narrowed attentional scope compared to non-depressed controls (NDC). In line with previous research, we selected a global-local letter task based on Navon (1977) to examine dispositional attentional breadth. Previous research has extensively used this task and has found that affective and motivational states influence performance on this task, with positive affect low in approach motivation being associated with a global preference (Gable & Harmon-Jones, 2010a). This task has been used successfully to estimate individual differences in global processing bias (Martin & Macrae, 2010).

Research has also demonstrated that the tunneling of attention may be helpful or harmful to performance, depending on the nature of the task at hand and the circumstances under which it must be performed. For example, when peripheral cues are irrelevant to an important primary task, it may be helpful to ignore them. However, if peripheral cues that might bear relevance to an important task are ignored, performance on that task may suffer. Thus, a narrowed attentional scope may hamper reallocation of cognitive resources to attend to more distal and peripheral stimuli, and thereby may slow down disengagement from focal stimuli. Given that impaired disengagement is also considered a hallmark feature of depression and rumination (De Raedt & Koster, 2010; Koster, De Lissnyder, Derakshan, & De Raedt, 2011), we propose that, because of a narrowed attentional scope, RMD individuals will experience more difficulties in disengaging from focal stimuli compared to NDC. Moreover, in dysphoric and depressed individuals, it has been shown that the ability to reallocate attention away from negative material to other more task-relevant information is hampered (Koster, De Raedt, Goeleven, Franck, & Crombez, 2005; Leyman, De Raedt, Schacht, & Koster, 2007). It has been proposed that the inability to exercise attentional control when confronted with stressful information is reflected in the tendency towards self-reflective rumination in depression (Koster et al., 2011). Importantly, after remission of depression, cognitive factors related to this process are still present (e.g. Joormann & Gotlib, 2007). Therefore, we propose in the current study that RMD individuals will be slower in disengaging from negative stimuli compared to NDCs. To examine attentional disengagement from neutral as well as emotional stimuli, we used a paradigm that was specifically proposed to examine this component of attention (Fox, Russo, Bowles, & Dutton, 2001; Georgiou et al., 2005). In this disengagement task, a single aversive, positive or neutral cue is presented in the centre of the screen (focal attention). After a brief interval (250 ms), a target is presented at one of four spatially different locations (above, under, right or left from the cue). As a result, participants are required to disengage attention away from the central cue, and to redirect it to the peripherally presented targets. The time needed to detect the targets is an index of how easily participants disengage their attention away from the stimuli presented in the middle of the screen.

Besides the hypothesis that, according to the broaden-and-build theory, positive emotions broaden peoples' thought-action repertoires, this theory also states that this broadened cognition in turn creates behavioral and *cognitive flexibility* that over time builds resilience. Psychological resilience has been characterized by the ability to bounce back from negative emotional experiences and by flexible adaptation to the changing demands of stressful experiences (Tugade & Fredrickson, 2004). Given that the down-regulation of stress is disrupted in depression, it is important to investigate whether RMD individuals are characterized by reduced attentional flexibility when processing neutral and negative information.

Several recent studies in healthy populations have demonstrated that trait resilience is associated with successful psychological and physiological adaptation to stress (Campbell-Sills, Barlow, Brown, & Hofmann, 2006; Campbell-Sills, Cohan, & Stein, 2006; Fredrickson, Tugade, Waugh, & Larkin, 2003) and with effective emotion regulation (Barrett, Mesquita, Ochsner, & Gross, 2007). Recently, the flexible processing of emotional material has been related to resilience in healthy populations. For instance, Genet and Siemer (2011) examined the relationship between affective flexibility, reappraisal, and resilience. To measure affective flexibility, they developed an affective task-switching paradigm that assessed the ability to flexibly switch between processing the affective versus neutral components of positive and negative words. The authors found that switching costs on the affective flexibility task predicted unique variance in trait resilience, controlling for switch costs on a general cognitive flexibility task. These results support the notion that affective flexibility is different from cognitive flexibility, and suggest that affective flexibility plays a role in emotional well-being, over and above the role of general cognitive flexibility. Moreover, affective flexibility is thought to be more closely related to emotion regulation rather than global executive control processes (Malooly, Genet, & Siemer, 2013).

The relationship between flexibility and emotion regulation has also been examined in the context of depression (e.g. Joormann & D'Avanzato, 2010). A recent study indicates that depression-related difficulties with flexibility may be particularly present on tasks that require processing of emotional, rather than neutral material (Murphy et al., 2012). De Lissnyder, Koster, Derakshan, and De Raedt (2010) examined the association between performance on an affective set-switching task with emotional faces and the habitual use of rumination (i.e., a response to negative emotions that is related to depression and vulnerability to depression; Rood, Roelofs, Bogels, Nolen-Hoeksema, & Schouten, 2009). They found that high ruminators showed higher overall switching-costs and inhibition impairments that were specific to the processing of negative information. The current study investigated whether affective flexibility, above and beyond general cognitive flexibility, was impaired in a RMD sample compared with NDCs. Furthermore, we examined whether individual differences in affective flexibility were related to resilience in RMD individuals. To examine affective flexibility, we used the task-switching paradigm that has been used by Malooly et al. (2013). This task is based on the affective task-switching paradigm of Genet and Siemer (2011), using emotional pictures instead of emotional words. The paradigm requires participants to flexibly switch between task-sets inhibiting a previous rule and shifting to a new rule.

In sum, in a sample of RMD individuals compared with NDCs, we provide a comprehensive test of attentive processing of neutral and affective information. Based on the available literature we predicted that RMD would be characterized by (a) reduced attentional breadth; (b) impaired disengagement from neutral and/or negative information; (c) impaired flexibility in processing neutral and/or negative information.

METHOD

Participants

A total of 56 adults (all Caucasian) participated in this study. They were divided into two groups; one group contained 28 RMD adults that were compared with a NDC group consisting of 28 participants who were individually matched for age and gender with the RMDs. Participants were recruited through advertisement in community papers and invited based on a telephone screening using the Major Depression Questionnaire (MDQ; Van der Does, Barnhofer, & Williams, 2003) and the Dutch version of the Mini International Neuropsychiatric Interview (MINI; Sheehan et al., 1998) (see further), which allowed excluding participants with a current depressive episode or other axis-I disorders. Participants of the RMD group were at least 6 months in remission at the time of the study. Based on cut-off depression scores at testing, 2 participants were removed from the dataset. The cut-offs applied were based on the clinically meaningful cut-offs provided by Beck, Steer, and Brown (1996). At the time of testing, participants in the NDC group were only included when their BDI-II-score was categorized as non-depressed (BDI-II range: 0 – 13). For the RMD group, the cut-off score was set on 20 (BDI-II > 20: 'Depressed') to ensure that, in the event of minor residual symptoms, RMD participants could still be included when they were non-depressed according to scores on the MINI. Analyses were run on the remaining 54 participants. In total, 38 women and 16 men between the ages of 22 and 63 (M = 46.26, SD = 10.76) took part in the study which was part of a larger study on underlying cognitive mechanisms of relapse in RMD adults. Participants of the RMD group (N = 27) had experienced on average 2.52 depressive episodes (SD = 1.67). At the moment of the study, 16 participants were still in treatment (i.e. anti-depressants, sleep medication or psychotherapy) for past depressive episodes. Participants of the NDC group (N = 27) had never experienced a depressive episode nor other axis-I disorder was ever diagnosed. Group characteristics are described in Table 1.

Materials

At first, participants were screened during a telephone interview concerning past depressive episodes. When meeting the inclusion criteria of having experienced one or more depressive episodes and being in remission for at least half a year, they were invited to come to Ghent University to complete the MINI (Sheehan et al., 1998), an extensive and structured interview concerning all axis-I disorders. When meeting the inclusion criteria of absence of other axis-I psychiatric disorders after the interview, participants were invited to complete the study. The specific measures used are outlined below.

Screening. To select eligible participants, the Dutch version of the Mini International Neuropsychiatric Interview (MINI; Sheehan et al., 1998) and the Major Depression

Questionnaire (MDQ; Van der Does et al., 2003) were administered. The MINI is a structured interview that assesses current and lifetime psychiatric disorders based on DSM-IV criteria in a valid and reliable way (Sheehan et al., 1998). The MDQ is based on the DSM-IV criteria of depression and investigates both current and past depressive symptoms. The MDQ is a validated questionnaire (Williams, Van der Does, Barnhofer, Crane, & Segal, 2008) that allows indexing past depressive episodes.

Questionnaires. At the moment of testing, participants completed a series of questionnaires concerning depressive symptoms, rumination, positive and negative affect, and resilience.

Depression. Depressive symptoms were assessed with the Beck Depression Inventory (BDI-II; Beck et al., 1996), in which the occurrence and severity of depressive symptoms over the past two weeks is questioned. Twenty-one items are scored on a four-point scale (0-3). The Dutch version of this scale (Van der Does, 2002) comprises three subscales assessing cognitive, somatic and affective aspects of depression. The Dutch translation showed good internal consistency, α = .92, and good convergent validity with, for example, the Hamilton Psychiatric Rating Scale for Depression, r = .71 (Van der Does, 2002).

Rumination. The Dutch translation of the Ruminative Response Scale (RRS; Nolen-Hoeksema & Morrow, 1991b; Raes & Hermans, 2007) was used to measure rumination. The Dutch version of the RRS is a 22 item self-report questionnaire that measures responses to a depressed mood that are repetitively focused on the self, symptoms or consequences of the depressed mood. The RRS questions how participants generally react when they feel down, sad or depressed. Participants have to indicate how often they engage in these responses on a four-point Likert scale ranging from 1 (almost never) to 4 (almost always). Although a total score can be calculated, rumination as measured by the RRS can not be seen as a unitary construct. An exploratory factor analysis of Treynor, Gonzalez, and Nolen-Hoeksema (2003) identified two distinct factors differentially related to depressive symptoms. The first factor, reflective pondering, consists of five items that assess the rather adaptive cognitive problem solving focused at improving one's mood and depressive symptoms. The second factor, ruminative brooding consists of five items that assess the maladaptive passive focus on the possible causes of the depressed mood. The RRS proved to be a reliable and valid measure of rumination (Treynor et al., 2003).

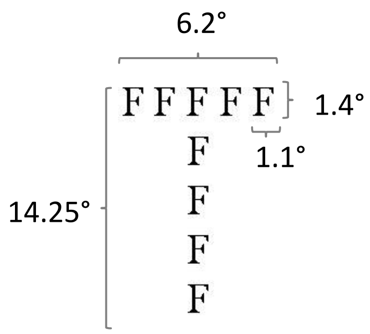
Positive and Negative Affect. The Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) is a brief measure of 20 items to assess both positive affect (PA) and negative affect (NA). Participants completed the trait version in which they rated the extent to which they generally experience an affective state on a 5-point scale. The Dutch translation of the PANAS has shown good psychometric properties (Peeters, Ponds, & Vermeeren, 1996).

Resilience. The Dutch version of the Resilience Scale (RS; Wagnild & Young, 1993) was used to measure participant's trait resilience and consists of 25 items arranged in two subscales: personal competence (17 items) and acceptance of self and life (8 items). Participants rate the extent to which each item reflects themselves on a 4-point Likert scale, ranging from 1 (totally disagree) to 4 (totally agree). Construct validity of the RS was supported through correlations with measures of self-esteem and perceived stress. Cronbach's alpha coefficients for the RS have ranged from .76 to .91.

Cognitive experimental tasks. Cognitive tasks assessing focal attentional breadth, attentional disengagement from neutral and emotional information, general cognitive and affective flexibility were administered. These tasks are outlined below.

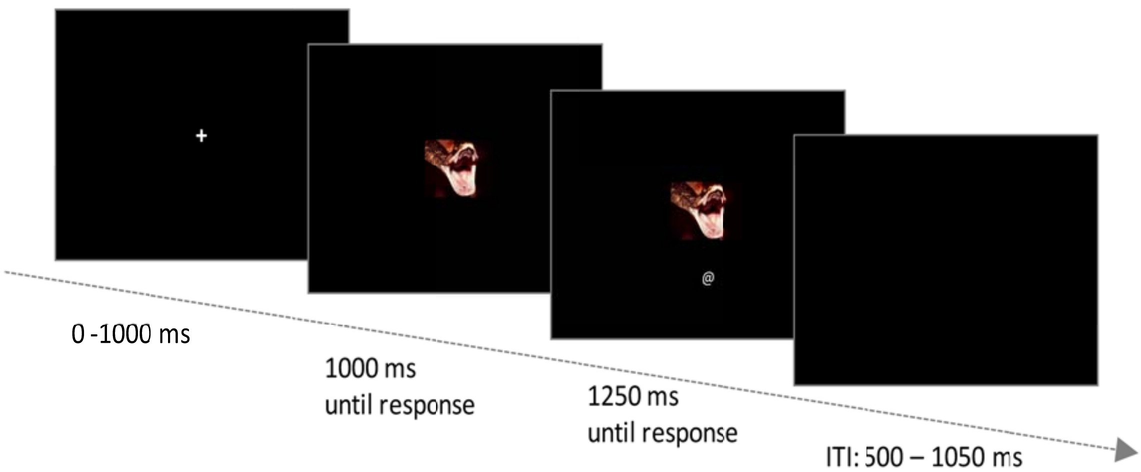
Attentional breadth and general cognitive flexibility. Participants completed a global-local Navon letter Task (Navon, 1977) to measure attentional breadth and general cognitive flexibility. The task was programmed using the E-PRIME 2 software package. Participants were seated at approximately 60 cm from the screen. Black stimuli were presented against a white background on a 17 inch computer screen. On every trial, a black fixation cross was presented in the middle of the screen for 500 ms. Then, a target was presented in the middle of the screen and consisted of 1 of 8 global-local Navon figures (Navon, 1977). Participants were instructed to identify the target as fast and correct as possible. There were two targets, the letter T and the letter H. On each trial, one of these letters was presented, either as a local shape (e.g. the global letter L made up of little T's) or as a global shape (e.g. the global letter H made up of little K's). On each trial, participants had to indicate whether the target presented was a T or an H. Thus, a local trial is a trial in which the target was a local feature, whereas a global trial is a trial where the target was a global feature (Figure 1). The test phase contained 64 trials. All figures were written in upper-case letters (Times New Roman). Global letters were either T's composed of local F's or L's, or global H's composed of local F's or L's. Each global letter encompassed a horizontal visual angle of 6.2° and a vertical angle of 14.3°, whereas each local letter encompassed a horizontal visual angle of 1.1° and a vertical angle of 1.4°. Participants were instructed to identify the T of H in the figure as fast and correct as possible. 50% of the trials were figures with a global target, 50% with a local target. The target remained on the screen for 300 ms. Responses were made by pressing one of two keys on a standard AZERTY keyboard. The intertrial interval (ITI) was 300 ms. Attentional breadth was assessed with the difference score between reaction times (RTs) on global versus local trials. Moreover, the difference in RTs on repetition (Global-Global, or Local-Local) versus switch trials (Global-Local, or Local-Global) gives an indication of general cognitive flexibility.

Figure 1. Visual angles and stimulus example.



Attentional disengagement from non-emotional and emotional information. To measure attentional disengagement from non-emotional as well as emotional material, participants performed an emotion interference task based on Fox et al. (2001). In this task, participants had to disengage their attention away from a picture and redirect their attention towards a spatial target. The task was programmed using the INQUISIT Millisecond software package. Cues and targets were presented against a black background on a 17 inch computer screen. Participants were seated approximately 60 cm from the screen. On every trial, a white fixation cross was presented in the middle of the screen. Cues were presented at fixation. Eight neutral, eight positive, and eight threatening pictures (height: 4.0 cm, width: 5.3 cm) were selected from the International Affective Picture System (Lang, Bradley, & Cuthbert, 2008). The positive (*M* = 6.41, *SD* = .75) and threatening (*M* = 6.73, *SD* = .36) set of pictures were matched for arousal ratings, $t(7) > 1$. On the basis of the original ratings of these pictures, valence scores of the neutral pictures ($M = 4.95$, $SD = .39$) were significantly higher than those of the threatening pictures ($M = 2.89$, $SD = .84$), $t(7) = 7.98$, $p < .001$, and significantly lower than those of the positive pictures ($M = 7.31$, $SD = .64$), $t(7) = 8.04$, $p < .001$. Eight neutral pictures were selected for use in the practice trials. 250 ms after presentation of the cue, a target appeared ("&" or "@" in ARIAL, 18) 3.5 cm above, under, left or right from the picture (Figure 2). Participants were instructed to react as fast and correct as possible to this target. Responses were made by pressing one of two keys on a standard AZERTY keyboard. Finally, on +/- 10 percent of the trials, we encouraged participants to focus on the center of the screen by presenting digit trials. On these trials, the fixation cross was replaces by a digit ranging from one to three after 1000ms. This digit remained on the screen for 100 ms. Participants were required to indicate which digit they had seen by pressing the corresponding key on the AZERTY keyboard. Participants were required to guess if they were unsure about the answer. In this manner, poor performance on digit trials indicated poor motivation of the participant or a lack of fixation on the fixation cross. The interference task consisted of two phases. First, in order to acquaint participants with the task at hand, they completed a practice phase using 8 neutral pictures. The practice phase contained 16 trials, and an error message was presented after incorrect responses. The test phase consisted of 128 trials. No error messages were presented in the test block. The ITI varied randomly between 500 and 1050 ms.

Figure 2. Example and sequence of a trial of the emotion interference task.



Affective flexibility. To examine affective flexibility, we used the task-switching paradigm as used by Malooly et al. (2013). This task is based on the affective task-switching paradigm of Genet and Siemer (2011), using emotional pictures that were drawn from International Affective Picture System (IAPS; Lang et al., 2008) instead of emotional words. In this task, participants were presented with a series of affective pictures and were required to sort the pictures based on either an affective rule (classifying pictures as positive or negative) or a non-affective rule (classifying pictures according to whether they show one or fewer human beings, or two or more human beings). The set of pictures included 160 IAPS images; 40 pictures were selected for the four categories: a) negative with one or fewer human beings (*M* valence = 3.19; *SD* = 1.32), b) negative pictures with two or more human beings (*M* valence = 2.96; *SD* = 1.06), c) positive pictures with one or fewer human beings (*M* valence = 7.06; *SD* = 1.04), and d) positive pictures with two or more human (*M* valence = 6.94; *SD* = 1.41). A 2 (Valence: positive, negative) x 2 (Number of humans: one or less, two or more) ANOVA with valence ratings as dependent variable revealed that valence ratings did not differ across the two number of human categories, $F(1, 156) < 1$.

At every trial, a picture was surrounded by a colored frame and trial cue on both the left and right, that were indicative for the active rule ("+" and "-" for positive and negative, or "≤ 1" and "≥ 2" for one or fewer human beings and two or more human beings). Participants were required to categorize the picture according to the cue using two adjacent keys on a AZERTY keyboard. The trial cue and picture type (i.e., the combination of the picture's valence and number of human beings) changed according to a pseudorandom sequence in order to measure affective flexibility, that is the ability to switch between affective and non-affective categorization rules for positive and negative pictures.

The affective flexibility consisted of 2 practice blocks of both 10 trials, in which participants had to sort valenced pictures based on one rule per block. The test phase consisted of 2 blocks of 160 trials each and required participants to sort pictures based on both rules. Participants were instructed to press adjacent keys on the keyboard to sort the stimuli by the active rule using their right-hand index finger to press the left-side key and their right-hand middle finger to press the right-side key. The cues and stimulus remained on the screen until a response was made, with no time limit for the response. After a response was made, the stimulus, and, on switch trials, the cue changed. The cues were presented with a 65-point, Courier New font, with black text on a white or grey background with each background color corresponding to one of the categorization rules. Eight versions of the task were created to counterbalance across participants in terms of which frame color (white and grey) corresponded to which cue (valence and number of people), and the mapping of the cue-categories onto the response keys.

Procedure

The research protocol was approved by the ethical committee of the faculty of Psychology and Educational Sciences of Ghent University. The protocol was administered to participants in three different parts and time moments. Via advertising, participants contacted the researchers via telephone or email. During a first telephone screening, questions about past and current depressive episodes and symptoms were answered. Participants were invited to the second part of the study when a) they were at least one time diagnosed as depressed in the past for the RMD group and b) participants reported to never have been depressed for the NDC group. During the second part that took place at Ghent University, participants were interviewed with the Dutch version of the MINI to explore previous depressive episodes and other axis-I disorders. When reporting no psychological disorders (except for depressive episodes in the RMD group) an appointment was made to fulfill the last part of the study which concerned the actual test moment. The moment of testing was always within 4 weeks of the interview. The participants were tested individually. They started with the global-local Navon letter task, followed by the emotion interference task and ending with the affective flexibility task. This test session lasted about 30 minutes and the fixed task order was selected as the affective flexibility task was the most difficult and could have elicited frustration or fatigue in some participants that could have interfered with performance on subsequent tasks. After these cognitive tasks, the participants completed the questionnaires. At the end of the experiment, participants were fully debriefed.

RESULTS

Participants characteristics

Table 1. Participants characteristics. Mean scores and SDs on all questionnaires measures for the RMD and NDC group.

	Group			
	RMD		NDC	
N	27		27	
Age; M, SD	46.37	10.71	46.15	11.01
Gender; F, M	19	8	19	8
Education level; M, SD	3.18	1.33	3.52	.89
Number of depr. epis.; M, SD	2.5	1.7	0	0
Hospitalization (past); %	37		0	
Current treatment; %	59		0	
Questionnaires	M	SD	M	SD
BDI	4.32	4.74	2.85	3.17
RRS total**	49.88	15.11	36.44	8.21
RRS brooding**	10.04	3.23	7.30	1.77
RRS reflection*	10.50	3.30	7.93	3.00
RS total*	81.96	10.34	87.78	6.91
RS pers. comp.*	56.33	6.18	59.56	5.33
RS acceptance*	25.35	4.46	28.22	2.03
PA	37.15	5.14	38.89	5.37
NA**	16.52	4.33	12.74	2.46

Note. Education level was coded as follows: 1 = did not finish high school, 2 = graduated high school, 3 = higher education, 3 years, 4 = higher education, > 3 years, 5 = University degree. Number of depr. epis.= number of past depressive episodes. Hospitalization (past) = participants who were in the past at least once hospitalized for depression. Current treatment = participants who were still in treatment (i.e. anti-depressants, sleep medication or psychotherapy) for past depressive episodes at testing. BDI = Beck Depression Inventory-II (Beck et al., 1996); RRS = Ruminative Response Scale (Nolen-Hoeksema & Morrow, 1991a); RS = Resilience Scale (Wagnild & Young, 1993); RS total = total score on RS; RS pers. comp. = score on personal competence subscale of Resilience Scale; RS acceptance = score on acceptance of self and life subscale of Resilience Scale. PA & NA = Positive And Negative Affect Scale (Watson et al., 1988).

* Significantly different at the .05 level
**Significantly different at the .001 level

Table 1 presents mean scores and SDs on all questionnaire measures for participants assigned to each group. Groups were matched for age and gender. The groups did not differ for education level, $t(52) = 1.08$, $p = .285$, or for depression scores, $t(50) = 1.32$, $p = .192$, and nor for positive affect, $t(52) = 1.22$, $p = .229$. As expected, the RMD group scored significantly higher on rumination, $t(50) = 4.02$, $p < .001$, brooding, $t(50) = 3.83$, $p < .001$, reflection, $t(51) = 2.98$, $p = .004$, and negative affect $t(52) = 3.94$, $p < .001$, and lower on total resilience, $t(51) = 2.42$, $p = .019$, personal competence, $t(52) = 2.05$, $p = .045$, and acceptance of self and life, $t(51) = 3.04$, $p = .004$, compared to the NDCs.

Attentional breadth and general cognitive flexibility

Attentional breadth and general cognitive flexibility were measured with the global-local Navon letter Task (Navon, 1977). Two participants in the RMD group were excluded for further analyses. One participant was excluded because of deviating more than 2.5 SDs from the group mean on overall RTs. Another participant was excluded because of responding on chance level for the global trials.

Attentional breadth. For reaction time (RT) data, trials with errors were discarded from analyses (< 2%). Furthermore, for each participant trials with RTs deviating more than 2.5 SDs from the participant's mean RT for that trial type were excluded (< 2%). Accuracy rates did not differ depending on group, $t(50) < 1$. A 2 (Trial Type: global, local) x 2 (Group: RMD, NDC) mixed ANOVA revealed that the expected differences in RTs between groups for the specific trials was not found: Interaction effect Trial type x Group, $F(1, 50) < 1$. Thus, our prediction that RMD individuals in comparison with NDCs would show a more narrowed attentional scope, as reflected in a higher preference for the local elements of the composite stimuli, was not confirmed. The commonly found main effect of Trial Type was found, $F(1, 50) = 6.20$, $p = .016$, meaning that RTs across all participants were faster on global trials (M = 971, SD = 255) compared to local trials (M = 1031, SD = 299). The main effect of Group was nearly significant, $F(1, 50) = 4.00$, $p = .051$, revealing that general RTs in RMD individuals were slower (M = 1075, SD = 257) compared to NDC (M = 933, SD = 284). See Table 2 for means and SDs.

As it is assumed that attentional breadth is a processing factor that underlies resilience, and that there exists high variability within RMD individuals in resilience levels, we explored whether differences in self-reported resilience within the groups could explain variance in attentional breadth. Therefore, an attentional breadth score was computed by subtracting mean RTs on the global trials from those of local trials. A positive score means a preference for global information, while a negative score reflects a preference for local information. Thus, a higher score means greater breadth of attention. After log-transformation, this attentional breadth variable was normally distributed. To test the hypothesis that resilience (RS: total score, personal competence, acceptance of self and life) moderated the relationship between group and attentional breadth, three hierarchical multiple regression analyses were conducted, following the approach of Aiken and West (1991). We used Group as predictor, and the three scores of the RS as moderators. All variables were centered and the interactions were calculated by multiplying the centered predictor and moderator scores. In the first step of all models, Group could not predict attentional breadth, all *t*s < 1. In three models, the different RS scores were entered in the second step and were not related to attentional breadth, all *t*s < 1. In the final step of the regression analyses, interaction terms between attentional breadth and the three RS scores were entered. The interaction term between Group and total RS was not significant, *b* = .004, *se* = .002, *t*(47) = 1.65, *p* = .105. The interaction term between Group and RS acceptance of self and life was not significant, *t*(47) < 1. The interaction term between Group and RS personal competence was nearly significant, *b* = .006, se = .003, *t*(47) = 1.90, *p* = .064, explaining a nearly significant proportion of the variance in attentional breadth, R^2 = .07, *F*(3, 48) = 1.44, *p* = .064. Thus, only RS personal competence was a nearly significant moderator of the relationship between group and attentional breadth. The unstandardized simple slope for the low level of RS personal competence (1 SD below the mean level) was not significant: *b* = -.02, *se* = .03, *t*(48) < 1; the unstandardized simple slope a mean level of RS personal competence was not significant: *b* = .01, *se* = .02, *t*(48) < 1; and unstandardized simple slope for the high level of RS personal competence (1 SD above the mean) was also not significant: *b* = .05, se = .03, *t*(48) = 1.83, *p* = .074.

General cognitive flexibility. For RT data, trials with errors were discarded from analyses (< 2%). Furthermore, for each participant trials with RTs deviating more than 2.5 SDs from the participant’s mean RT for that trial type were excluded (< 4%). A 2 (Trial Type: switch, no switch) x 2 (Group: RMD, NDC) mixed ANOVA revealed that RTs on switching trials (*M* = 1057, *SD* = 265) were significantly higher than RTs on repetition trials (*M* = 923, *SD* = 265), *F*(1, 50) = 50.80, *p* < .001, confirming the presence of switch costs. However, the expected interaction with Group was not found, $F(1, 50) < 1$, revealing that RMD individuals did not show impairments in general cognitive flexibility compared to the RMD group. The Group effect was nearly significant, $F(1, 50) = 3.87$, $p = .055$, indicating that RMD individuals ($M = 1061$, $SD = 268$) show a trend towards general slower responding compared to NDCs ($M = 925$, $SD = 263$). See Table 2 for means and SDs.

As it is assumed that general cognitive flexibility is a processing factor that underlies resilience, we explored whether individual differences in self-reported resilience within the groups could explain variance in general cognitive flexibility. Therefore, general switch cost was computed by subtracting mean RTs on the no-switch trials from those of the switch trials. To test the hypothesis that resilience (3 scores of the RS: total score, personal competence, acceptance of self and life) moderated the relationship between group and general cognitive flexibility, three hierarchical multiple regression analyses were conducted, following the approach of Aiken and West (1991). We used group as predictor, and the three scores of the RS as moderators. All variables were centered and the interactions were calculated by multiplying the centered predictor and moderator scores. Results of these regression analyses revealed that none of the RS scores moderated the relationship between group and general flexibility, all *F*s < 1.

Attentional disengagement from non-emotional and emotional information

For RT data, trials with errors were discarded from analyses (< 2%). Furthermore, for each participant trials with RTs deviating more than 2.5 SDs from the participant's mean RT for that trial type were excluded (< 2%). One participant who differed more than 2.5 SDs from the group mean on general RTs was excluded from further analyses. A 3 (Valence: neutral, positive, threat) x 2 (Group: RMD, NDC) mixed ANOVA revealed that RTs on specific trials types did not differ between groups: interaction between Valence and Group, $F(2, 50) < 1$. The effect of Group was nearly significant, $F(1, 51) = 3.88$, $p = .054$, revealing that the RMD ($M = 773$, $SD = 135$) tended to react slower compared to controls ($M = 699$, $SD = 136$), meaning that RMD individuals were overall slower to disengage attention from the middle of the pictures to the peripheral targets. The commonly found main effect of Valence, $F(2, 50) = 3.28$, $p = .046$, revealed that RTs on neutral trials ($M = 726$, $SD = 141$) did not differ from RTs on positive trials ($M = 734$, $SD = 146$), $t(52) = 1.17$, $p = .249$, but were significantly faster compared to threat trials (*M* = 745, *SD* = 139), $t(52) = 2.55$, $p = .014$. RTs on positive trials were nearly significantly faster compared to threatening trials, $t(52) = 1.84$, $p = .071$. See Table 2 for means and SDs.

Table 2. Mean RTs and SDs for all trial types of the global-local Navon letter task and the emotion interference task for the RMD (*N* = 25) and the NDC (*N* = 27) group.

		Group			
		RMD		NDC	
Task	Trial type	M	SD	M	SD
NLT	Global	1037	238	910	238
	Local	1113	308	955	275
	Switch	1131	256	988	259
	No Switch	991	279	861	239
EIT	Neutral	767	141	686	133
	Positive	771	142	698	144
	Threat	780	133	713	139

Note. NLT = Global-Local Navon letter Task; EIT = Emotion Interference Task.

We further explored whether differences in self-reported resilience within the groups could explain variance in attentional disengagement from positive and negative information. An attentional bias score for negative and positive information, was calculated by subtracting the mean target probe discrimination RT on the neutral trials from those on the threatening and on the positive trials, respectively. The attentional bias scores for positive and negative information were normally distributed after logarithmic transformation. To test the hypothesis that resilience (RS total, personal competence, acceptance of self and life) moderated the relationship between group and attentional bias for positive and negative information, six hierarchical multiple regression analyses were conducted, following the approach of Aiken and West (1991). We used group as predictor, and the three scores of the RS as moderators. All variables were centered and the interactions were calculated by multiplying the centered predictor and moderator scores. Results of these regression analyses revealed that none of the RS scores moderated the relationship between group and attentional bias for positive or negative information, all *F*s < 1.

Affective flexibility

Affective flexibility was assessed using a novel affective flexibility task that was identical in design to the task used by Malooly et al. (2013). All RTs from inaccurate trials were deleted from further analysis (< 7%). Similar to the procedure of Malooly et al. (2013), the influence of outliers was reduced by using a RT window of 2.5 SDs around the mean. These RT values outside of this window were replaced with the value corresponding to 2.5 SDs below or above the mean. Furthermore, one participant was discarded from analyses because of overall RTs deviating more than 2.5 SDs from the group mean. Groups did not differ in general RTs and accuracy, both *F*s < 1.

A 2 (Trial Type: switch, repetition) x 2 (Group: RMD, NDC) mixed ANOVA revealed that RTs on switching trials (when switching between the affective and non-affective categorizing rules within pictures with the same valence) (*M* = 1990, *SD* = 465) were significantly higher than RTs on repetition trials (when classifying according to the same rule as in the previous trial, within pictures with the same valence) (*M* = 1813, *SD* = 399): main effect of Trial Type, $F(1, 51) = 38.82$, $p < .001$, confirming the presence of switch costs. Groups did not differ in RTs depending on Trial Type: interaction effect Trial Type x Group, $F < 1$. No main effect of Group was found, $F < 1$.

A 2 (Rule: affective, non-affective) x 2 (Group: RMD, NDC) mixed ANOVA revealed no differences in RTs for the different rules (affective rule: *M* = 1894, *SD* = 404, non-affective rule: *M* = 1909, *SD* = 450): main effect of Rule, $F < 1$. Also, there were no differences between the groups for the different rules: interaction Rule x Group, $F < 1$, nor main effect of Group, $F < 1$.

Interestingly, a 2 (Valence: positive, negative) x 2 (Group: RMD, NDC) mixed ANOVA revealed a significant difference in RTs on negative (*M* = 2021, *SD* = 446) versus positive (*M* = 1781, *SD* = 413) trials: main effect Valence, $F(1, 51) = 108.22$, $p < .001$. Furthermore, there was a marginally significant interaction between Valence and Group, $F(1, 51) = 3.11$, $p = .084$, showing that the differences in RTs between the negative and positive trials tended to be higher in the NDC (negative: *M* = 1989, *SD* = 496; positive: *M* = 1709, *SD* = 439) compared to the RMD group (negative: *M* = 2055, *SD* = 393; positive: *M* = 1857, *SD* = 378). See Table 3 for means and SDs.

Specific switch costs

Switching processing rule. Similar to previous research, we calculated specific switch costs associated with switching away from the affective (valence) and to the non-affective (human being) rule when the attended image was negative (switch cost to NA/N) or positive (switch cost to NA/P). For example, switch costs to the non-affective rule when the image was negative were calculated by subtracting RTs on trials in which the affective rule was repeated and the image was negative, from RTs on trials in which the cue switches to the non-affective rule and the picture was negative. Switch costs toward the non-affective rule when the image was positive were calculated in the same way. We also calculated the specific switch costs for switching away from the non-affective and towards the affective rule when the image was positive (switch cost to A/P) or negative (switch cost to A/N). Specific switch costs are presented in Figure 3.

To explore whether these specific switch costs differ when the rule switches within the same (either positive or negative) image valence, we ran a 2 (Switch Rule to: non-affective, affective) x 2 (Image Valence: negative, positive) x 2 (Group: RMD, NDC) mixed ANOVA. A nearly significant main effect of Rule, $F(1, 51) = 3.91$, $p = .053$, revealed that switch costs to switch towards the non-affective rule were higher (*M* = 233, *SD* = 417) compared to the switch costs to switch towards the affective rule (*M* = 101, *SD* = 381), indicating that it is easier to switch to the emotional components of the image than the non-emotional components. Furthermore, the interaction between Switching Rule and Image Valence was significant, $F(1, 51) = 65.23$, $p = .001$, showing higher switch costs when switching towards the non-affective rule in negative images (*M* = 421, *SD* = 418) compared to positive pictures (*M* = 45, *SD* = 404), and less switch costs when switching towards the affective rule in negative images (*M* = -108, *SD* = 392) compared to positive images (*M* = 310, *SD* = 353). This interaction indicates that it is easier to switch to the affective components in negative images than in positive images, and easier to switch to the non-affective components of the images when they are positively valenced. Importantly, there was a significant interaction between Image Valence and Group, $F(1, 51) = 11.61$, $p = .001$, revealing that NDCs tended to show more switch costs in negative pictures (*M* = 240, *SD* = 425) relative to positive images (*M* = 118, *SD* = 369), $t(26) = 1.73$, $p = .095$, while the RMD group showed less switch costs in negative pictures (*M* = 73, *SD* = 385) relative to positive images (*M* = 237, *SD* = 388), $t(25) = 3.70$, $p = .001$. The expected three-way interaction between Switching Rule, Image Valence and Group was not found, $F(1, 51) < 1$. Mean RTs and SDs for each of the specific switch costs are presented in Table 3.

Switching image valence. Besides the usually reported specific switch costs when switching processing rules (affective rule versus non-affective rule) when classifying positive or negative images, it is also interesting to look at specific switch costs when the valence of the images switches while classifying pictures according to a same (affective of non-affective) rule. More specifically, we calculated switch costs when: switching away from a positive toward a negative image when the rule was non-affective (switch cost to N/NA), switching away from a negative toward a positive image when the rule was non-affective (switch cost to P/NA), switching away from a positive toward a negative image when the rule was affective (switch cost to N/A), and switching away from a negative toward a positive image when the rule was affective (switch cost to P/A). For example, switch costs toward the negative image valence when the active switching rule was non-affective (switch cost to N/NA) were calculated by subtracting RTs on trials in which a positive image was repeated and the rule was non-affective, from RTs on trials in which image valence switches to negative and the rule was non-affective. Switch costs toward the positive valence when the rule was non-affective (switch cost to P/NA) were calculated in the same way. We also calculated the specific switch costs for switching image valence from positive to negative (switch cost to N/A) and from negative to positive (switch cost to P/A) when the rule was affective. Specific switch costs are presented in Figure 3.

To explore these specific switch costs when the image valence switches within the same (either affective or non-affective) switching rule, we ran a 2 (Rule: non-affective, affective) x 2 (Switch Image Valence to: negative, positive) x 2 (Group: RMD, NDC) mixed ANOVA. A significant main effect of Rule, $F(1, 51) = 49.09$, $p < .001$, revealed that switch costs were higher in the non-affective rule (*M* = 133, *SD* = 260) compared with the affective rule (*M* = -72, *SD* = 312). Furthermore, the interaction of switching between image valences and the different rules was significant, $F(1, 51) = 81.30$, $p < .001$, indicating that in the non-affective rule, switch costs were higher when switching toward a negative image valence (*M* = 513, *SD* = 264) compared with switching toward a positive valence (*M* = -246, *SD* = 256). In the affective rule, switch costs were lower when switching toward a negative image (*M* = -108, *SD* = 330) compared with switching toward a positive image (*M* = -36, *SD* = 293). This interaction indicates that it is easier to switch to a negative image relative to a positive image when categorizing according to the affective rule, and more difficult when categorizing according to the non-affective rule. Results also showed a significant main effect of Image Valence, $F(1, 51) = 78.62$, $p < .001$, revealing higher switch costs to switch toward a negative image (*M* = 202, *SD* = 297) compared with switching toward a positive image (*M* = -72, *SD* = 275). This latter effect seemed to be mainly driven by the high switch costs towards a negative image in the non-affective rule. The expected three-way interaction between Rule, Image Valence and Group was not found, $F(1, 51) < 1$. No other effects of Group were found, *F*s < 1. Mean RTs and SDs for each of the specific switch costs are presented in Table 3.

We further explored whether differences in self-reported resilience in interaction with group could explain variance in affective flexibility. An affective flexibility score was calculated by taking the mean of the all standardized specific switch costs for each participant. To test the hypothesis whether resilience (RS total, personal competence, acceptance of self and life) moderated the relationship between group and affective flexibility, hierarchical multiple regression analyses were conducted, following the approach of Aiken and West (1991). In the first step of all models, group was included and could not predict affective flexibility, all *t*s < 1. In three different models, total resilience scores, personal competence, or acceptance of self and life were entered in the second step and were differently related to affective flexibility; $b = .02$, $se = .01$, $t(48) = 1.91$, $p = .062$; $b = .02$, $se = .01$, $t(49) = 1.95$, $p = .058$; $t(48) < 1$. In the final step of the regression analyses, interaction terms between affective flexibility and the RS scores were created. None of the interaction terms between group and RS total, RS personal competence, and RS acceptance of self and life were significant, $b = -.03$, $se = .02$, $t(49) = 1.68$, $p = .099$; $b = -.04$, $se = .02$, $t(49) = 1.67$, $p = .101$; $t(48) < 1$, respectively.

Table 3. Mean RTs and SDs for negative and positive trials and all switch cost in the affective flexibility task for the RMD and the NDC groups.

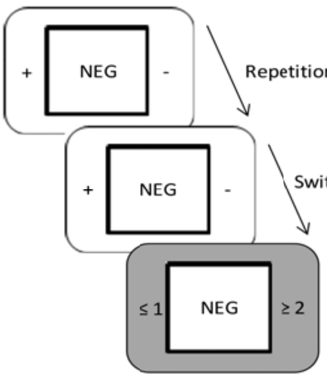
	Group			
	RMD		NDC	
	M	SD	M	SD
Negative	2055	393	1989	496
Positive	1857	378	1709	439
Switch cost to NA/N	289	452	553	383
Switch cost to NA/P	57	442	32	365
Switch cost to A/N	-143	317	-73	466
Switch cost to A/P	416	334	204	371
Switch cost to N/NA	541	296	485	230
Switch cost to P/NA	-280	220	-213	287
Switch cost to N/A	-148	349	-69	312
Switch cost to P/A	-60	313	-12	276

Note. NA/N = switching to non-affective rule in negative images; NA/P = switching to non-affective rule in positive images; A/N = switching to affective rule in negative images; A/P = switching to affective rule in positive images; N/NA = switching to negative image in non-affective rule; P/NA = switching to positive image in non-affective rule; N/A = switching to negative image in affective rule; P/A = switching to positive image in affective rule.

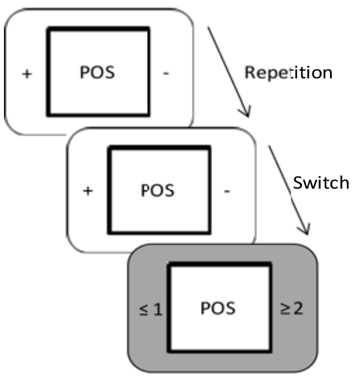
Figure 3. Specific switch costs in the affective flexibility task.

a) Switching processing rule

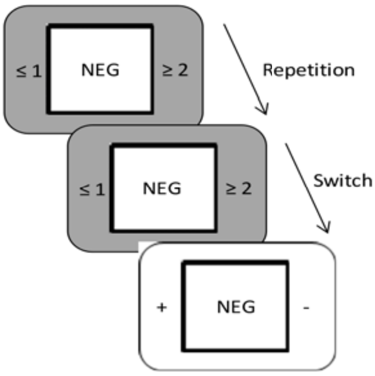
Switch cost to NA/N



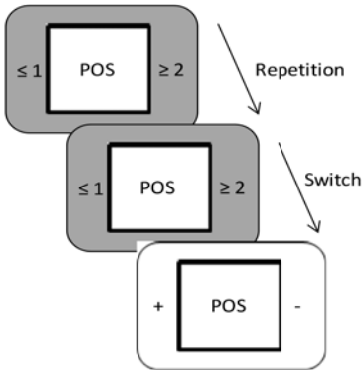
Switch cost to NA/P



Switch cost to A/N

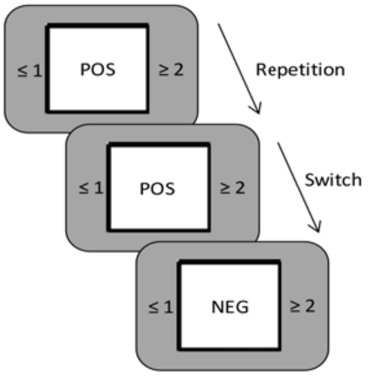


Switch cost to A/P

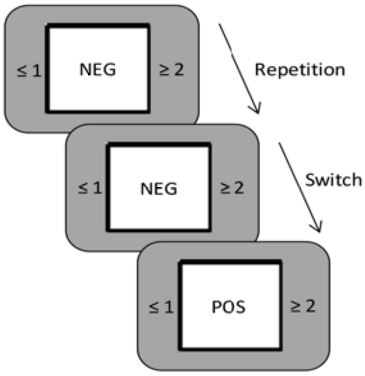


a) Switching image valence

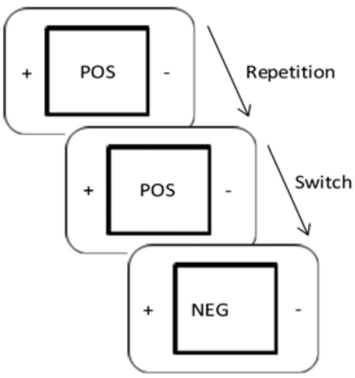
Switch cost to N/NA



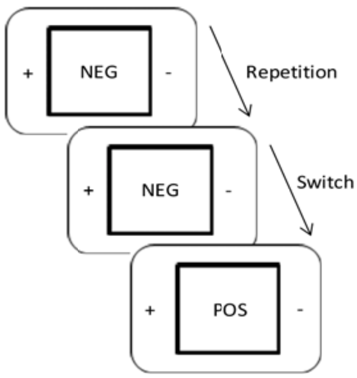
Switch cost to P/NA



Switch cost to N/A



Switch cost to P/A



Switch costs = RT SWITCH – RT REPETITION

Note. NA/N = switching to non-affective rule in negative images; NA/P = switching to non-affective rule in positive images; A/N = switching to affective rule in negative images; A/P = switching to affective rule in positive images; N/NA = switching to negative image in non-affective rule; P/NA = switching to positive image in non-affective rule; N/A = switching to negative image in affective rule; P/A = switching to positive image in affective rule.

Correlational analyses

Based on previously published research and the high variability between participants in the above reported measures of attentional breadth, attentional bias, and general and affective flexibility, we conducted correlational analyses to explore the relations between these different attentional mechanisms, and, the relations of these specific attentional mechanisms with individual differences in resilience, positive and negative affect, depression, and rumination. Three participants of the RMD group were excluded for correlational analyses. As mentioned earlier, two were excluded because of general RTs that deviated more than 2.5 SDs from the group mean on the global-local task, emotion interference task or affective flexibility task and a third one was excluded because of responding at chance level on the global trials of the global-local Navon letter task. Because in the affective flexibility task, 8 specific switch costs were used as outcome measures of affective flexibility, a Bonferroni-adjusted significance level of .00625 was calculated to account for the increased possibility of type-I error.

Relations among attentional breadth, general cognitive flexibility, attentional disengagement, and affective flexibility. Table 4 shows the correlation coefficients of the inter-correlations among the attentional processes that were measured. Correlations with specific switch costs are only reported when meeting a significance level of .00625 (Bonferroni-corrected). Main correlations are discussed below.

Attentional breadth. We predicted that attentional breadth would be related to attentional disengagement, and general and affective flexibility. Correlational analyses showed that attentional breadth, as reflected in a preference score for global information in the global-local Navon letter task, was significantly negatively correlated with general switch costs, $r(51) = -.30$, $p = .033$, and with attentional bias for aversive information, $r(51) = -.30$, $p = .034$. Attentional breadth was not related to affective flexibility.

Attentional disengagement. Within the emotion interference task, attentional disengagement from positive information was positively correlated with attentional disengagement from threat, $\rho(51) = .59$, $p = < .001$, revealing that disengaging from emotional stimuli does not specifically depend on the valence of the emotional content of the presented material in this task.

General and affective flexibility. General cognitive flexibility as measured with the global-local Navon letter task did not correlate with specific affective switch costs as measured with the affective flexibility task. Thus, the current measures of cognitive and affective flexibility seem to operationalize largely separate constructs. Furthermore, relations between specific affective switch costs ranged from zero to high, indicating that the specific switching costs measured related but also independent processes.

Individual differences. Because the presence of robust differences between the groups in trait characteristics as measured with the self-report questionnaires, we conducted correlational analyses for each group to examine whether individual differences in these attentional processes were related to depression, rumination, resilience, and positive and negative affect. Correlations with specific switch costs are only reported when meeting a significance level of .00625 (Bonferroni-corrected). Main correlations are discussed below.

Attentional breadth, attentional disengagement and general flexibility were not related to depressive symptoms, rumination, and positive and negative affect in both groups.

However, in the RMD group, attentional breadth was significantly related with the subscale acceptance of self and life of the RS, $r(23) = .49$, $p = .018$, and nearly significantly correlated with the total score of the RS, $r(23) = .40$, $p = .059$.

Interestingly, in the RMD group, the amount of past depressive episodes was nearly significantly associated with general cognitive inflexibility, $\rho(23) = .40$, $p = .052$. Furthermore, in the RMD group, reflective ruminating was positively correlated with switch costs toward negative images when the affective rule is active, $\rho(23) = .58$, $p = .003$.

In the NDC group, there were significant correlations between specific affective switch costs and resilience. That is, switch costs toward a negative image when classifying images according the non-affective rule tended to be positively correlated with total resilience, $\rho(27) = .51$, $p = .007$, and was positively related with acceptance of the self and life, $\rho(27) = .53$, $p = .005$.

Table 4. Inter-correlations between attentional breadth, general cognitive flexibility, attentional disengagement from emotional information, and affective flexibility (*N* = 51). Pearson correlation coefficients are reported for normally distributed variables and are white scaled. Spearman's rank coefficients are reported for not-normally distributed variables and are grey scaled.

Task	Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
GLT	1. Global preference	---	-.30*	-.09	-.30*	-.27	-.29*	.11	.07	-.20	.23	-.18	-.30*	-.02
	2. General switch costs		---	-.04	.05	.04	.01	-.11	-.11	-.03	-.07	.13	.07	-.15
EIT	3. AB Positive			---	.59***	-.31*	.02	.06	-.09	-.16	.22	.08	-.05	-.10
	4. AB Negative				---	-.07	.07	.03	-.20	-.25	-.05	.12	.09	-.16
AFT	5. Switch costs to NA/P					---	.26	-.24	-.11	.31*	-.26	.01	.59***	.36**
	6. Switch costs to NA/N						---	-.10	-.11	.03	.18	.70***	.18	.55***
	7. Switch costs to A/P							---	.22	-.02	.41***	.14	-.13	.34**
	8. Switch costs to A/N								---	.61***	-.04	-.03	.26	.51***
	9. Switch costs to P/ NA									---	-.24	.10	.45***	.53***
	10. Switch costs to N/ NA										---	.15	-.09	.37**
	11. Switch costs to P/A											---	-.09	.56***
	12. Switch costs to N/A												---	.52***
	13. General affective switch costs													---

Note. GLT = Global local task; EIT = Emotion Interference Task; AI = Attentional Interference; AFT = Affective Flexibility Task; NA/P = switching to the non-affective rule when images are positive; NA/N = switching to the non-affective rule when images are negative; A/P = switching to the affective rule when images are positive; A/N = switching to the affective rule when images are negative; P/NA = switching to a positive image when the rule is non-affective; N/NA = switching to a negative image when the rule is non-affective; P/A = switching to a positive image when the rule is affective; N/A = switching to a negative image when the rule is affective.

* Significant at the .05 level
** Significant at the .01 level
*** Significant at the .006 level (Bonferroni corrected)

Table 5. Correlations between all task and questionnaire variables for the RMD group (*N* = 23). Pearson correlation coefficients are reported for normally distributed variables and are white scaled. Spearman's rank coefficients are reported for not-normally distributed variables and are grey scaled.

Task	Variable	BDI	RRS total	RRS brooding	RRS reflection	RS total	RS p. comp.	RS Acc.	PA	NA	Depr. Episodes
GLT	1. Global Preference	.11	.07	.04	-.16	.40	.36	.49*	.32	-.22	-.00
	2. General Switch costs	.11	-.16	-.30	-.08	-.11	-.07	-.16	-.33	-.07	.40*
EIT	3. AB Positive	.30	-.11	-.07	-.18	-.04	-.16	-.06	-.25	-.16	.11
	4. AB Negative	.25	-.02	.14	-.08	-.06	-.20	-.07	-.10	-.04	.15
AFT	5. Switch costs to NA/P	-.51*	.23	.13	.50*	.05	.06	.01	.35	.07	-.18
	6. Switch costs to NA/N	-.06	.12	.08	.27	-.32	-.36	-.31	-.20	-.16	.02
	7. Switch costs to A/P	.26	.10	.24	-.00	.19	.10	.22	-.08	.19	-.25
	8. Switch costs to A/N	-.13	.02	.15	-.06	.07	.04	.15	.20	.16	.10
	9. Switch costs to P/ NA	-.23	.12	.22	.37	.17	.21	.15	.26	.08	-.21
	10. Switch costs to N/ NA	.14	.15	.16	.02	.04	-.06	.14	-.03	-.35	-.51*
	11. Switch costs to P/A	-.03	-.01	.13	.11	-.39	-.47*	-.37	-.22	-.04	.13
	12. Switch costs to N/A	-.47*	.37	.35	.58***	.30	.30	.27	.35	-.15	-.33
	13. General affective switch costs	-.21	.23	.34	.39	.03	.03	.04	.25	-.36	-.26

Note. GLT = Global local task; EIT = Emotion Interference Task; AB = Attentional Bias; AFT = Affective Flexibility Task; NA/P = switching to the non-affective rule when images are positive; NA/N = switching to the non-affective rule when images are negative; A/P = switching to the affective rule when images are positive; A/N = switching to the affective rule when images are negative; P/NA = switching to a positive image when the rule is non-affective; N/NA = switching to a negative image when the rule is non-affective; P/A = switching to a positive image when the rule is affective; N/A = switching to a negative image when the rule is affective.

* Significant at the .05 level; * *p* = .052
** Significant at the .01 level
*** Significant at the .006 level (Bonferroni corrected)

Table 5. Correlations between all task and questionnaire variables for the NDC group (*N* = 27). Pearson correlation coefficients are reported for normally distributed variables and are white scaled. Spearman's rank coefficients are reported for not-normally distributed variables and are grey scaled.

Task	Variable	BDI	RRS total	RRS brooding	RRS reflection	RS total	RS p. comp.	RS Acc.	PA	NA	Depr. Episodes
GLT	1. Global Preference	-.01	.02	-.16	.03	-.14	-.19	.04	-.19	-.21	---
	2. General Switch costs	-.17	-.03	.12	-.07	.20	.20	.13	.29	-.16	---
EIT	3. AB Positive	.28	-.22	-.33	-.15	-.03	-.02	-.04	-.21	.17	---
	4. AB Negative	.00	.03	-.27	.10	.16	.19	.02	.04	.06	---
AFT	5. Switch costs to NA/P	.04	.04	-.02	-.07	.33	.42*	.02	.08	.05	---
	6. Switch costs to NA/N	-.08	.00	.06	-.22	.30	.28	.27	-.15	.05	---
	7. Switch costs to A/P	-.18	-.05	-.17	.06	.17	.20	.10	.27	-.05	---
	8. Switch costs to A/N	-.25	-.23	-.10	-.35	-.02	-.05	-.02	-.01	-.17	---
	9. Switch costs to P/ NA	-.05	-.08	-.13	-.16	.02	.07	-.21	.16	-.05	---
	10. Switch costs to N/ NA	-.17	-.15	.04	-.19	.51**	.47*	.53***	.13	.03	---
	11. Switch costs to P/A	-.15	.09	.19	-.06	-.04	-.04	-.09	-.04	-.22	---
	12. Switch costs to N/A	.13	.14	.12	.01	.15	.19	-.04	.26	.06	---
	13. General affective switch costs	-.09	-.00	-.04	-.11	.23	.27	.03	.12	-.03	---

Note. GLT = Global local task; EIT = Emotion Interference Task; AB = Attentional Bias; AFT = Affective Flexibility Task; NA/P = switching to the non-affective rule when images are positive; NA/N = switching to the non-affective rule when images are negative; A/P = switching to the affective rule when images are positive; A/N = switching to the affective rule when images are negative; P/NA = switching to a positive image when the rule is non-affective; N/NA = switching to a negative image when the rule is non-affective; P/A = switching to a positive image when the rule is affective; N/A = switching to a negative image when the rule is affective.

* Significant at the .05 level
** Significant at the .01 level
*** Significant at the .006 level (Bonferroni corrected)

Discussion

Several studies report that the rate of depression relapse in recovered patients runs up to 72% depending on the number of past episodes (e.g. Kessler, Zhao, Blazer, & Swartz, 1997). This high relapse rate is often explained by cognitive *vulnerability* factors that remain unchanged after recovery. In order to understand the large amount of variability across individuals in their ability to become resilient to new depressive episodes, the current study set out a comprehensive investigation of *resilience-related* attentional processes, such as attentional breadth, attentional disengagement, and general and affective flexibility. In resilience research, the influential broaden-and-build theory of positive emotions (Fredrickson, 1998, 2001) is often used as a theoretical framework for resilience, explaining the association between positive emotions and resilience via broad and flexible attentive information processing mechanisms. Given the crucial role of these attentional mechanisms in the adaptive responding to stressful information, the major interest in this study was to examine whether deficits in these attentional processes could be observed in an RMD sample. To this end, we administered several cognitive experimental tasks measuring each of abovementioned components of attention in a RMD sample and in healthy controls.

The main findings were that no group differences between the RMD and NDC group were observed in attentional breadth, nor in attentional disengagement from emotional material, nor in general flexibility. There were also no group differences found in affective flexibility in terms of flexibility in switching between the affective and non-affective categorizing rule in emotional pictures. However, regardless of the specific rule, results showed that RMD individuals had more difficulties in switching between the rules in positive pictures relative to negative pictures, while the NDCs showed less switch costs in positive pictures relative to negative pictures. Besides these main results, correlational data showed that attentional breadth was related to attentional disengagement from aversive material. Moreover, in the RMD group, we found attentional breadth to be related with resilience. Furthermore, specific affective switch costs were associated with self-reported resilience. We will discuss these main findings in turn.

First, the hypothesis that RMD individuals would show reduced dispositional attentional breadth compared to NDCs was not confirmed. Dispositional breadth of attention was measured using Navon's (1977) global-local letter task, an objective measure of attentional breadth used in many past experiments which has shown robust differences in attentional breadth in previous research (Gable & Harmon-Jones, 2010b; Yovel, Revelle, & Mineka, 2005). Current data did show the commonly found global preference effect, attesting to the reliability of this task. One could argue that the difference in attentional breadth between vulnerable and non-vulnerable individuals is most likely to be apparent when vulnerable individuals experience negative affect (Teasdale, 1988). However, past research showed that not only situationally but also chronic moods were associated with attentional breadth (Basso et al., 1996). In the current study, data of self-reported trait negative affects revealed significantly higher trait negative affect in the RMD group compared with the NDCs.

Second, the hypothesis that RMD individuals would, because of a narrowed attentional scope, show difficulties in disengaging from focal information towards peripheral targets and that this disengagement impairment would be most pronounced for negative material was not confirmed. Similar to the results of the global-local task, the main effect of Group revealed that the RMD group had non-valence specific overall slower RTs. The task showed the well-established finding that participants generally have greater difficulty shifting attention away from negative compared to neutral information, suggesting sensitivity of our attentional bias task (e.g. Fox et al., 2001). Interestingly, individual differences in attentional breadth were negatively significantly correlated with disengagement impairments for negative material, indicating that a broadened attentional scope might be beneficial in disengaging away from aversive information.

Finally, we predicted that the RMD group would show impaired flexibility in neutral and affective information. First, we could not find differences in general flexibility between the RMD and the NDC group. However, despite the absence of robust group differences in flexibility for neutral information, general flexibility seemed to be impaired in RMD individuals with a high amount of previous depressive episodes. Moreover, higher general flexibility was also correlated with a broadened attentional breadth. General flexibility was measured with the global-local Navon (1977) letter task which required participants to flexibly switch between a global and a local attentional set. The task seemed reliable as RTs on switch trials were significantly higher compared with repetition trials. Furthermore, there were also no group differences found in affective flexibility, which was operationalized as the ability to flexibly switch between processing the affective versus neutral components of positive and negative pictures in the affective flexibility task (Malooly et al., 2013). Remarkably, although the groups did not differ in general RTs in the affective flexibility task, they did differ in RTs for the different valences of the images, regardless of switching between image valences or processing rules. That is, the RMD group seemed to react slower on negative relative to positive images in comparison with the NDC group. However, with regard to switch costs, RMD individuals showed less switch costs to switch between the different rules when classifying negative pictures while NDCs showed less switch costs when they are classifying positive pictures. Thus, compared with NDCs, RMD individuals tended to focus their attention longer on negative information, but also seemed to be more used to process both affective and non-affective aspects of negative information as switch cost in negative pictures were lower compared with NDCs. Complementary, this result could also be explained by the idea that healthy individuals tend to direct their attention towards positive information, and, that they are more used to process emotional as well as non-emotional aspects of positive information compared with RMD individuals.

Correlational analyses between resilience-related attentional processes and self-report questionnaire data revealed some interesting correlations between specific affective switch costs and resilience. That is, in the NDC group, resilience was related to more difficulties in switching from positive towards negative information while processing information according to non-affective aspects. Also, in the RMD group, reflective ruminating, which is considered as the more adaptive form of ruminating, was associated with more switch costs to switch from positive to negative information when processing the affective aspects.

In summary, although we could not observe the hypothesized robust group differences in attentional breadth and resilience-related processes, such as disengaging from and flexibly switching between emotional material, we found some indications that a broadened attentional scope is beneficial to disengage from aversive information and general flexibility. Moreover, in the RMD group, a broadened attentional scope was associated with higher self-reported resilience. Next, attentional breadth was correlated with general flexibility. Indeed, according to the broaden-and-build theory (Fredrickson, 1998, 2001), it is thought that a broadened attentional scope enhances cognitive flexibility. Moreover, in the RMD group, a higher amount of previous depressive episodes was associated with an impairment in general flexibility.

It is important to consider whether our failure to detect group differences may be due to methodological issues. First, we aimed to select homogeneous samples for both the RMD and NDC group. That is, participants of the RMD group were only included when they had experienced at least 1 depressive episode with no comorbid disorders; when they were in remission for at least 6 months and, never have been diagnosed for other psychological disorders. For the NDC group, we selected a matched sample for age and gender and included only people with no past and current psychological disorders. We used well-established and reliable measurements to ensure accurate inclusion. Data of self-report questionnaires at testing moment confirmed that the groups did not differ on depressive symptoms nor on positive affect, but did show heightened vulnerability as reflected in higher rumination, negative affect, and lower resilience scores compared with the NDC group. Furthermore, we used well-established and reliable tasks to measure the attentional processes in which we always could detect the commonly found basic effects. However, despite our secure sample selection, matched control group and reliable tasks, we observed large variability in our data which might have reduced statistical power to detect differences. Hence, a sample size of 28 individuals per group could be too small and could prevent finding results when conducting the more fine-grained analyses (for instance, the valence-specific switch costs in the affective flexibility task). This observation might indicate that the current design might not have served as the most adequate test for our hypotheses.

The high variability observed in the RMD as well as in the NDC group might also indicate that the attentional processes that are assumed to underlie resilience (Fredrickson, 2001) are not as robust as hypothesized. Though, additional analyses with individual differences in the attentional processes within the different groups were not totally consistently associated with resilience-related self-reported trait characteristics. Unfortunately, the lack of these correlations might be due to our selection procedure, as this selection limits variability in these self-reported questionnaires.

Finally, it is also possible that differences in attentional processes should not be seen as a trait, but rather as a state-variable. In the literature, attentional breadth, disengagement and flexibility are thought to be associated with several state variables, such as mood, stress, and motivational states. Hence, it is possible that we examined these attentional processes at a time when they were not operative.

The present study aimed to comprehensively test several protective attentional processes that may underlie resilience in an at risk population. As resilience refers to the ability to overcome stress and maintain an effective level of appropriate behavior or performance when confronted with obstacles, distractions, or aversive stimuli, this study is of crucial importance to delineate the protective attentional factors that are thought to promote well-being and reduce the influence of risk factors, such as past depressive episodes. It has become increasingly clear that the attentional processes that are thought to underlie resilience are not yet well-understood and are depended on several intermediate variables (e.g. positive affect, rumination).

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CHAPTER 4

CAN BREADTH AND ORIENTING OF ATTENTION PREDICT WELL-BEING? A PROSPECTIVE STUDY

ABSTRACT

A prospective design was used to examine whether inter-individual differences in breadth and orienting of attention play a moderating role between the occurrence of stress, negative and positive events, and emotional well-being experienced during a stressful period, and emotional well-being 18 months later. At baseline, the Attentional Network Test (ANT) was administered in an undergraduate sample to measure breadth and orienting of attention. Eight weeks after baseline, self-report questionnaires were administered at 4 fixed moments during the examination period at university, measuring negative and positive events, depressive symptoms, and emotional well-being. Eighteen months after baseline measurements, self-report questionnaires measuring depressive symptoms and well-being were administered. Overall results revealed that efficient spatial orienting of attention may, to some extent, foster beneficial effects of positive events on well-being (e.g. lower depressive symptoms), while unexpectedly, greater breadth of attention seemed to elevate depression risk. The theoretical implications of the current findings are discussed.

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INTRODUCTION

Mental health disorders are a leading cause of disabilities worldwide (Alonso et al., 2004). Across the life span, people inevitably experience stressful life events such as loss, failure, threat, humiliation or defeat. The link between adverse or stressful life events and psychological health has been well-established, with many studies reporting that stressful life events can influence the onset or course of psychological disorders, such as depression (e.g. Kendler, Karkowski, & Prescott, 1999a, 1999b; Kessler, 1997). However, not all people who encounter stressful life events develop depressive symptoms. Some individuals can experience a high level of adverse life events without their psychological health being affected. Indeed, resilience refers to the positive side of individual differences in people's responses to adversity (Rutter, 1987). Given that resilience allows individuals to cope well with and overcome adversity, research on underlying mechanisms and characteristics of resilience may be important in management, recovery, and relapse prevention of mental illnesses (Fava & Tomba, 2009).

Interestingly, it has been argued that positive emotions play a crucial role in psychological resilience to stressful events. A central theory of positive emotions, the broaden-and-build theory (Fredrickson, 1998, 2001), states that negative as well as positive emotions have distinct complementary adaptive functions, as well as cognitive and psychophysiological effects. Where negative emotions narrow attention and the behavioral repertoire to cope with specific negative and/or threatening situations, positive emotions *broaden* one's thought-action repertoire. Furthermore, it is proposed in the theory that such a broad cognitive processing style is a crucial factor for processing new information which is involved in physical, intellectual, and social behavior. Over time, this broadened attentional focus would help to *build* resilience (Fredrickson, 2004).

Many researchers have investigated the different proposals of the broaden-and-build theory (Fredrickson, 1998, 2001). First, as the key factor of the proposal that positive emotions trigger resilience is that positive emotions *broaden* attention and cognition, many studies have investigated the relationship between positive emotions and attentional breadth. Indeed, it has been shown that positive emotions produce a broadened conceptual attentional mindset as reflected in patterns of thought that are unusual, flexible, creative, and receptive (Ashby, Isen, & Turken, 1999; Fredrickson, 2004; Fredrickson & Branigan, 2005; Isen, 2001; Johnson, Waugh, & Fredrickson, 2010). Moreover, there is evidence showing that positive emotions also influence a more direct form of attentional breadth. For instance, evidence shows that chronic negative mood states such as anxiety and depression, predict perceptional narrowed attention, whereas positive states such as well-being and optimism predict a broadened perceptual attentional scope (Basso, Schefft, Ris, & Dember, 1996; Derryberry & Tucker, 1994). Thus, affect can tune attentional breadth on both conceptual and perceptual levels.

Second, besides the broadening hypothesis of positive emotions, it is also proposed that the effects of a broadened attentional scope may *build* resilience. In line with this second proposal, recent studies have attempted to reveal the causal impact of attentional breadth on emotional resilience. First, in the emotion regulation literature, researchers have shown beneficial effects of conceptual attentional broadening by training individuals to use reappraisal strategies that broaden peoples' perspective on distressing events on for instance rumination and negative feelings (e.g. Kross, Duckworth, Ayduk, Tsukayama, & Mischel, 2011; Kross, Gard, Deldin, Clifton, & Ayduk, 2012). Other researchers focused on manipulating perceptual attentional breadth. Hanif et al. (2012) showed that participants significantly improved their performance on a stress task after the induction of a broad attentional focus in a visual discrimination task, while participants tended to be worse after the narrow attentional focus induction. These results suggest that attentional breadth training can induce change in emotional resilience.

Interestingly, also the impact of positive emotions on direct and long-term stress resilience has been investigated. It has been proposed that "upwards spirals of positive emotions" may be key for building resilience: the broadened attention and cognition that is triggered by positive emotions, might in turn increase positive emotions because people will be more able to attend to and engage in positive events (Garland et al., 2010). These effects of positive emotions on attentional breadth should accumulate and compound, and over time build resilience. Indeed, a number of studies indicate that positive emotions protect psychological health by "undoing" or buffering against the effects of stress (Cohn, Fredrickson, Brown, Mikels, & Conway, 2009; Fredrickson, Tugade, Waugh, & Larkin, 2003; Tugade & Fredrickson, 2004). It is proposed that in stressful situations, the narrowing of attention is associated with a stress response that prepares the body for action while positive emotions broaden cognitive processing and undo the stress response causing the body to return to a state of homeostasis (Fredrickson & Levenson, 1998). In the laboratory, film clips eliciting positive emotions were associated with faster cardiovascular recovery from a stressful situation than neutral or sad films (Fredrickson, Mancuso, Branigan, & Tugade, 2000). Although these "upward spiral effects" and "undoing stress effects" of positive emotions are explained by attentional breadth, these studies did not include measures of attentional breadth. In contrast, Fredrickson and Joiner (2002) tested the mediating role of attentional breadth by examining whether positive emotions broaden the scope of attention and cognition, and, by consequence, initiate upward spirals toward increasing emotional well-being. They demonstrated that initial positive affect predicted broad-minded coping, characterized by taking a broad perspective on problems and generating multiple possible solutions, 5 weeks later. Also, initial broad-minded coping predicted increased positive affect 5 weeks later. Moreover, mediational analyses showed that positive affect and broad-minded coping serially enhanced one another. These findings support that positive emotions initiate, via broadened cognitions, upwards spirals to enhanced well-being. In this latter study, attentional breadth has been conceptualized in a conceptual modality such as coping strategies and problem-solving. No such studies have been conducted with a more direct measure of perceptual attentional breadth. Given the relationship between more chronic mood states and perceptual attentional breadth (Basso et al., 1996), we propose that visual attentional breadth may also account for the effects of emotional events on emotional well-being.

Although research has shown that positive emotions relate to broadened visual attention, this relationship is probabilistic. For instance, Gable and Harmon-Jones (2010) proposed in their influential theory about the role of motivation (approach vs. withdrawal) that affective states with the same valence can have opposite effects on attentional breadth. Positive as well as negative affect that is low in motivational intensity broadens, whereas affect high in motivational intensity narrows cognitive processes. Besides the fact that not all positive emotions enhance attentional breadth, it is also thought that people tend to have a dispositional or default attentional focus (Dale & Arnell, 2010), which have been related to chronic mood states. Chronic negative mood states such as depression, are characterized by a narrowed attentional focus, whereas positive states are associated with a broadened perceptual attentional scope (Basso et al., 1996; Derryberry & Tucker, 1994; Whitmer & Gotlib, 2012). Hence, because a broadened attentional focus facilitates coping with stress and fosters resilience, we propose that a broad attentional focus will be beneficial for emotional well-being. As people inevitably encounter major positive and negative life events which influence emotional well-being (Needles & Abramson, 1990), we predict that a broad attentional focus will buffer the effects of adverse life events, and enhance the effects of positive events on emotional well-being. In order to examine potential moderation of the relationship between positive and negative events and emotional well-being by attentional breadth, the interaction between positive and negative events, and attentional breadth is tested. If those interactions contribute positively to the experience of emotional well-being, those results would suggest that visual attentional breadth is a crucial factor in enhancing the "upward spiral effect" of positive events and in the "undoing stress effect" of adverse events on emotional well-being. From this perspective, a broad visual attentional focus could be crucial to serve expansive understanding of resilience.

We conducted a prospective longitudinal study in a large group of undergraduates who were tested six times over an 18 month period. As we hypothesized that visual attentional breadth would moderate the relation between emotional life events and well-being, visual attention was assessed at baseline with the Attention Network Test (ANT; Fan, McCandliss, Sommer, Raz, & Posner, 2002). Human attention has been subdivided into at least three functionally and neuro-anatomically separate networks (Fan et al., 2002; Posner & Petersen, 1990). These networks have been claimed to drive three different types of attention, namely alerting, orienting, and selective attention. Although the hypothesized role of positive emotions on spatial attention has usually been measured in selective attention tasks – which would tap into the selective attentional network - the orienting network might be related in similar ways. Some findings suggest that affect influences the ability to overtly attend to the spatial location of a stimulus. Consistent with the hypothesized role of positive affect in cognitive flexibility, it has been shown that positive mood improves the rapid covert orienting of attention (Compton, Wirtz, Pajoumand, Claus, & Heller, 2004; Johnson et al., 2010). The third, alerting function of attention refers to the ability to prepare and sustain alertness to process relevant signals is not thought to be related to positive affect (Compton et al., 2004). Hence, we will investigate the moderating role of the selective and orienting attention networks on the relation between positive and negative events and emotional well-being.

As psychological resilience has been characterized by the ability to bounce back from negative emotional experiences and by flexible adaptation to the changing demands of stressful experiences, and thus is crucial for emotional well-being (Tugade & Fredrickson, 2004), we tested this prediction in the context of a naturalistic stressor (i.e., exam stress; Fox, Cahill, & Zougkou, 2010; Vanderhasselt, Koster, Goubert, & De Raedt, 2012). More specifically, we predicted that emotional events would lead to more psychological resilience in a stressful period, and that this relationship would be stronger in participants with greater spatial attention. We selected a period that included naturally occurring stress events for undergraduates, namely the examination period. It is well known that a period of examination induces high levels of stress (e.g. Fox et al., 2010). During this naturalistic stress generating context, we planned four assessment moments to measure the occurrence of positive and negative events, depressive symptoms, and psychological resilience. Psychological resilience was assessed by measuring the use of adaptive cognitive emotion regulation strategies (CERS) which have been found implicated in well-being (Gross & John, 2003). Moreover, CERS to adaptively deal with stress related thoughts are considered a protective factor against the activation of depressive feelings (e.g. Garnefski & Kraaij, 2006). The use of CERS to cope with potentially stressful cognitions and depressive symptoms were also measured at baseline, unrelated to a stressful situation two months before the start of the examinations.

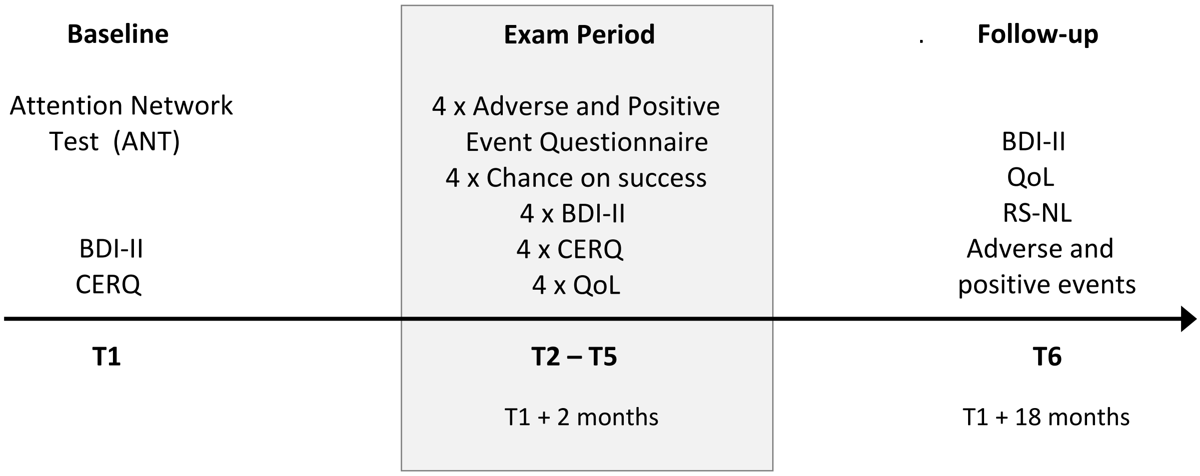
Second, as the attentional broadening effects of positive emotions that facilitate coping with stress and adversity accumulate and compound, this improved coping should over time build people's psychological resilience and enhance their emotional well-being. We predicted that dispositional breadth and orienting of attention would moderate the relationship between the occurrence of major emotional events and emotional well-being after 18 months. At follow-up, emotional well-being was assessed by measuring self-reported depressive symptoms, quality of life, and psychological resilience.

METHOD

Design overview

This study used a prospective design where we examined breadth (selective attention network) and orienting of spatial attention as predictor of emotional well-being (depression, cognitive emotion regulation strategies, quality of life) in the context of a naturalistic stressor (i.e., exam stress; Fox et al., 2010; Vanderhasselt et al., 2012), and as predictor of well-being (depressive symptoms, quality of life, resilience) after 18 months. At baseline (T1), the Attentional Network Test (ANT; Fan et al., 2002) was administered to measure breadth and orienting of attention. Then, participants completed self-report questionnaires measuring depressive symptoms and cognitive emotion regulation strategies (see below). Subsequently, eight weeks after baseline, internet self-report questionnaires measuring stress level, negative and positive events, depressive symptoms, cognitive emotion regulation strategies, and quality of life were administered every week (T2-T5) during the exam period at university. An online questionnaire-based follow-up moment measuring depressive symptoms, quality of life, and resilience, took place 18 months after baseline measurements (T6). A general overview of the design is presented in Figure 1.

Figure 1. Schematic outline of the prospective research design (*N* = 92).



Note. BDI-II: Beck Depression Inventory; CERQ: Cognitive Emotion Regulation Questionnaire; QoL: Quality of Life; RS-NL: Resilience Scale (NL: Dutch version).

Participants

In this study, 92 undergraduates from Ghent University (20 males, 72 females) with a mean age of 20.27 (*SD* = 2.04) participated in return for monetary reward. The study was advertised through an online experiment managing system.

Materials

Breadth and orienting of attention. At baseline (T1), breadth and orienting of attention were measured using the Attention Network Test (ANT; Fan et al., 2002; for details), which was programmed in E-prime 2 and run on a computer with a 60 Hz, 19-inch color monitor. This task is designed to test alerting, orienting, and selective attention. The ANT combines the standard arrow flanker task with a cued reaction time (RT) task. The ANT presents participants with a target item (>) surrounded by congruent (< < < < <), neutral (- - < - -), or incongruent (> > < > >) flanker stimuli. In this task, participants have to decide as quickly and accurately as possible whether this target arrow is pointing left or right using an index finger response on the buttons "1" and "2". On each trial, the set of arrows can be presented either above or below fixation point, and remain on the screen until either the participant makes a response or 1700 milliseconds pass. The ANT also combines multiple warning cues. The manipulations of cue and flanker type allow the calculation of RT difference scores that represent the three attention networks. Three different types of cue are used, as well as a no-cue condition. Alerting is defined as the ability to make use of a temporally informative cue and is evaluated by comparing RTs of the no-cue condition to RTs of the double cue condition (a cue above and below fixation at the two possible target locations). Orienting is the ability to make use of a spatially informative cue above and beyond a temporally informative cue. Orienting is evaluated by comparing RTs of the center cue condition (where the cue is presented at fixation) to RTs of the condition with the single spatially informative cue that appears where the target arrow will appear. Finally, selective attention (the ability to ignore incompatible distractors) has been evaluated by comparing RTs of trials in which the distracter arrows are incompatible with RTs of trials in which the target arrow and the distracter arrows are compatible. All participants completed 12 practice trials with accuracy feedback before performing 3 blocks of test trials, containing a total of 288 test trials, which did not include feedback.

Questionnaires. All questionnaires were administered online using Limesurvey (Schmitz, 2010). To avoid missing values on items of the questionnaires, completion was checked automatically by this program. Participants were only allowed to go to the next questionnaire if all items were answered.

Depression. In order to measure depressive symptoms, the Dutch translation of the Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown, 1996; Van der Does, 2002) was used. The BDI-II is a 21 item (scored from 0 to 3) self-report measure and has been found to be a valid measure to assess depressive symptoms in both clinical and non-clinical samples (Beck et al., 1996; Beck, Steer, & Garbin, 1988). The BDI-II questioned these symptoms concerning the last two weeks. Because the BDI-II is completed weekly during the examination period, participants were instructed to report symptoms of the past week at T2 till T5.

Cognitive Emotion Regulation Questionnaire. The Cognitive Emotion Regulation Questionnaire (CERQ; Garnefski, Kraaij, & Spinhoven, 2001, 2002) was used to measure the self-regulating, conscious cognitive strategies individuals use to cope with arousing thoughts in response to stressful life events. The scale consists of 36 items (responding via a 5 point scale) which are divided into nine conceptually different subscales (each consisting of the sum of four items): acceptance (thoughts of accepting what you have experienced and resigning yourself to what has happened); refocus on planning (thinking about what steps to take and how to handle the negative event); refocus positive (thinking about joyful and pleasant issues instead of thinking about the actual event); positive reappraisal (thoughts of creating a positive meaning to the event in terms of personal growth); putting into perspective (emphasizing the relativity when comparing it to other events); self-blame (thoughts of putting the blame of what you have experienced on yourself); other-blame (thoughts of putting the blame of what you have experienced on the environment or another person); rumination or focus on thought (thinking about the feelings and thoughts associated with the negative event); catastrophizing (thoughts of explicitly emphasizing the terror of what you have experienced). In general, self-blame, rumination, catastrophizing, and blaming on others are considered as maladaptive whereas acceptance, positive refocusing, refocus on planning, positive reappraisal, and putting into perspective are regarded as adaptive (Aldao & Nolen-Hoeksema, 2010; Garnefski et al., 2001). We calculated two sum scores: "CERQ adaptive" referring to individuals' scores to a class of adaptive cognitive emotion regulation strategies; and "CERQ maladaptive" referring to individuals' scores to a class of maladaptive cognitive emotion regulation strategies. The internal consistency of the adaptive as well as the maladaptive subscale at baseline was very high: $\alpha = .93$, $\alpha = .90$, respectively.

Adverse and positive events. The Adverse Event Questionnaire (AEQ; Carver, 1998) is a self-report questionnaire designed for a student population and is intended to measure the occurrence of adverse events. In the current study, participants were asked to indicate if they have had a 'relatively major bad experience' for each day during last week in the examination period by answering "No = 0" or "Yes = 1". Similarly, we examined the occurrence of a 'relatively major positive experience' for each day during the last week in the exam period. We calculated two sum scores: "negative events" referring to the number of days on which they experienced a relatively major adverse event during that week, and "positive events" referring to the number of days on which they had experienced a relatively major positive event during that week (T2-T5). At follow-up (T6), participants indicated whether they have had a 'relatively major bad experience' and 'relatively major positive experience' during the 18 past months by indicating "No = 0" or "Yes = 1".

Chance on exam success. To examine stress levels during the exam period, participants were asked each week how big they estimated their chances to pass all exams, ranging from "1 = very small" to "6 = very big".

Quality of life. The WHOQoL-Bref is a 26-item version of the extended quality of life questionnaire of the World Health Organisation (WHO). This scale provides a valid and reliable index of different domains of quality of life (Skevington, Lotfy, & O'Connell, 2004). The first two items give a good indication of general quality of life (QoL) and general health respectively. Four subscales can be distinguished, indexing physical, psychological, social, and environmental aspects of QoL. The total score reflects a general index of perceived quality of life. All items are scored on a five-point Likert scale ranging from 1 to 5.

Resilience. The Dutch version of the Resilience Scale (RS; Wagnild & Young, 1993), used to measure participant's resilience, consists of 25 items arranged in two subscales: personal competence (17 items) and acceptance of self and life (8 items). Participants rated the extent to which each item reflects them on a 4-point Likert scale, ranging from “1 = totally disagree” to “4 = totally agree”. Construct validity of the RS was supported through correlations with measures of self-esteem and perceived stress. Cronbach’s alpha coefficients for the RS have ranged from .76 to .91.

Procedure

This study was approved by the local ethics committee of the Faculty of Psychology and Educational Sciences of Ghent University. This study was part of a larger project investigating the influence of attentional mechanisms on stress-related thought processes.

In the initial laboratory session, all participants received a complete description of the study and informed consent was obtained. Next, the ANT was administered. At the end of this session, participants received an overview of the dates on which they were required to fill in the online questionnaires. These questionnaires were filled out for the first time on the same day as the initial laboratory session. Approximately eight weeks after the initial laboratory session, all participants were preparing for and performing their examinations. During that period, participants had to fill in questionnaires during four consecutive weeks (T2-T5). Importantly, the instructions of these questionnaires were modified to examine a period of one week. The questionnaires were sent out weekly through an internet application at fixed days. Participants were instructed to complete the questionnaires on the same day or the day after receipt. Finally, participants completed the online questionnaires 18 months after baseline (T6).

Data-analytic strategy: multilevel modeling

To investigate whether breadth and orienting of attention moderated the relation between negative and positive events, and emotional well-being (depressive symptoms, cognitive emotion regulation strategies, quality of life), over 4 time moments during a stressful period, multilevel modeling was used. In this hierarchically nested data structure, online questionnaire data (depressive symptoms, cognitive emotion regulation strategies, quality of life) at T2 - T5 (Level 1) were nested within individuals’ baseline breadth and orienting of attention (ANT) (Level 2). Using the Hierarchical Linear and Nonlinear Modeling software package (Raudenbush, Bryk, & Congdon, 2013), we tested whether there was a linear association between reported stress, negative, and positive events, and depressive symptoms, cognitive emotion regulation strategies, and quality of life (Level 1). Then, we tested if baseline breadth and orienting of attention (Level 2) moderated this linear relationship. Level 1 predictors were standardized and group-mean centered, and level 2 predictors were standardized and grand-mean centered to allow for comparisons across Level-2 units. Full maximum likelihood estimation was used for all models. Significance level was set at an alpha level of .05.

To test our hypotheses, the following set of analyses was executed. First, a baseline model was run to calculate how much variance in depressive symptoms / cognitive emotion regulation strategies / quality of life was attributed to variation between participants (Level 2), and to evaluate whether a multilevel approach was appropriate. Second, the Level-1 predictor stress / positive events / negative events) was entered into the model to investigate the (Level-1) relationship between the predictor and depressive symptoms / cognitive emotion regulation strategies / quality of life. Third, it was investigated how this Level-1 association varied as a function of the Level-2 predictor breadth / orienting of attention. We assumed that participants differed randomly in their overall level on dependent variables (random intercepts), and we allowed that participants differed randomly in the regression coefficients of the Level-1 variable (random slopes). If a random error term was non-significant, it was removed from the model and the independent variable constrained to be fixed across participants (Nezlek, 2001).

RESULTS

Participant characteristics

Mean scores (M) and standard deviations (SDs) of self-report measurements at all test moments are listed in Table 1. One participant was excluded because he did not complete the ANT. Another participant was excluded for analyses because of general RTs deviating more than 3 SDs from the group mean on the ANT. Mean age of the remaining 90 participants was 20.23 (*SD* = 2.03). Most of them were female (20M/70F). Of 90 participants, two did not complete the questionnaires at one test moment, and one did not return the questionnaires at two test moments during the exam period. At the follow-up moment, 16 participants did not return their questionnaires. Their data were all listed as missing.

Table 1. Mean scores (and standard deviations) of all self-report questionnaires at baseline (T1), examination period (T2-T5), and follow-up (T6). Examination period is grey scaled.

	Baseline	Examination period				Follow up
	T1	T2	T3	T4	T5	T6
BDI-II	6.17 (6.33)	8.28 (6.66)	8.11 (7.49)	7.74 (7.80)	5.43 (7.28)	4.70 (5.33)
CERQ adaptive	59.64 (14.57)	57.76 (14.90)	54.89 (15.13)	52.83 (16.99)	52.05 (16.18)	N/A
CERQ maladaptive	36.36 (10.16)	32.98 (10.03)	32.11 (10.82)	31.10 (10.76)	30.29 (10.71)	N/A
Chance on success	N/A	3.49 (1.19)	3.37 (1.23)	3.34 (1.31)	3.17 (1.40)	N/A
Negative event	N/A	.60 (1.35)	.30 (0.68)	.46 (1.18)	.37 (.98)	.52 (.50)
Positive event	N/A	1.19 (1.85)	.68 (1.25)	.96 (1.41)	1.21 (1.60)	.55 (.50)
Quality of life	N/A	98.60 (11.47)	99.53 (12.43)	100.08 (11.56)	103.38 (12.41)	102.23 (11.69)
RS total	N/A	N/A	N/A	N/A	N/A	76.96 (8.07)

Note. BDI-II: Beck Depression Inventory (Beck et al., 1996); CERQ adaptive: sum scores of all the adaptive emotion regulation strategies of the Cognitive Emotion Regulation Questionnaire (Garnefski et al., 2002); CERQ maladaptive: sum scores of all the maladaptive emotion regulation strategies of the CERQ; Chance on success: estimation of the chance of passing all exams, ranging from 1 = very small to 6 = very big; RS: Resilience Scale (Wagnild & Young, 1993).

Perceptual Attention. RT data of the ANT were analysed to index breadth and orienting of attention. Only correct trials were included in the RT analyses (> 96%). A 4 (Cue: no, centre, double, single) x 3 (Flanker: compatible, incompatible, neutral) mixed ANOVA was conducted. Means of the median RTs and SDs for each of the conditions are listed in Table 2. Results showed a main effect of Flanker, $F(2, 88) = 467.80$, $p < .001$, revealing faster RTs for congruent (*M* = 441, *SD* = 46) and neutral flankers (*M* = 444, *SD* = 48), compared with incompatible flankers (*M* = 546, *SD* = 63). Also, there was a main effect of Cue, $F(3, 87) = 298.61$, $p < .001$, revealing faster RT in single cue trials (*M* = 440, *SD* = 54) compared with centre (*M* = 482, *SD* = 52) or double cue trials (M = 475, *SD* = 50), which were again faster than no cue trials (*M* = 512, *SD* = 54). The interaction between Cue and Flanker was significant, $F(6, 84) = 11.89$, $p < .001$.

In order to create individual difference variables for the attention networks, difference scores were calculated for the alerting, orienting and selective attention (≈ attentional breadth) effects. The ANT produced a robust alerting attention effect (RT No cue versus RT Double cue), $t(89) = 17.27$, $p < .001$, orienting attention effect (RT Centre cue versus RT Single cue), $t(89) = 19.89$, $p < .001$, and selective attention effect (RT Incompatible versus RT Compatible), $t(89) = 29.90$, $p < .001$. A higher orienting score indicates faster spatial orienting of attention. A higher selective attention score reflects greater attentional breadth.

Table 2. Means of median RT (milliseconds) and standard deviation in each condition of the Attention Network Test (ANT) (*N* = 90).

	Cue			
Flanker	No	Centre	Double	Single (valid)
Compatible	483 (50)	438 (45)	432 (44)	411 (45)
Incompatible	570 (65)	563 (62)	551 (61)	499 (68)
Neutral	483 (50)	444 (46)	440 (44)	410 (43)

Pearson correlations between the attentional networks and initial depressive symptoms and cognitive emotion regulation strategy scores were calculated. The orienting network score was negatively correlated with selective attention, $r = -.29$, $p = .005$. Furthermore, orienting of attention was negatively correlated with CERQ maladaptive, *r* = -

.22, p = .036, and CERQ maladaptive was significantly correlated with depressive symptoms, r = .41, p < .001. However, after controlling for BDI-II scores, orienting of attention was not significantly related to CERQ maladaptive, r = -.17, p = .116. See Table 3 for zero-order correlations between attentional networks and questionnaire data at baseline.

Table 3. Baseline Pearson correlations between the alerting, orienting, and selective attention network as measured with the Attention Network Test (ANT) and questionnaires at baseline. (N = 90)

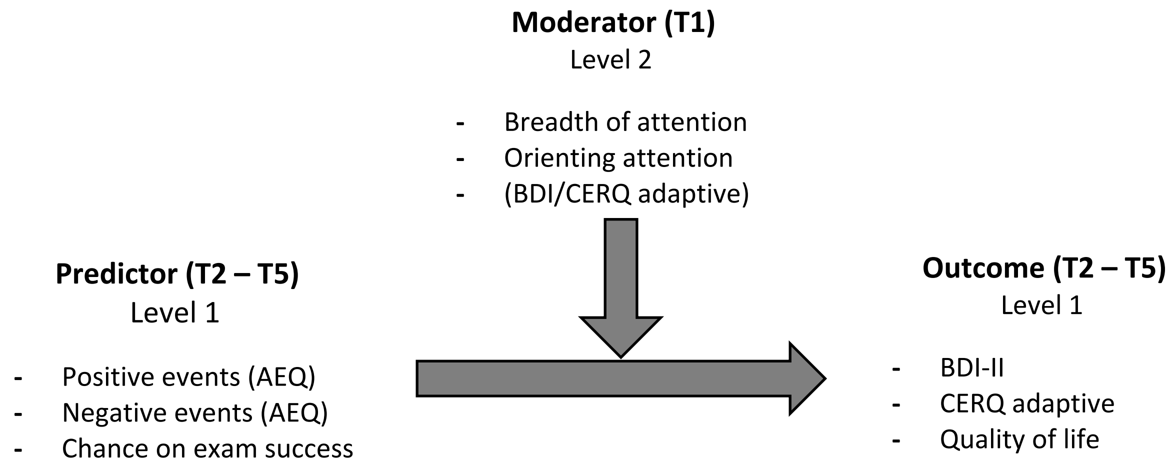
Baseline T1	1	2	3	4	5	6
1 Alerting	---	-.12	-.02	.10	.05	.12
2 Orienting		---	-.29**	-.17	-.10	-.22*
3 Selective			---	.10	.04	.04
4 BDI-II				---	-.13	.41**
5 CERQ adaptive					---	.35**
6 CERQ maladaptive						---

Note. BDI-II: Beck Depression Inventory-II; CERQ adaptive: sum scores of all the adaptive emotion regulation strategies of the Cognitive Emotion Regulation Questionnaire (CERQ); CERQ maladaptive: sum scores of all the maladaptive emotion regulation strategies of the CERQ.
* p < .05; ** p < .01.

Orienting and breadth of attention as moderator between emotional events and well-being during a stressful period

Multilevel models. All tested models are represented in Figure 3. Each Level 1 predictor – Level 1 outcome – Level 2 moderator combination is considered as one model. Thereupon 24 separate models were tested. Each model is examined using the same sequence of statistical tests. In a first step, the variance caused by differences between participants (Level 2) is calculated in the baseline model without predictors. If this variance is significantly different from zero, it is meaningful to continue with a multilevel approach. In a second step, one or more Level 1 predictors are entered into the model. If a significant linear association between a predictor and the outcome is found, cross-level interactions can be tested in a third step. In this final step, the effect of baseline (Level 2) variables on the intercept and slope of the linear Level 1 association is analyzed. Also, baseline BDI-II and CERQ scores can be added as Level 2 variables to control for initial depressive symptoms and CERQ scores.

Figure 3. Multilevel models



In a first step, baseline models without predictors were run for all outcome variables. The baseline models indicated that there was a significant amount of unexplained variance in participants' depressive symptoms (BDI-II), adaptive cognitive emotion regulation strategies (CERQ adaptive), and quality of life (QoL) as significant chi-squares associated with the variance components: $\chi^2(89) = 1115.16$, $p < .001$, $\chi^2(89) = 1267.92$, $p < .001$, $\chi^2(89) = 1443.18$, $p < .001$, respectively, were found. In the second and third step, Level 1 predictors (positive events, negative events, chance on success) and Level 2 moderators (attentional breadth, orienting of attention) were added to the model to test the specific hypotheses, which are outlined below. We predicted that a) positive events, b) negative events, and c) stress level (chance on success) would predict emotional well-being (depressive symptoms, adaptive cognitive emotion regulation strategies, quality of life), moderated by breadth and orienting of attention. Specific models for each hypothesis are outlined below.

Do positive events experienced during a stressful period lead to enhanced well-being in participants with greater breadth and/or orienting of attention? This hypothesis was tested in 6 models: Level 1 association of positive events (AEQ) with BDI-II / CERQ / QoL, moderated by Level 2 breadth / orienting of attention variables, controlled for baseline BDI-II scores. After running the baseline model, positive events was added to the models. Positive events was neither significantly associated with BDI-II, $\beta = -.75$, $t(265) = 1.37$, $p = .172$, nor with CERQ adaptive, $t(265) < 1$, but was significantly correlated with QoL, $\beta = 2.86$, *t*(265) = 3.60, *p* < .001. In a third step, the Level 2 moderators (breadth / orienting of attention) were added to the models.

Depressive symptoms. Although not significant, the association between the number of positive events and BDI-II tended to show a trend towards moderation by breadth of attention, β = .03, *t*(263) = 1.63, *p* = .104, and by orienting of attention, β = -.04, *t*(263) = 1.66, *p* = .098. Thus, a higher number of positive events tended to lead to less depressive symptoms in participants with greater orienting of attention. However, in contrast to our hypothesis, number of positive events tended to lead to more depressive symptoms in participants with greater breadth of attention (selective attention).

Adaptive cognitive emotion regulation strategies. The association between the number of positive events and CERQ adaptive was not moderated by orienting or breadth of attention, both *t*(263) < 1, controlled for baseline CERQ adaptive scores.

Quality of life. The association between the number of positive events and QoL was nearly significantly moderated by breadth of attention, β = -.05, *t*(263) = 1.94, *p* = .053. This means that, unexpectedly, a higher breadth of attention is associated with a decreased positive association between positive events and quality of life. No significant moderation effect was found for orienting of attention, *t*(263) < 1.

Can greater breadth and/or orienting of attention buffer for the effect of negative events experienced during a stressful on emotional well-being? This hypothesis was tested in 6 models: Level 1 association of negative events (AEQ) with BDI-II / CERQ / QoL, moderated by Level 2 breadth / orienting of attention variables, controlled for baseline BDI-II scores. After running the baseline model, the number of negative events was added to the models. The number of negative events was positively associated with BDI-II, β = .85, *t*(265) = 3.75, *p* < .001, CERQ adaptive, β = .94, *t*(265) = 1.89, *p* = .048, and negatively associated with QoL, β = -.1.73, *t*(265) = 5.33, *p* < .001. In a third step, the Level 2 moderators (breadth / orienting of attention) were added to the models.

Depressive symptoms. The association between the number of negative events and BDI-II was not moderated by breadth of attention, *t*(263) < 1, nor by orienting of attention, β = -.02, *t*(263) = 1.19, *p* = .234.

Adaptive cognitive emotion regulation strategies. The association between the negative events and CERQ adaptive was moderated by orienting of attention, β = .05, $t(263) = 2.08$, $p = .038$, controlled for baseline CERQ adaptive scores. This means that a greater orienting of attention was associated with an increased positive association between negative events and CERQ adaptive. No significant moderation effect was found for breadth of attention, $t(263) < 1$.

Quality of life. The association between the number of negative events and QoL was not moderated by breadth or orienting of attention, both $t(263) < 1$.

Does estimated chance on success experienced during a stressful period lead to enhanced well-being in participants with greater breadth and/or orienting of attention? This hypothesis was tested in 6 models: Level 1 association of chance on success with BDI-II / CERQ / QoL, moderated by Level 2 breadth / orienting of attention variables. In a second step, the chance on success was added to the models. Chance on success was negatively associated with BDI-II, β = -1.30, $t(265) = 3.75$, $p < .001$, but not significantly associated with CERQ adaptive, $t(265) < 1$, nor with QoL, β = .72, $t(265) = 1.08$, $p = .279$. In a third step, the Level 2 moderators (breadth / orienting of attention) were added to the models.

Depressive symptoms. The association between chance on success and BDI-II was significantly moderated by breadth of attention, β = .03, $t(265) = 2.44$, $p = .015$. However, this means that, a greater breadth of attention is associated with a less negative association between chance on success and depressive symptoms. No significant moderation effect was found for orienting of attention, $t(263) < 1$.

Adaptive cognitive emotion regulation strategies. The association between chance on success and CERQ adaptive was not moderated by breadth or orienting of attention, both $t(263) < 1$, controlled for baseline CERQ adaptive scores.

Quality of life. The association between chance on success and QoL was not moderated by breadth of attention, $t(263) < 1$. The association between chance on success and QoL was nearly significantly moderated by orienting of attention, β = .08, $t(265) = 1.96$, $p = .051$. This means that, a greater orienting of attention is associated with a more positive association between chance on success and quality of life.

Orienting and breadth of attention as moderator between emotional events and well-being 18 months later

To test the hypothesis whether orienting and breadth of attention (T1) moderated the relationship between the presence or absence of a positive or negative event (T6), and depressive symptoms (BDI-II) (T6), quality of life (QoL) (T6), and resilience (RS total) (T6), controlling for initial depression scores (T1), twelve hierarchical multiple regression analyses were conducted, following the approach of Aiken and West (1991). We used the presence / absence of a ‘relatively major positive and negative event’ experienced during the past 18 months as predictors. Forty-one participants reported to have experienced a relatively major positive event during the past 18 months, and 34 participants did not report having experienced such an event. Thirty-nine participants reported to have experienced a relatively major negative event during the past 18 months, and 36 participants did not report having experienced such an event. All variables were centered and the interactions were calculated by multiplying the centered predictors and moderator scores. In the regression analyses, the centered predictors were added in a first step and the interaction term in the second step of the analyses. See Appendix A for beta values and standard errors, R^2, and significance for all tested models.

Can greater breadth and/or orienting of attention enhance the effects of a positive event on well-being in participants after 18 months? Six moderation analyses with the presence of a positive event (T6) as predictor, depressive symptoms (BDI-II) / quality of life (QoL) / resilience (RS total) (T6) as outcome variable, breadth / orienting of attention (ANT) (T1) as moderators, controlled for baseline depression scores, were conducted.

Depressive symptoms. Results of these regression analyses on depressive symptoms (T6) revealed that attentional breadth did moderate the relationship between positive events and depressive symptoms. The interaction term (positive event x attentional breadth) was a significant predictor, $b = .10$, $se = .04$, $t(70) = 2.45$, $p = .017$, and added an explained variance to the model of $\Delta R^2 = .07$. To better understand this moderation effect, we estimated different conditional effects of the focal predictor on the outcome variable at low (one SD below the mean), moderate (sample mean), and high (one SD above the mean) values of the moderator, using Hayes and Matthes (2009). Results show a negative correlation between positive event and depressive symptoms for a low level of attentional breadth, $b = -3.60$, $t(70) = 2.05$, $p = .045$. Such relation was non-significant for a moderate level (mean) or high level of attentional breadth, $b = -.64$, $t(70) < 1$, $b = 2.32$, $t(70) = 1.33$, $p = .186$, respectively. This indicates that the presence of a positive event could significantly predict lower depressive symptoms, but only in individuals with a smaller breadth of attention.

Orienting of attention also significantly moderated the relationship between positive event and depressive symptoms, $b = -.18$, $t(70) = 2.61$, $p = .011$, and added an explained variance to the model of $\Delta R^2 = .08$. Results show a negative correlation between positive event and depressive symptoms for a high level of orienting of attention, $b = -3.65$, $t(70) = 2.09$, $p = .040$. Such relation was non-significant for a moderate level (mean) or low level of orienting of attention, $b = -.50$, $t(70) < 1$, $b = 2.65$, $t(70) = 1.52$, $p = .132$, respectively. Thus, the presence of a positive event could significantly predict lower depressive symptoms in individuals with a higher level of orienting of attention.

Quality of life. Neither breadth, nor orienting of attention moderated the relation between the presence or absence of a positive event and quality of life.

Resilience. Neither breadth, nor orienting of attention moderated the relation between the presence or absence of a positive event and resilience.

Can greater breadth and/or orienting of attention buffer for the adverse effects of a negative event on well-being in participants after 18 months? Six moderation analyses with the presence of a negative event (T6) as predictor, depressive symptoms (BDI-II) / quality of life (QoL) / resilience (RS total) (T6) as outcome variable, breadth / orienting of attention (ANT) (T1) as moderators, controlled for baseline depression scores, were conducted.

Depressive symptoms. Neither attentional breadth, nor orienting of attention moderated the relation between the presence or absence of a negative event and depressive symptoms.

Quality of life. Breadth of attention significantly moderated the relationship between the presence or absence of a negative event and quality of life, $b = .18$, $t(69) = 2.30$, $p = .024$, and added an explained variance to the model of $\Delta R^2 = .06$. Results show a negative correlation between the presence of a negative event and quality of life for a low and moderate level of attentional breadth, $b = -14.08$, $t(69) = 4.08$, $p < .001$, $b = -8.48$, $t(69) = 3.46$, $p < .001$, respectively. Such relation was non-significant for a high level of attentional breadth, $b = -2.89$, $t(69) < 1$. In line with the predictions, these results indicated that in the presence of a negative event, a low and moderate level of attention breadth resulted in lower quality of life.

Orienting of attention did not moderate the relation between the presence of a negative event and quality of life.

Resilience. Neither breadth, nor orienting of attention moderated the relation between the presence or absence of a negative event and resilience.

Discussion

The broaden-and-build theory (Fredrickson, 1998, 2001), proposes that attentional breadth is a crucial factor in enhancing the beneficial effects of positive emotions, as well as in buffering the detrimental effects of negative emotions on emotional well-being, which over time helps to build resilient responding to daily life stressors. Using a prospective longitudinal design, we investigated in a large sample of undergraduates whether spatial breadth and orienting of attention moderated the relation between emotional life events and emotional well-being during a real life stressful examination period at university, and out of an examination period 18 months later. Breadth and orienting of attention were assessed at baseline measurement outside of a stressful period 2 months before the examination period. During the examination period, we assessed well-being via measuring depressive symptoms, quality of life and adaptive cognitive emotion regulation strategies (CERS). Adaptive CERS have been found implicated in well-being (Gross & John, 2003) and are considered a protective factor against the activation of depressive feelings (e.g. Garnefski & Kraaij, 2006). Furthermore, we tested whether dispositional breadth and orienting of attention could predict the relationship between the occurrence of major emotional life events and emotional well-being after 18 months. At this follow-up moment emotional well-being was assessed by measuring self-reported depressive symptoms, quality of life, and resilience.

Our hypothesis was twofold. First, we predicted that greater breadth and orienting of attention would enhance the "upward spiral effect" of positive life events on emotional well-being. Indeed, results partly showed that breadth and orienting of attention seemed to play a moderating role on the relationship between positive life events and emotional well-being. During the examination period, greater orienting of attention seemed to enhance the negative association between the number of positive events and depressive symptoms, and the positive association between chances on exam success and quality of life. Hence, orienting of attention seemed to positively have contributed to emotional well-being. However, in contrast to our hypothesis, in participants with higher breadth of attention, the number of positive events and chances on exam success tended to lead to more depressive symptoms. Similarly, during this stressful period, greater breadth of attention was associated with a decreased positive association between positive events and quality of life. Hence, as opposed to orienting of attention, higher levels of breadth of attention seemed to have influenced well-being in a negative way. Interestingly, breadth and orienting of attention moderated the relationship between the presence of a major positive life event and emotional well-being after 18 months in similar ways. That is, the presence of a positive event significantly predicted lower depressive symptoms in individuals with a higher level of orienting of attention, and, in contrast to our hypothesis, in individuals with lower levels of attentional breadth. Breadth and orienting of attention did not moderate the relationship between positive events and resilience (CERS and RS) within and outside a stressful period.

Second, we predicted that greater breadth and orienting of attention would facilitate the "undoing stress effect" by buffering for the effects of negative life events on emotional well-being. Results showed that greater orienting of attention enhanced the use of adaptive cognitive emotion regulation strategies when facing negative events during a stressful period. Also, after 18 months, the presence of a negative event lead to lower quality of life for low and moderate levels, but not for high levels of attentional breadth. However, breadth and orienting of attention did not moderate the relationship between negative events and depressive symptoms and quality of life within a stressful period, nor between the presence of a negative life event and depressive symptoms and resilience outside of a stressful period.

Remarkably, the overall findings of the present study tended to show that efficient spatial orienting of attention may foster beneficial effects of positive events on well-being (e.g. lower depressive symptoms), while unexpectedly, greater breadth of attention seemed to have opposite effects. One explanation for this unexpected result may be found in the conceptualization of the two different components of spatial attention. In the literature, a broad distinction is made into spatial attentional processes that are related to the breadth of attention and the orientation of attention (Derryberry & Tucker, 1994). Breadth of attention refers to the idea that the perceptual scope of attention can be adjusted. It is thought that the visual attentional scope can constrict to focus more on the detailed information, with high resolving power, or alternately focus on a large region of space, with lower resolving power (C. W. Eriksen & Stjames, 1986). The orienting approach views attention in terms of a flexible mechanism whose direction can be adjusted by disengaging from a current location, moving to a new location, and engaging in the new location (Posner & Petersen, 1990). Interestingly, breadth and orienting of attention may be related as positive emotions motivate a focus on global, broad patterns rather than specific details and features (Basso et al., 1996), and are also shown to foster flexible thinking and flexible adaptation to accommodate behavior to changes in the environment. In this study, orienting and breadth of attention were assessed with the ANT (Fan et al., 2002), which combines a cued reaction time task (Posner & Petersen, 1990) and the Eriksen flanker task (B. A. Eriksen & Eriksen, 1974) to assess alerting, orienting and selective attention. Breadth of attention has usually been measured in selective attention tasks which would tap into the selective attentional network in the ANT. The idea is that a broader attentional scope in the visuospatial domain is reflected by an impairment of spatial selective attention, whereby ignored information is more fully processed (Lavie, Hirst, de Fockert, & Viding, 2004). Indeed, it is shown that positive affect can impair visual selective attention by increasing processing of spatially adjacent flankers in the Eriksen flanker task (Rowe, Hirsh, & Anderson, 2007), because positive mood would reflect a global relaxation of cognitive control resulting in an altered capacity for selective attention (Friedman & Miyake, 2004). Cognitive control refers to the ability to override pre-potent responses and to inhibit the processing of irrelevant information (Miyake et al., 2000). However, impaired cognitive control is also considered as an important vulnerability factor for psychopathology such as depression (for a review, see Joormann & D'Avanzato, 2010). De Raedt and Koster (2010) proposed that reduced cognitive control may also lead to increased vulnerability for depression after recurrent episodes because vulnerable individuals fail to disengage from negative material, which can in turn enhance depressive symptoms. Moreover, theories of depression have also argued that this mood disorder is associated with a narrowed attentional scope, which should facilitate performance on such selective attention tasks. However, evidence shows that depression is associated with impaired response monitoring and control processes (Vanderhasselt & De Raedt, 2009). Hence, the conceptualization of breadth of attention as impaired selective attention may be more an assessment of cognitive control rather than a measure of the specific breadth of the attentional focus.

At a theoretical level, our findings do not support the idea that the broadening of attention helps explaining the association between positive mood and higher-level processes such as stress resilience (Fredrickson, 2001), and health (Burton & King, 2009). However, orienting of attention, the ability to overtly attend to the spatial location of a stimulus, seemed, to some extent, to foster mental well-being. Orienting of attention reflects spatial flexibility of attention, and positive mood has shown to improve the rapid orienting of attention (Compton et al., 2004; Johnson et al., 2010). Hence, a possible explanation for the current results could be that not the breadth of the attentional scope per se, but rather the flexible orienting of spatial attention underlies the association between positive mood and stress-resilience**.** Notably, in the literature, broadening the focus of attention is associated with enhanced cognitive flexibility (Olivers & Nieuwenhuis, 2005).

Although the present study has a number of strengths at the methodological level, such as a large sample size and the use of a prospective longitudinal design, there are some limitations. The use of a sample of undergraduates limits the generalizability of our results. Moreover, because the majority of our sample consisted of females, we are unable to test gender effects. Future research based on larger and more representative populations are therefore warranted to extend the current findings for theoretically breadth and orienting of spatial attention.

In summary, the results of the current study provide new insights for the idea that spatial attention can attenuate the association between emotional events and mental well-being. A better understanding of the individual differences in spatial attention could help to gain more insight in individual trajectories and in the long-term impact of these mechanisms on psychological health and well-being, which has important implications for clinical practice.

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APPENDIX

Appendix A. Regression table for the multiple hierarchical regression approach of the moderation analyses. Predictive interactions between the presence of a positive or negative event with breadth and orienting of attention for depression, quality of life, and resilience.

	Coefficients				Model statistics		
T6	*b*	SE b	*t*	*p*	*F*	*P*	R^2
Depression							
Model 1					3.35	.014	.16
Constant	3.40	.85					
Depression (T1)	.25	.10	2.60	.011			
Positive event	-.64	1.26	.50	.616			
Breadth of attention	-.01	.02	.72	.474			
Interaction	.10	.04	2.45	.017			
Model 2					3.39	.014	.16
Constant	3.38	.84					
Depression (T1)	.24	.10	2.49	.015			
Positive event	-.50	1.25	.40	.692			
Orienting of attention	.01	.03	.41	.681			
Interaction	-.18	.08	2.61	.011			
Model 3					5.66	< .001	.24
Constant	3.67	.79					
Depression (T1)	.18	.09	2.05	.045			
Negative event	4.39	1.15	3.81	< .001			
Breadth of attention	-.02	.02	.85	.401			
Interaction	-.01	.04	.33	.743			
Model 4					5.71	< .001	.25
Constant	3.71	.79					
Depression (T1)	.18	.09	2.03	.046			
Negative event	4.50	1.16	3.89	< .001			
Orienting of attention	.03	.03	.80	.425			
Interaction	.03	.07	.44	.661			
Quality of Life							
Model 1					2.99	.025	.15
Constant	105.83	1.82					
Depression (T1)	-.61	.21	2.90	.005			
Positive event	6.54	2.73	2.39	.019			
Breadth	.04	.04	.89	.377			
Interaction	-.07	.09	.82	.417			
Model 2					2.82	.031	.14
Constant	105.75	1.82					
Depression (T1)	-.59	.21	2.81	.007			
Positive event	6.23	2.73	2.29	.025			
Orienting	-.01	.07	.20	.843			

Interaction	.15	.15	1.00	.319			
Model 3					5.93	< .001	.26
Constant	104.51	1.67					
Depression (T1)	-.36	.19	1.89	.062			
Negative event	-8.48	2.45	3.46	< .001			
Breadth	.03	.04	.68	.499			
Interaction	.18	.08	2.30	.024			
Model 4					4.62	.002	.21
Constant	104.34	1.72					
Depression (T1)	-.37	.20	1.87	.066			
Negative event	-8.52	2.53	3.37	.001			
Orienting	-.02	.07	-.22	.827			
Interaction	-.16	.14	1.13	.260			
Resilience							
Model 1					3.03	.023	.15
Constant	79.80	1.26					
Depression (T1)	-.47	.14	3.24	.002			
Positive event	3.94	1.89	2.09	.041			
Breadth	.00	.03	.00	.999			
Interaction	-.02	.06	.26	.794			
Model 2					3.40	.013	.16
Constant	79.74	1.24					
Depression (T1)	-.46	.14	3.26	.002			
Positive event	3.90	1.86	2.10	.039			
Orienting	.02	.05	.32	.751			
Interaction	.11	.10	1.13	.261			
Model 3					2.66	.040	.13
Constant	79.08	1.25					
Depression (T1)	-.34	.14	2.43	.018			
Negative event	-2.95	1.83	1.62	.110			
Breadth	-.01	.03	.27	.787			
Interaction	.04	.06	.67	.503			
Model 4					2.82	.032	.14
Constant	79.07	1.24					
Depression (T1)	-.36	.14	2.54	.013			
Negative event	-2.82	1.82	1.55	.126			
Orienting	.02	.05	.40	.685			
Interaction	-.11	.10	1.02	.131			

CHAPTER 5

CAN MANIPULATIONS OF FOCAL ATTENTION FACILITATE THREAT PROCESSING?[1]

ABSTRACT

In recent years cognitive-motivational theories have argued that attentional breadth exerts a major influence on cognitive processes and emotional disposition. Interestingly, theorists have proposed that greater attentional breadth might be of crucial importance in building psychological resilience to stress. A number of recent studies designed to examine the causal relationship between attentional breadth and emotional resilience have yielded promising results. In a series of 4 experiments, we aim to replicate and extend this work by investigating whether training procedures designed to induce differential attentional breadth also serve to alter biased attentional responding to threat information. Across these different experiments we also assess the transfer of such attentional breadth training across tasks through training procedures. Results show that it is possible to manipulate attentional breadth. However, we observed no impact of this attentional breadth training either on our measures of biased attentional responding to threat, or on attentional breadth measures not directly related to the training task.

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[1] Bruyneel, L., Koster, E. H. W., Notebaert, L., MacLeod, C., & De Raedt, R. (2013). Can manipulations of focal attention facilitate threat processing? *Unpublished manuscript.*

INTRODUCTION

In recent years cognitive-motivational theories have argued that attentional breadth plays a major role in cognitive processes and emotion. It has been proposed that greater breadth of attention affects basic processes such as perception and associative thinking (Bar, 2009) in ways that can positively influence higher-order mental processes such as problem-solving, emotion regulation, and creativity (Fredrickson & Branigan, 2005). Emotional and motivational phenomena that have been linked to individual differences in attentional breadth include, among others, positive mood (Gasper & Clore, 2002), approach and avoidance motivation (Gable & Harmon-Jones, 2010a), rumination (Whitmer & Gotlib, 2012), and anxiety (Derryberry & Reed, 2002).

In the context of psychopathology, it has been observed that negative affect is characterized not only by narrowed attention, but also by selective difficulty moving attention away from negative information. Furthermore, it has been argued that narrow attention may causally contribute to this attentional bias, thereby maintaining negative affect and contributing to unconstructive thinking such as rumination (Koster, De Lissnyder, Derakshan, & De Raedt, 2011). In contrast, positive affect is characterized by greater attentional breadth, and it has been suggested that this may functionally enhance psychological resilience to stress (Fredrickson, 2004).

While the idea that attentional breadth may causally impact on emotional states is an interesting and important one, the existence of an association between attentional breadth and emotional functioning need not imply a causal relationship of this nature. Indeed, there is much evidence that emotional state can causally influence attentional breadth. For example, a large number of studies have demonstrated that positive emotional states expand, and negative states narrow the scope of attention on both perceptual and conceptual levels. This supports the Easterbrook (1959) hypothesis, according to which anxious emotional states, characterized by high physiological arousal as well as negative valence, narrow the scope of attention. According to Derryberry and Tucker (1994) a narrow attentional scope can be adaptive under threatening circumstances, as it facilitates concentration on the problem at hand thus creating potential solutions. A narrowed attentional scope decreases encoding of information that is not at the center of attention, which will make it easier for individuals to respond to target information in the presence of distracting information, but more difficult for them to notice important changes in the environment (Biss, Hasher, & Thomas, 2010; Dreisbach & Goschke, 2004). Indeed, increased anxiety has been shown to be associated with an enhanced focus on the local features of composite visual stimuli, as well as reduced attention to how these features are globally configured (Derryberry & Tucker, 1994; Tucker & Williamson, 1984). However, when the individual is no longer in a threatening situation, broadened attention is adaptive as it increases the likelihood of detecting novel incentives and enables individuals to update mental representations of their external environment. Fredrickson (2001) has suggested that the broadening of attention produced by positively valenced emotions prompts individuals to engage in atypical patterns of thought and actions. This facilitates building an expanded repertoire of responses and resources that can aid in survival when threats arise. In line with this proposition, numerous studies support this general idea that positive affects lead individuals to focus globally at the expense of the local information, whereas for negative moods the reverse is true. For example, Gasper and Clore (2002) had their participants write about a happy and positive or a sad and negative life event. In the subsequently presented Kimchi-Palmes-figures-task they found that happy moods lead to global processing whereas sad moods lead to local processing. Not only situationally induced but also chronic moods, such as trait happiness and optimism, are associated with attention toward global as opposed to local structures, whereas trait depression and anxiety correlate negatively with global processing (Basso, Schefft, Ris, & Dember, 1996).

While the above findings demonstrate that negative and positive emotion can serve to narrow and broaden attention respectively, it is also plausible that variation in attentional breadth can serve to influence emotion. Theorists have causally implicated broader attentional processing of crucial importance in building psychological resilience to stress, which is defined as "the effective coping and adaptation although faced with hardship, or adversity" (Tugade & Fredrickson, 2004). Several recent studies have demonstrated that trait resilience is associated with successful psychological and physiological adaptation to stress (Campbell-Sills, Barlow, Brown, & Hofmann, 2006; Campbell-Sills, Cohan, & Stein, 2006; Fredrickson, Tugade, Waugh, & Larkin, 2003) and with effective emotion regulation (Barrett, Mesquita, Ochsner, & Gross, 2007). As efficient allocating attention towards and away from emotional material seems a crucial factor for resilient responding to stress, the current research sought to examine the association between attentional breadth and selective attentional responding to emotional material. Indeed, greater breadth of attention may facilitate reallocation of attention to alternative stimuli, and thereby may assist with attentional avoidance of aversive stimuli. Variability in breadth of attention has been causally implicated in the determination of emotional resilience, mood, and psychopathology. For instance Calvo and Eysenck (2000) proposed that anxiety is characterized and maintained by initial broad vigilance for threat followed by strong attentional narrowing towards and by difficulty attentionally avoiding threat. Such an attentional bias is also considered a hallmark feature of depression and rumination (De Raedt & Koster, 2010; Koster et al., 2011).

In order to test the hypothesis that narrow breadth of attention might causally contribute to the biased attentional processing of threat information known to characterize emotional dysfunction, this present study exposed participants to training procedures designed to directly manipulate attentional breadth in order to test the prediction that this manipulation will also modify biased attentional responding to threatening information. Several recent studies have attempted to reveal the causal impact attentional breadth on emotional resilience by directly manipulating breadth of attention. For example, Gable and Harmon-Jones (2012) showed in an ERP-study that manipulating attentional breadth influenced attentional capture by disgust pictures. In this study, attentional breadth was manipulated on a trial by trial basis, by presenting either a global or local stimulus before presenting an affective picture. In contrast, other researchers have endeavored to induce more enduring change in attentional breadth, by using training variants of classic global versus local processing tasks (Basso et al., 1996) inspired by CBM literature. In classical CBM studies, researchers usually have tried to change biased attentional responding to emotional information through cognitive training methodologies where participants are exposed to an experimentally established contingency during performance of a simple task designed to encourage the acquisition or attenuation of the target attentional bias (Koster, Fox, & MacLeod, 2009). Along similar lines, Hanif et al. (2012) recently developed a procedure designed to manipulate attentional breadth using a training variant of the global-local task. In order to modify attentional breadth, participants were presented with hierarchical shape stimuli and were asked to only identify the global shape in the training condition intended to broaden attention, or to only identify the local shape in the training condition intended to narrow attention. These alternative attentional training conditions were found to also differentially modify emotional reactivity to a subsequent stressor. Participants significantly improved their performance on a self-regulation task after the induction of a broad focus of attention in a visual discrimination task, while participants tended to be worse after the narrow attentional focus induction. These results suggest that attentional breadth training can induce change in emotional resilience.

Given these encouraging results, we set up a series of 4 experiments to determine if it is possible to replicate the finding that breadth of attention can be experimentally manipulated, and to examine whether this serves to alter the type of selective attentional responding to emotional information associated with resilient emotional responding to stress. In experiments 1 and 2 we used attentional breadth training procedures based on Hanif et al. (2012), using a similar global-local target identification task, while in experiment 3 and 4 we introduce a novel attentional breadth training task. We examined the influence of manipulating visual attentional breadth on a probe task designed to assess selective attentional responding to differentially valenced emotional stimuli (experiment 1-3). In experiment 4, we examined the influence of manipulating attentional breadth on a stressor task (Hanif et al., 2012). Across these different studies we examined the degree to which change in attentional breadth, induced by the training procedure, generalized to alternative measures of attentional breadth. To anticipate the results, we show that it is possible to manipulate attentional breadth (experiment 3-4). However, we observed no transfer of training neither to other attentional breadth tasks (Navon, 1977), not did we find any effect of such training on biased attentional responding to emotional stimuli, and we observed no impact of the attentional breadth training on emotional resilience.

EXPERIMENT 1 & 2

Experiments 1 and 2 tested the hypothesis that there is a causal relationship between attentional breadth and capacity to move attention away from threatening stimuli. Because broader visual attention may enable more ready reallocation of attentional resources to alternative stimuli, it may assist attentional avoidance of aversive stimuli. To test this hypothesis, we exposed participants to a training procedure designed to directly manipulate attentional breadth in order to examine participants ability to attentionally avoid threatening images.

In line with previous research, we selected variants of the global-local letter task developed by Navon (1977) both to assess and to create the training designed to manipulate attentional breadth. Previous research using assessment versions of this task has shown that affective and motivational states are associated with differences in attentional breadth, with positive affect low in approach motivation being associated with broader attention as evidenced by preferential processing of global relative to local target stimuli (Gable & Harmon-Jones, 2010a). To examine biased attentional responding to threatening stimuli, we used a paradigm based on an approach adopted by several previous researchers (Fox, Russo, Bowles, & Dutton, 2001; Georgiou et al., 2005). In this attentional bias assessment task, a single threatening, positive or neutral image is presented in the centre of the screen (focal attention). After a brief interval (250 ms), a target probe is presented at one of four spatially different locations (above, below, right or left from the central image), which participants must respond to. Thus, participants must move attention away from the central image, and towards the peripherally presented target probes. The time taken to identify the target probes was used as an index of how easily participants could move their attention away from the stimulus image presented in the middle of the screen. Participants performed this task before and after the attentional breadth training procedure, which was slightly different between experiments (see below). In both experiments, participants were randomly assigned to a broad or narrow attentional breadth training condition. The training procedure consisted of the global-local task, configured either in a manner designed to encourage narrowing of attention (by consistently requiring processing of the local rather than global feature of the composite stimuli) or to encourage broadening of attention (by consistently requiring processing of the global rather than local feature of the composite stimuli). The hypothesis that greater attentional breadth facilitates selective attentional avoidance of threatening information generates the prediction that participants receiving the training designed to broaden attention will come to move attention away from threatening central images more quickly than participants who instead receive the training designed to narrow breadth of attention.

As both experiments used similar designs, tasks and hypotheses, analyses were conducted on data across the 2 experiments where possible to increase statistical power.

METHOD

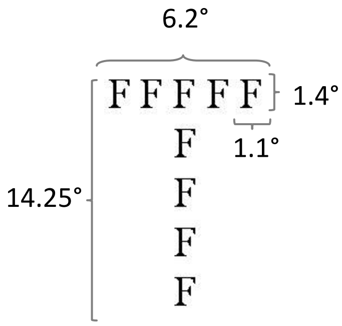
Participants

Across the 2 experiments, participants were 110 undergraduate students (90 females, 20 males) with a mean age of 21.93 years (*SD* = 2.83) ranging from 18 to 33 years. Participants were randomly assigned to either the broad or the narrow attentional breadth training group. Age and gender rates did not differ between experiments, nor between groups within experiments, all *p*s > .05. Group characteristics for each experiment separately are described in Table 3.

Materials

Attentional Breadth Assessment Task. In both experiments, participants' attentional breadth was measured with a global-local Navon Letter task (Navon, 1977). The task was programmed using the E-PRIME 2 software package. Participants were approximately seated at 60 cm from the screen. Black stimuli were presented against a white background on a 17 inch computer screen. On every trial, a black fixation cross was presented in the middle of the screen for 500 ms. Then, 1 of 8 global-local Navon figures (Navon, 1977) was presented. The target in each figure was either the letter T or the letter H. On each trial, only one of these two letters was presented, either as a local shape (e.g. the global letter L made up of little T's) or as a global shape (e.g. the global letter H made up of little K's). On each trial, participants had to indicate whether the target presented was a T or an H, as quickly and accurately as possible. Thus, a local trial was one in which the target was the local feature, whereas a global trial was one in which the target was the global feature (Figure 1). All global-local figures were written in upper-case letters (Times New Roman). Global letters were either T's composed of local F's or L's, or global H's composed of local F's or L's. Each global letter encompassed a horizontal visual angle of 6.2° and a vertical angle of 14.3°, whereas each local letter encompassed a horizontal visual angle of 1.1° and a vertical angle of 1.4°. 50% of the trials were figures with a global target, 50% with a local target. The target remained on the screen until response. Responses were made by pressing one of two keys on a standard AZERTY keyboard. The intertrial interval was 2000 ms. In experiment 1 this attentional breadth assessment task was given once and delivered 64 trials. In experiment 2 this assessment task was given twice, once before and once after exposure to the intended training procedure, and on each occasion it delivered 32 trials (Table 3).

Figure 1. Visual angles and example of a global-local stimulus of the Attentional Breadth Assessment Task.

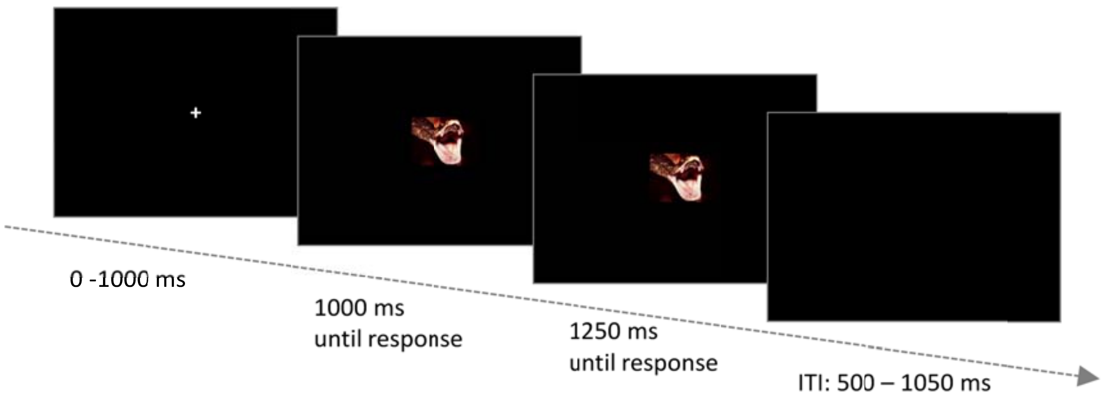


Attentional Bias Assessment Task. To measure attentional bias, reflecting differences in relative speed to move attention away from threatening emotional material, participants performed 1 of 2 versions of an attentional probe task based on Fox et al. (2001). Because participants performed this task before and after training, we selected 2 different sets of cues of which the order was counterbalanced across participants. On each trial of this task, participants were required to move attention away from a central picture in order to process a peripheral target probe. The task was programmed using the INQUISIT Millisecond software package. In both versions, cues and targets were presented against a black background on a 17 inch computer screen. Participants were seated approximately 60 cm from the screen. On every trial, a white fixation cross was first presented in the middle of the screen, and participants were told to direct attention to this location. To encourage participants to focus on this fixation point, on +/-10 percent of the trials the fixation cross was replaced by a digit ranging from one to three after 1000ms that participants were required to identify. This digit remained on the screen for 100 ms, and participants were required to indicate which digit they had seen by pressing the corresponding key on the AZERTY keyboard. However, on +/- 90 percent of the trials, the fixation cross instead was replaced with single picture (height: 4.0 cm, width: 5.3 cm). 250 ms after presentation of this picture, a target probe appeared (& or @ in ARIAL, 18) 3.5 cm above, under, left or right from the picture (Figure 2). Participants were instructed to identify this target probe, and indicate its identity as quickly and accurately as possible, by pressing one of two keys on a standard AZERTY keyboard. The intertrial interval varied randomly between 500 and 1050 ms. The set of pictures, comprised 8 neutral, 8 positive, and 8 threatening images selected from the International Affective Picture System (Lang, Bradley, & Cuthbert, 2008). The positive and threatening set of pictures were matched for arousal ratings (Table 1). On the basis of the original ratings of these pictures, valence scores of the neutral pictures were significantly higher than those of the threatening pictures and significantly lower than those of the positive pictures (Table 1). A further 8 neutral pictures were selected for use in practice trials. The practice phase consisted of 16 trials, and during the practice task an error message was presented after incorrect responses. The main task delivered 128 trials. No error messages were presented in the test block.

Table 1. Means and SDs of arousal and valence ratings on a 9-point Likert scale for selected IAPS pictures for the 2 sets in the Attentional Bias Assessment Task.

		Practice Phase	Test Phase		
		Neutral	Neutral	Positive	Threat
		M (SD)	M (SD)	M (SD)	M (SD)
Set 1	Arousal	2.68 (.32)	2.78 (.65)	6.41 (.75)	6.73 (.36)
	Valence	5.30 (.51)	4.95 (.39)	7.31 (.64)	2.89 (.84)
Set 2	Arousal	2.68 (.32)	2.75 (.46)	6.47 (.47)	6.67 (.45)
	Valence	5.30 (.51)	4.83 (.29)	7.20 (.54)	2.66 (.55)

Figure 2. Example and sequence of a trial of the Attentional Bias Assessment Task.



Attentional breadth training. The training procedure intended to manipulate attentional breadth was a modified version of the abovementioned global-local Navon Letter task (Navon, 1977). Specifically, we exposed participants either of two training variants of this task, each delivering 160 trials, one variant designed to encourage broadening of attention by delivering 80% global versus 20% local trials, and the other variant designed to encouraging narrowing of attention by delivering 80% local versus 20% global trials (Koster et al., 2009).

Table 2. Schematic overview of the differences in the experimental procedures between experiments.

Tasks	Experiment 1	Experiment 2
Pre training Navon letter task	64 trials	32 trials
Attentional breadth training	Respond to all trials	Respond only to trained trial type depending on group
	Target on screen until response	Target presented for 200 ms
Post Navon letter task	No post measurement	32 trials

Questionnaires

Positive and negative affect. The Positive and Negative Affect Schedule (Watson, Clark, & Tellegen, 1988) is a brief measure of 20 items to assess both positive affect (PA) and negative affect (NA). Participants completed the state version in which they rate the extent to which they experience an affective state at the current moment on a 5-point scale. The Dutch translation of the PANAS has shown good psychometric properties (Peeters, Ponds, & Vermeeren, 1996).

Depression. Depressive symptoms were assessed with the Beck Depression Inventory (Beck, Steer, & Brown, 1996). Through 21 items, the occurrence and severity of depressive symptoms over the past two weeks is questioned. Items are scored on a four-point scale (0-3). The Dutch version of this scale (Van der Does, 2002) comprises three subscales inventorying cognitive, somatic and affective aspects of depression.

Resilience. The Dutch version of the Resilience Scale (Wagnild & Young, 1993), used to measure participant's resilience, consists of 25 items arranged in two subscales: personal competence (17 items) and acceptance of self and life (8 items). Participants rate the extent to which each item reflects them on a 4-point Likert scale, ranging from 1 (totally disagree) to 4 (totally agree). Construct validity of the RS was supported through correlations with measures of self-esteem and perceived stress. Cronbach's alpha coefficients for the RS have ranged from .76 to .91.

Procedure

Written informed consent was obtained at the beginning of each experiment after which participants completed the PANAS state questionnaire. Participants then completed the attentional breadth assessment task, followed by the attentional bias assessment task. Then, participants were randomly assigned to one of the two training conditions, and proceeded to complete the training procedure designed to manipulate attentional breadth. There were some minor differences in this training procedure between the two experiments (see Table 2). In experiment 1, participants were instructed to react on every trial while in experiment 2, they only had to react when the target letters (T or H) were the global letter in the broad training group or the local letter in the narrow group. Furthermore, in experiment 1, the Navon figure stimulus remained on the screen until response while in experiment 2, the figure was presented for 200 ms. Immediately after exposure to this intended attentional breadth training procedure, the attentional bias assessment task was re-administered. In experiment 2 alone, participants also repeated the attentional breadth assessment task post-training, which served as a manipulation check. The experiment concluded with participants filling in the remaining questionnaires. Afterwards, all participants were fully debriefed.

RESULTS

Participant characteristics

Table 3 presents mean scores (M) and standard deviations (SDs) on all questionnaires measures for participants assigned to each of the two training conditions. There were no significant differences between experiments in participant scores on either the negative or positive affect scales of the PANAS, or on the BDI, or RS questionnaires (all $F < 1$). Within experiment, there was no significant pre-existing difference between participants assigned to the two differing training conditions in terms of either the negative and positive affect scales of the PANAS, BDI score or RS score (all *F* < 1).

Table 3. Means (M) and standard deviations (SD) for all questionnaires per group, per experiment, and across experiments.

	Experiment 1		Experiment 2		Total	
	Group		Group		Group	
	Global	Local	Global	Local	Global	Local
N	33	32	23	22	56	54
Age	21.61	20.84	22.78	23.09	22.09	21.76
Gender (F/M)	27/6	27/5	17/6	19/3	44/12	46/8
Questionnaires	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)
PA state	29.56 (5.99)	30.47 (6.39)	30.00 (6.33)	31.81 (4.57)	29.74 (6.08)	31.01 (5.70)
NA state	12.44 (2.61)	12.10 (3.10)	12.09 (2.49)	12.14 (3.28)	12.26 (2.54)	12.12 (3.14)
BDI	5.63 (5.42)	6.90 (5.64)	4.82 (4.72)	5.14 (3.31)	5.30 (5.11)	6.18 (4.86)
RS Total	78.13 (8.98)	76.17 (11.23)	78.68 (8.45)	75.81 (7.55)	78.35 (8.69)	76.02 (9.80)
RS p.c.	54.53 (7.31)	53.47 (7.75)	55.09 (6.32)	52.48 (5.57)	54.76 (6.87)	53.06 (6.89)
RS acc.	23.59 (3.28)	22.70 (3.98)	23.68 (2.98)	23.38 (2.85)	23.63 (3.13)	22.98 (3.54)

Note. PA and NA state = positive and negative affect (PANAS; Watson et al., 1988); BDI = Beck Depression Inventory (BDI-II; Beck et al., 1996); RS p. c. = subscale ‘personal competence’ of Resilience Scale (RS; Wagnild & Young, 1993); RS acc. = subscale ‘acceptance of self and life’ of Resilience Scale.

Pre-training Attentional Breadth Assessment Task. Analyses were run on data across experiments. Two participants were excluded from analyses because of responding at chance levels. For reaction time (RT) data, trials with errors were discarded from analyses (< 2%). Furthermore, for each participant trials with RTs deviating more than 2.5 SDs from the participant’s mean RT for that trial type were excluded (< 3%). Means and SDs of RTs can be found in Table 5. These RT data were submitted to a 2 (Trial Type: global, local) x 2 (Training Group: broad, narrow) mixed ANOVA. A significant main effect of Trial Type, $F(1, 106) = 31.85$, $p < .001$, revealed that responses were faster on global trials ($M = 681$, $SD = 124$) than on local trials ($M = 732$, $SD = 153$), which is typically found in this task and attests to the reliability of this assessment task (Gable & Harmon-Jones, 2012). There was no significant main effect of Training Group, $F(1, 106) < 1$, and no significant interaction between Trial Type and Training Group, $F(1, 106) < 1$, showing that pre-differences between training groups in attentional breadth before training were absent.

Pre-training Attentional Bias Assessment Task. Analyses were run on data across experiments. One participant was excluded from analyses because of responding at chance level. For RT data, trials with errors were discarded from analyses (< 4%). For each participant, trials with RTs deviating more than 2.5 SDs from that participant's mean RT for that condition were excluded (< 5%). Means and SDs of RTs can be found in Table 5. To check for pre-existing differences between training groups in attentional bias for emotional information, these RT data were submitted to a 3 (Image Valence: neutral, positive, threat) x 2 (Training Group: broad, narrow) mixed ANOVA. As expected, there was no significant interaction effect between Image Valence and Training Group, $F(2, 106) < 1$. No main effect of Training Group, $F(1, 107) < 1$, was found. The common main effect of Image Valence, $F(2, 106) = 18.70$, $p < .001$, was found and was typically driven by slower RTs to threat trials. Separate analyses showed that RTs on neutral trials ($M = 509$, $SD = 66$) did not differ from RTs on positive trials ($M = 511$, $SD = 64$), $t(108) < 1$, but were significantly faster compared to threat trials ($M = 524$, $SD = 67$), $t(108) = 5.58$, $p < .001$. RTs on positive trials were significantly faster compared to threat trials $t(108) = 5.26$, $p < .001$.

Pre-effects of trait attentional scope on attentional bias, resilience, and depression. From the attentional breadth assessment task, an attentional breadth score was computed, to reflect ready perception of global compared to local targets, by subtracting mean RTs on the global trials from those of local trials. A positive score means a preference for global information, while a negative score reflects a preference for local information. Thus, a higher score means greater breadth of attention. From the attentional bias task, an attentional shift time score, reflecting speed to move attention away from threatening images, and from positive images, was calculated by subtracting the mean target probe discrimination RT on the neutral trials from those on the threatening and on the positive trials, respectively. After excluding 3 participants who responded at chance levels on the Attentional Breadth Assessment Task or on the Attentional Bias Assessment Task, correlational analysis revealed a significant correlation between attentional breadth and the index reflecting attentional shifting away from threatening pictures, *r*(107) = -.24, *p* = .014, supporting the hypothesis that broader attention is related to enhanced attentional shifting away from threat. Furthermore, the index reflecting speed to move attention away from threatening images correlated significantly with the index reflecting speed to move attention away from positive images, *r*(107) = .54, *p* < .001, suggesting that both index scores reflect an overarching individual difference in speed to move attention away from emotional images in general. Finally, attentional breadth index scores were negatively correlated with depression scores, *r*(107) = -.21, *p* = .029, consistent with the hypothesis that greater attentional breadth may protect against depression, but these attentional breadth index scores were not related to self-reported resilience. All correlations are presented in Table 4.

Table 4. Pre training Pearson's correlations between trait attentional breadth, attentional bias for emotional information, resilience and depression scores.

	1	2	3	4	5	6	7
1 Global Preference	---	-.24*	-.12	-.21*	.10	.06	.14
2 AB threat		---	.536**	.05	.01	.03	-.05
3 AB positive			---	-.09	-.02	-.01	-.02
4 BDI				---	-.31**	-.36**	-.13
5 RS total					---	.96**	.81**
6 RS pers. comp.						---	.60**
7 RS acceptance							---

Note. AB threat/positive = attentional bias for of threatening/positive information (BDI = Beck Depression Inventory-II (BDI-II; Beck et al., 1996); RS = Resilience Scale (Wagnild & Young, 1993); RS total = total score on RS; RS pers. comp. = score on personal competence subscale of Resilience Scale; RS acceptance = score on acceptance of self and life subscale of Resilience Scale.
**p* < .05, ***p* < .001

Impact of Training Condition on Attentional Breadth

Because of different training procedures, analyses were run separately for experiment 1 and 2.

Experiment 1. In this task, participants were instructed to respond on all trials. To check for training effects during the training procedure, the target identification RT data were submitted to a 4 (Block: 1, 2, 3, 4) x 2 (Trial Type: global, local) x 2 (Training Group: broad, narrow) mixed ANOVA (see Table 5). Results showed a main effect of time with decreasing RTs across blocks, *F*(3, 61) = 25.18, *p* < .001. There was no interaction between Block and Trial Type, *F*(3, 61) = 1.40, *p* > .05, nor a three way interaction between Block, Trial Type, and Training Group, *F*(3, 61) < 1, nor main effect of Training Group, *F*(1, 63) < 1. Hence, there was no evidence that the intended training procedure was successful in inducing differential attentional breadth in the two participant groups.

Experiment 2. In this task, participants in the training condition designed to broaden attention were directed to identify only the global letter while participants in the training condition designed to narrow attention were directed to identify only the local letter. See Table 5 for means and SDs. We assessed impact of training condition on attentional breadth by re-administering the attentional breadth assessment task subsequent to training. RTs from trials with errors were discarded from analyses (< 2%). Furthermore, for each participant RTs that deviated more than 2.5 SDs from the participant's mean RT for that condition were excluded (< 3%). Mean RTs and SDs for different trial types and groups are presented in Table 6. These RT data were submitted to a 2 (Time: pre, post training) x 2 (Trial Type: global, local) x 2 (Training Group: broad, narrow) mixed ANOVA. Results showed a significant main effect of Time, *F*(1, 39) = 34.11, *p* < .001, but no significant main effect of Trial Type, *F*(1, 39) = 2.15, *p* > .05. There was a significant interaction between Time and Trial Type, *F*(1, 39) = 11.58, *p* = .002. A closer look to this interaction revealed that a global preference (RT global trials – RT local trials), *t*(41) = 3.61, *p* < .001, evident before the training, was no longer evident after training, *t*(41) = 1.20, *p* > .05. However, there was no three-way interaction between Time, Trial Type, and Training Group, *F*(1, 39) < 1. Thus, the two training conditions did not exert a differential impact on attentional breadth, as intended.

Impact of Training Condition on Attentional Bias

To analyze whether the intended attentional breadth manipulation influenced on relative speed to move attention away from the threatening, positive and neutral images, target probe discrimination RT data from the attentional bias assessment task, given before and after this training were analyzed across experiments (Table 6). One participant was excluded from analyses because responding at chance level. Trials with errors were discarded from analyses (< 2%) and for each participant trials with RTs deviating more than

2.5 SDs from the participant's mean RT for that particular condition were excluded (< 2%). These RT data were submitted to a 2 (Time: Pre, post) x 3 (Image Valence: threat, neutral, positive) x 2 (Training Group: broad/narrow) mixed ANOVA. A significant main effect of Time, $F(1, 105) = 49.39$, $p < .001$, revealed that RTs pre-training ($M = 514$, $SD = 63$) were significantly longer than RTs post-training ($M = 491$, $SD = 60$). Furthermore, a significant main effect of Image Valence, $F(2, 104) = 28.45$, $p < .001$, revealed that target probe discrimination RTs on neutral image trials ($M = 498$, $SD = 59$) did not differ from RTs on positive image trials ($M = 499$, $SD = 60$), $t(106) < 1$, but were significantly faster than the probe discrimination RTs on threat image trials ($M = 511$, $SD = 62$), $t(106) = 4.13$, $p < .001$. However, the three-way interaction effect between Time, Image Valence, and Training Group was not significant, $F(2, 104) < 1$, and no main effect of Training Group, $F(1, 105) < 1$, was found. Hence there was no impact of the intended attentional breadth manipulation on biased attentional responding to the emotional images.

Table 5. RT means and SDs for all different trial types and groups of the training task of experiment 1 and 2.

EXPERIMENT 1		Block							
		1		2		3		4	
Training group	Trial type	M	SD	M	SD	M	SD	M	SD
Broad	Global	616	123	574	108	570	99	559	117
	Local	597	120	575	121	565	129	555	119
Narrow	Global	635	150	568	117	582	135	556	113
	Local	648	177	591	137	575	119	584	136
EXPERIMENT 2									
Broad	Global	549	73	517	80	499	73	498	70
Narrow	Local	545	88	518	59	525	66	525	71

Table 6. RT means and SDs as a function of training group and image valence of the pre and post Attentional Bias Assessment Task.

Task	Global training group				Local training group			
	M_{pre}	SD_{pre}	M_{post}	SD_{post}	M_{pre}	SD_{pre}	M_{post}	SD_{post}
AB task								
Neutral	513	73	492	66	505	58	482	50
Positive	512	66	493	72	509	63	483	53
Threat	527	67	505	74	520	64	491	64
Global-local			(Post: Only Exp. 2)				(Post: Only Exp. 2)	
Global	671	137	(668	133)	691	110	(636	104)
Local	725	172	(652	150)	740	132	(623	75)

Discussion

In these experiments, we attempted to manipulate attentional breadth in order to test whether increased attentional breadth would change biased attentional responding to emotional images. We observed that our training procedure did not modify attentional breadth as intended. Hence, we could not examine the impact of modifying attentional breadth on our measure of attentional bias.

We used a modified global-local task with a manipulated proportion global versus local trials in our attempt to train differential attentional breadth. However, results showed that the training conditions did not differentially influence attentional breadth, as no differences in reaction times between the trained trial type and the other trial could be found during the training procedure in experiment 1. Moreover, a post-measurement of attentional breadth in experiment 2 revealed that, after both the training procedure intended to broaden attention and after the training intended to narrow attention, the pre-existing preference for global targets compared to local targets disappeared.

Importantly, our pre-training results did nevertheless show that attentional bias is associated with attentional breadth, as participants who initially displayed greater attentional breadth also showed a pattern of RTs on the bias assessment task suggesting a ready ability to move attention away from threatening images. This attests to the validity of our measures of both attentional breadth and attentional bias. Furthermore, in line with the literature, we found that higher depression scores were related to narrower attention on our attentional breadth assessment task, which attests to the importance of the current research in the context of psychopathology.

To further investigate whether attentional broadening is causally related to attentional disengagement from arousing emotional information, there is need for a more effective attentional breadth manipulation. For this purpose, in experiment 3 and 4, we developed and tested a new innovative attentional breadth manipulation.

EXPERIMENT 3

To examine the effect of attentional broadening on biased attentional responding to threatening information, in experiment 3, we used a new and innovative attentional breadth training aimed to manipulate attentional breadth more effectively. This was designed to tailor task-difficulty to the performance of the participant during the training, and so individualize attentional breadth training in ways that could enhance its efficacy. In this task, individuals needed to identify a target probe surrounded by several distractors. In the training condition designed to broaden attention, the spatial distribution of stimulus and distractors will be wide, and so performance will be optimized by adopting a broad attentional scope. In the training condition designed to narrow attention, the spatial distribution of stimulus and distractors will be narrow, and so performance will be optimized by adopting a narrow attentional scope. Before and after training, biased attentional responding to emotional images will be assessed to test the hypothesis that broadening attention will facilitate ability to move attention from threatening stimuli.

METHOD

Participants

Sixty undergraduate students from Ghent University participated in a one hour experiment in exchange for money (10 Euros). They were randomly assigned to one of the two attentional breadth training conditions. Two candidate participants with depression scores deviating more than 2.5 SDs from the sample mean were excluded, and another 4 participants were excluded because their RTs deviating more than 2.5 SDs from the sample mean on either the pre-training assessment of attentional breadth or attentional bias. The mean age of the remaining 54 participants was 22.57 (*SD* = 3.57). Most participants (79.6%) were female. Twenty-eight participants were assigned to the training condition designed to broaden attention, and 26 were assigned to the training condition designed to narrow attention (Table 7).

Materials

Questionnaires. Similar to experiment 1 and 2, positive and negative affect (PANAS; (Watson et al., 1988), depression (BDI-II; Beck et al., 1996) and resilience scores (RS; (Wagnild & Young, 1993) were measured.

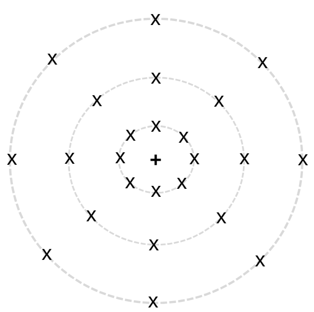
Attentional Breadth Assessment Task. Before and after the attentional breadth training, participants' attentional breadth was measured using 32 trials of the same attentional breadth assessment task employed in experiments 1 and 2 (Navon, 1977).

Attentional Bias Assessment Task. Before and after the attentional training, participants performed the same attentional bias assessment task employed in experiments 1 and 2, based on Fox et al. (2001).

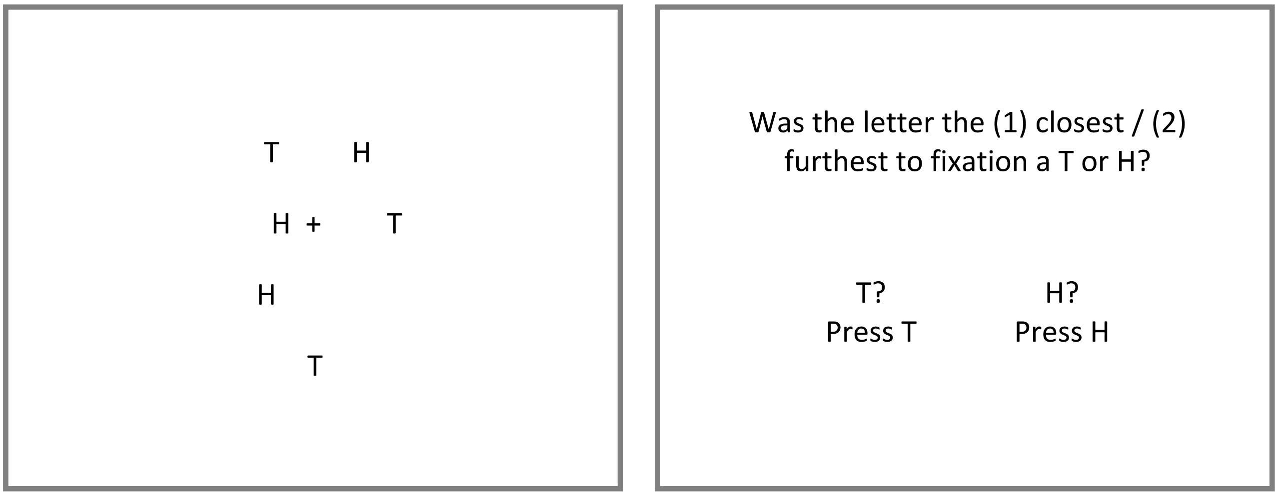
Attentional breadth training. This new training was configured in two conditions designed to differentially modify attentional breadth, one intended to train attention to become more narrow and the other intended to train attention to become more broad. The task was programmed using the E-PRIME 2 software package. Participants were seated at 30 cm from the screen using a chinrest to ensure accurate positioning. Black stimuli were presented against a white background on a 19 inch computer screen. All relevant instructions were projected on the screen and read together with the experimenter prior to testing. Participants were instructed to maintain their gaze on the center of the screen throughout the experiment and to use the chinrest to control the viewing distance. On every trial, a black fixation cross was presented in the middle of the screen. After 500 ms, while the fixation cross stayed on the screen, 6 letters, randomly chosen T's and H's (all uppercase, Calibri, 18) were briefly and simultaneously exposed on screen for 100 ms. These 6 letters were positioned at differing distances from the middle of the screen, located on 6 of the 24 positions arranged on 8 invisible positions on 3 imperceptible circles (Figure 3a). More specifically, 1 of the 6 letters was presented at random at 1 of the 8 positions on the circle the closest to fixation (radius circle = 50 pixels), 4 of the 6 letters were presented at the circle on medium distance from fixation (radius circle = 150 pixels) and 1 of the 6 letters was presented at random at 1 of the 8 positions on the circle the furthest from fixation (radius circle = 250 pixels). Depending on the training condition, participants required to either identify the letter closest (narrow group) or furthest (broad group) from the middle of the screen (Figure 3b). In this way, participants in each of these two training conditions were continually required to adopt either a narrow or broad attentional focus, respectively, to optimally perform the task. In the training condition designed to broaden attention, whenever accuracy level on a block of trials was above 80%, the radiuses of the imperceptible circles were increased by 20 pixels to encourage the further broadening of attention. In the narrow group, radiuses remained constant across all blocks. The trials were presented in 8 blocks of 32 training trials and 4 manipulation check trials, each block separated by a short break. In the manipulation check trials, a set of 6 different letters were presented with the same random configurations and presentation time as the training trials. However, on these trials, individuals were asked to identify as many letters as possible. This allowed to examine whether the letters that were best identified were those presented closest, middle distant or furthest from the screen center. These letters also formed a word (Figure 3b: "MOERAS" (swamp)), where it is possible that individuals who deploy attention more broadly may perceive it. If attention was sufficiently broadened, participants could be able to report the word. However, anticipating the results, none of these 16 words that were presented twice, was ever perceived.

Figure 3. New attentional breadth training. a) all 24 possible positions, b) (1) narrow (2) broad training and c) manipulation check trial examples.

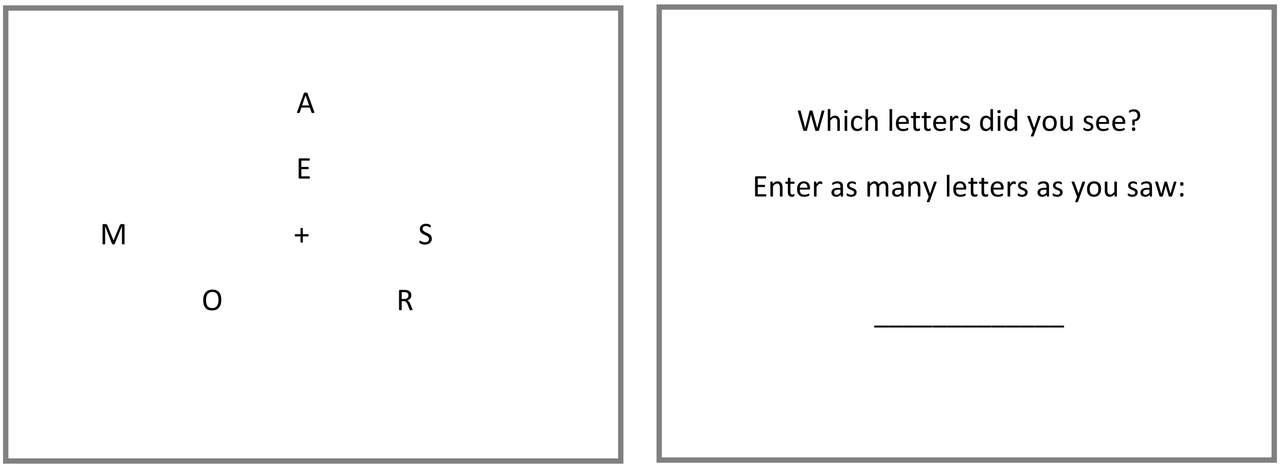
a)



b)



c)



Procedure

The procedure was similar to that adopted in experiment 1 and 2. Written informed consent was obtained at the beginning of the experiment after which participants completed the PANAS state questionnaire. They then completed the pre-training attentional breadth assessment task, followed by the pre-training attentional bias assessment task. Next, participants were randomly assigned to one of the two training conditions, and completing the attentional breadth training task in this assigned condition. Immediately following this training procedure, the attentional bias assessment task was re-administered, and following this the attentional breadth assessment task was again completed. Finally, participants filled in the remaining questionnaires, after which they were fully debriefed.

RESULTS

Participant characteristics

Table 7 gives an overview of means and SDs for all questionnaires, for both groups. There were no significant group training group differences in PANAS (Watson et al., 1988) negative affect scores, $F(1, 52) = 2.92$, $p > .05$, or positive affect scores, $F(1, 52) = 2.21$, $p > .05$, nor in BDI depression scores (Beck et al., 1996), $F(1, 52) = 1.28$, $p > .05$, or RS resilience scores (Wagnild & Young, 1993), $F < 1$.

Table 7. Mean scores and SDs for all questionnaires per training group.

	Attentional training group			
	Broad		Narrow	
N	28		26	
Age, M (SD)	22.00 (3.62)		23.19 (3.49)	
Gender, F/M	26/3		18/8	
Questionnaire	M	SD	M	SD
PA state	32.79	5.57	30.65	4.92
NA state	12.54	2.80	14.12	3.94
BDI	6.39	4.86	8.15	6.53
RS total	78.89	9.77	77.58	8.93
RS pers. comp.	55.36	6.72	53.92	6.75
RS acc.	23.54	3.96	23.65	3.21

Note. PA/NA state = state positive and negative affect (PANAS; Watson et al., 1988); BDI = Beck Depression Inventory-II (Beck et al., 1996); RS = Resilience Scale (Wagnild & Young, 1993); RS pers. comp. = subscale 'personal competence' of Resilience Scale; RS acceptance = subscale 'acceptance of self and life' of Resilience Scale.

Pre-training Attentional Breadth Assessment Task. Trials with errors (< 2%) were excluded, as were trials on which RTs deviating more than 2.5 SDs from a participants mean RT for that condition (< 3%). The remaining RT data were submitted to a 2 (Trial Type: global, local) x 2 (Training Group: broad, narrow) mixed ANOVA. A significant main effect of Trial Type, $F(1, 52) = 19.48$, $p < .001$, revealed that responses were faster in global trials ($M = 728$, $SD = 157$) than in local trials ($M = 799$, $SD = 191$). No interaction between Trial Type and

Training Group, *F*(1, 54) < 1, nor main effect of Training Group, *F*(1, 52) < 1, was found, showing that pre-differences between training groups in attentional breadth before training were absent (Table 9).

Pre-training Attentional Bias Assessment Task. Trials with errors (< 3%) and those on which RTs deviating more than 2.5 SDs from the participants mean RT for that condition (< 2%) were excluded. The remaining RT data were submitted to a 3 (Image Valence: neutral, positive, threat) x 2 (Training Group: broad, narrow) mixed ANOVA. As typically found in this task, a significant main effect of Image Valence, *F*(2, 51) = 13.49, *p* < .001, revealed that target probe discrimination RTs on neutral trials (*M* = 542, *SD* = 71) did not differ from RTs on positive trials (*M* = 546, *SD* = 73), *t*(53) = 1.26, *p* > .05, but were significantly faster than RTs on threat trials (*M* = 559, *SD* = 78), *t*(53) = 4.76, *p* < .001. RTs on positive trials were significantly faster than RTs on threat trials, *t*(53) = 3.87, *p* < .001. Unexpectedly, there was a significant interaction effect found between Image Valence and Training Group, *F*(2, 51) = 4.74, *p* = .013, indicating differences in attentional bias between groups before attentional breadth training, which could undermine effects of the attentional breadth training on attentional bias after training. To explore these differences, separate ANOVAs for each valence revealed neither a difference on neutral trials for the broad training group (*M* = 543, *SD* = 55) compared to the narrow training group (*M* = 541, *SD* = 86), *F*(1, 52) < 1, nor on the positive trials for the broad training group (*M* = 539, *SD* = 56) compared to the narrow training group (*M* = 554, *SD* = 88), *F*(1, 52) < 1, nor for the threatening trials for the broad training group (*M* = 551, *SD* = 60) compared to the narrow training (*M* = 567, *SD* = 94), *F*(1, 52) < 1. However, when comparing the attentional bias score for positive information between groups (RTs positive trials – RTs neutral trials), we observed a significant difference, *F*(1, 52) = 7.09, *p* = .010, with participants showing a smaller attentional bias score for positive information in the broad training group (*M* = -4, *SD* = 24) compared to the narrow training group (*M* = 13, *SD* = 21). Furthermore, when comparing the attentional bias score for threatening information between training groups (RTs threat trials – RTs neutral trials), we observed a significant difference, *F*(1, 52) = 7.13, *p* = .010, with participants showing a smaller attentional bias for threatening information in the broad training group (*M* = 8, *SD* = 23) compared to the narrow training group (*M* = 26, *SD* = 26).

Associations between pre-training measures of attentional breadth, attentional bias, resilience, and depression. Our hypothesis predicted that greater attentional breadth, indexed by greater speeding on global trials relative to local trials on the attentional breadth assessment task (RTs local trials – RTs global trials) would be associated with increased ability to move attention away from threatening images in the attentional bias task, with higher self-reported resilience, and with lower depression scores. However, none of these correlations were significant. The only significant association was between the index reflecting slowing to the peripheral target probes on the attentional bias assessment task when images were threatening compared to neutral, and when images were positive compared to neutral. In line with experiment 1 and 2, these two indices of attentional bias were significantly correlated, $r(54) = .534$, $p < .001$, suggesting that both may reflect shared variability in the capacity to move attention away from emotional information. See Table 8 for all pre-training correlations.

Table 8. Pre-training Pearson's correlations between trait attentional breadth, attentional bias for emotional information, resilience and depression scores.

	1	2	3	4	5	6	7
1 Global Preference	---	-.02	.13	.03	-.01	-.03	.03
2 AB threat		---	.53**	.01	-.11	-.12	-.06
3 AB positive			---	-.02	.17	.19	.10
4 BDI				---	-.45**	-.37*	-.48**
5 RS total					---	.95**	.82**
6 RS pers. comp.						---	.59**
7 RS acceptance							---

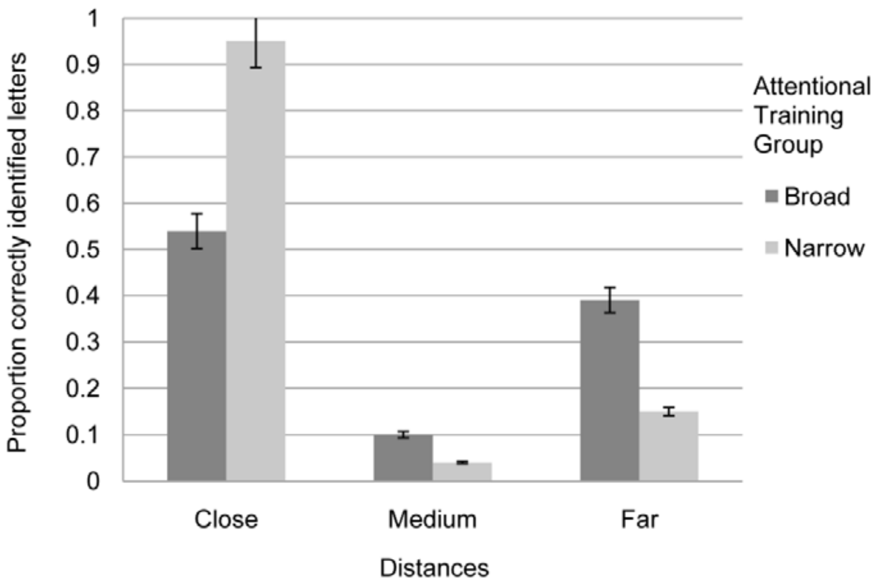
Note. AB threat/positive = attentional bias for threatening/positive information. BDI = Beck Depression Inventory-II (Beck et al., 1996); RS = Resilience Scale (Wagnild & Young, 1993); RS pers. comp. = subscale 'personal competence' of Resilience Scale; RS acceptance = subscale 'acceptance of self and life' of Resilience Scale.
**p* < .05. ***p* < .001.

Impact of Training of Attentional Breadth

Manipulation Check Trials in Attentional Training Task. Accuracy rates on the manipulation checks trials included in the attentional breadth training task were submitted to a 3 (Distance: close, middle, far) x 2 (Training Group: broad, narrow) mixed ANOVA. A significant main effect of Distance, $F(2, 51) = 1409.46$, $p < .001$, revealed that targets close to the centre were identified more correctly ($M = .74$, $SD = .23$) compared to targets in the middle ($M = .07$, $SD = .04$) and furthest from the centre ($M = .28$, $SD = .17$). Of most importance, there was a significant interaction effect between Distance and Training Group, $F(2, 51) = 101.87$, $p < .001$, revealing that variation in accuracy rates across target positions differed depending on training group. Separate analyses for each distance revealed that participants receiving the training designed to broaden attention were more accurate in reporting letters presented on the furthest radius ($M = .39$, $SD = .13$) than were participants receiving the training designed to narrow attention ($M = .16$, $SD = .13$), $F(1, 52) = 42.02$, $p < .001$. The latter group was significantly more accurate on the closest radius ($M = .96$, $SD = .06$) compared to the broad training group ($M = .55$, $SD = 14$), $F(1, 52) = 181.72$, $p < .001$. Also, participants receiving the training designed to broaden attention were more accurate in reporting letters on the middle radius ($M = .10$, $SD = .03$) than were participants receiving the training designed to narrow attention ($M = .04$, $SD = .03$), $F(1, 52) = 42.02$, $p < .001$.

Furthermore, a significant main effect of Training Group, $F(1, 52) = 5.80$, $p = .020$, was found, revealing that participants in the narrow training group ($M = .39$, $SD = .07$) identified a higher proportion of letters in the manipulation checks correctly compared to the broad training group ($M = .35$, $SD = .10$), which is probably due to the difference in task difficulty between training groups. Depending on accuracy rates, distances between imperceptible circles do expand in the broad training group but do not in the narrow training group, resulting in more difficult manipulation checks in the broad compared to the narrow training group. When comparing accuracy rates of manipulation checks between groups in the first half of the training -when the configurations of the manipulation checks are more comparable between groups- results show that participants in the broad training group identified significantly more letters ($M = .48$, $SD = .10$) compared to the narrow training group ($M = .41$, $SD = .14$), $F(1, 52) = 4.66$, $p = .036$. To explore the evolution of accuracy data on the manipulation checks during the training, manipulation check data were submitted to a 3 (Distance: close, middle, far) x 4 (Block: mean block 1 and 2, block 3 and 4, block 5 and 6, block 7 and 8) x 2 (Training Group: broad, narrow) mixed ANOVA. Results showed a three-way interaction effect between Distance, Block, and Training Group, $F(6, 47) = 3.21$, $p = .010$. Separate ANOVAs for each distance revealed no differences in evolution with blocks between training groups for the close distance, $F(3, 50) = 1.30$, $p > .05$, nor for accuracy for the far distance, $F(3, 50) = 1.31$, $p > .05$. Yet, results for the middle distance revealed a significant interaction between Block and Training Group, $F(3, 50) = 4.94$, $p = .004$. A closer inspection of this interaction revealed that in the narrow training group, participants identified significantly more targets on the middle distance in the last two blocks ($M = 1.61$, $SD = .77$) of the task compared to the first two blocks ($M = 1.25$, $SD = .70$), $t(25) = 3.97$, $p = .001$, while participants in the broad training group could not identify more targets on the middle distance in the last two blocks ($M = 1.79$, $SD = .36$) compared to the first two blocks ($M = 1.90$, $SD = .51$), $t(27) = 1.23$, $p > .05$. This observation could also be explained by the difference in task-difficulty between the different training tasks.

Figure 4. Proportion means and SDs of accuracy of manipulation checks of the first four blocks as a function of 3 distances and training group.



Post-training Attentional Breadth Assessment Task. RT data from the pre-training and post-training Attentional Breadth Assessment Task were used to determine the impact of training condition on attentional breadth. Trials with errors and with RTs deviating more than 2.5 SDs from a participants mean RT for that condition, were excluded (< 5%). The remaining RT data were submitted to a 2 (Time: pre-training, post-training) x 2 (Trial Type: global, local) x 2 (Training Group: broad, narrow) mixed ANOVA. Results showed a main effect of Time, *F*(1, 52) = 50.45, *p* < .001, and a significant main effect of Trial Type, *F*(1, 52) = 17.32, *p* < .001. However, there was no interaction between Time, Trial Type and Training Group *F*(1, 52) < 1, indicating that the attentional training manipulation did not induce differential attentional breadth as measured with the global-local Navon letter task.

Impact of Training on Attentional Bias

To determine whether the intended attentional breadth training manipulation influenced capacity to move attention away from threatening material, RT data from the attentional bias assessment task, given before and after this training, were analyzed (Table 9). Trials with errors, or on which RTs deviating more than 2.5 SDs from the participants mean RT for this condition, were excluded (< 7%). The remaining RT data were submitted to a 2 (Time: Pre-training, post-training) x 3 (Image Valence: threat, neutral, positive) x 2 (Training Group: broad, narrow) mixed ANOVA. Results showed a significant main effect of Image Valence, *F*(2, 51) = 14.59, *p* < .001, and a significant main effect of Time, *F*(1, 52) = 12.67, *p* = .001. No main effect of Training Group, *F*(1, 52) < 1, was found. More importantly, the expected three-way interaction effect between Time, Image Valence, and Training Group was not significant, *F*(2, 51) = 2.06, *p* = .138.

Table 9. RT means SDs as a function of training group and image valence of the pre and post Attentional Bias Assessment Task and Attentional Breadth Assessment Task.

	Attentional training group							
	Broad				Narrow			
Trial type	M_{pre}	SD_{pre}	M_{post}	SD_{post}	M_{pre}	SD_{pre}	M_{post}	SD_{post}
Neutral	542	55	522	55	541	86	532	80
Positive	539	56	527	65	554	88	537	88
Threat	551	60	534	66	567	94	551	96
Global	719	153	625	154	738	164	651	139
Local	792	216	659	157	807	164	677	136

DISCUSSION

In experiment 3 we tested a new procedure to train attentional breadth. In line with experiment 1 and 2, we could not observe any effects of attentional breadth training condition on the subsequent measure of attentional bias, or on the subsequent measure of attentional breadth task. However, the pattern of accuracy rates observed on the manipulation check trials delivered during the training procedure itself suggested that the two training conditions were influencing attentional breadth as intended. Participants receiving the condition designed to broaden attention showed a greater ability than those receiving the condition designed to narrow attention to correctly identify targets on the furthest radius, consistent with the broader deployment of attention. Moreover, when comparing manipulation checks of the first half of the training (when manipulation checks were more comparable between training groups), results showed that a broader attentional scope resulted in a higher proportion of perceived letters. Hence, our new attentional breadth training appears to have manipulated attentional breadth effectively, while it was being performed.

Yet, participants who received the two training conditions did not subsequently show any differential relative ability to move attention away from threatening images in our attentional bias assessment task. Although the training procedures appeared to be effective, it is possible that there was no residual impact of the intended training procedures beyond the intended training task. That is, the procedure might have merely required participants to adapt differing breadths of attention during execution of this task, but did not train differential attentional breadth to deliver effects on the subsequent task. Second, it is also possible that no such effect of attentional breadth training on attentional bias occurred because the attentional breadth training procedure contained only neutral material.

In experiment 4, we again attempted to test the hypothesis that variation in attentional breadth is causally related to variation in emotional resilience, using the self-regulation task as used in Hanif et al. (2012) to assess emotional resilience. The concept of self-regulation is defined as an “individual-difference dimension that includes goal setting, planning, task persistence, and environmental management as well as modulation of behavioral, emotional, and attentional reactivity” (Rothbart & Posner, 2005), and thus considered as a source of resilience (Gardner, Dishion, & Connell, 2008).

EXPERIMENT 4

In experiment 4, we attempted to replicate and extend the study of Hanif et al. (2012), using our new attentional breadth training procedure. Hanif et al. (2012) claimed to have demonstrated that a broadened attentional focus facilitated performance of a task requiring efficient self-regulation, which is in turn considered as a source of emotional resilience (Gardner et al., 2008). Capacity for self-regulation was assessed before and after the attentional manipulation by measuring the length of time that participants were willing to squeeze a handgrip exerciser. A broad focus of attention is expected to enhance self-regulation by enabling participants to avoid attend to detrimental factors such as the pain they are experiencing during squeezing the handgrip exerciser that might undermine self-regulation. The neural bases of pain regulation have also shown to overlap considerably with those associated with emotion regulation (Ochsner & Gross, 2005). If attentional breadth is causally related to the ability to avoid attending to negative information this may aid self-regulation and so enhance performance during stress. Thus, in keeping with Hanif et al. (2012), we predicted that participants who received the training condition designed to broaden attention would display better self-regulation performance than participants who received the training condition designed to narrow attention.

METHOD

Participants

Fifty undergraduate students of Ghent University took part in exchange for money. One candidate participant was eliminated because his baseline handgrip squeeze-duration deviated more than 2.5 standard deviations from the group mean. A further 2 were excluded because their BDI scores deviated more than 2.5 standard deviations from the group mean. The final sample comprised 47 participants (36 women; 11 men) with a mean age of 21.72 (*SD* = 3.57) ranging from 18 to 38 years. Gender rates did not differ between groups, $\chi^2(1, 47) < 1$. Participants were randomly assigned the attentional breadth training condition designed to either broaden or to narrow attention. Participant characteristics are described in Table 10.

Materials

Self-regulation. Similar to Hanif et al. (2012), self-regulation performance was assessed before and after the attentional breadth training manipulation by measuring the length of time participants were willing to squeeze a handgrip exerciser.

Attentional breadth training. The attentional breadth training task was based on the procedure employed in experiment 3, with two minor methodological changes. First, the initial radiuses of the (imperceptible) circles on which the letters were displayed were made slightly bigger (50, 160, and 270 pixels for the close, medium and far circle respectively). Second, whereas the radius of these circles continued to expand in the in the attentional broadening condition in experiment 3, manipulation check trials now were given using the original radius setting (i.e. 50, 160, and 270 pixels for the close, medium and far circle respectively), to make manipulation checks more comparable between training groups.

Self-report measures. Participants completed the Attentional Control Scale (Derryberry & Reed, 2002) which allowed us to ensure that any between-group differences in self-regulation performance were not due to pre-existing differences in individuals' capacity for attentional control. Given the established interaction between mood and scope of attention (Gasper & Clore, 2002), broadening the focus of attention might induce a positive mood, which in turn can influence the capacity for self-regulation. We therefore administered the PANAS (Watson et al., 1988) in order to account for possible influences of mood on self-regulation. Furthermore, depression scores (BDI-II; Beck et al., 1996) and resilience scores (RS; Wagnild & Young, 1993) were administered because of their association with self-regulation and dispositional attentional focus.

Procedure

Written informed consent was obtained at the start of the experiment. Then, participants squeezed the handgrip exerciser for as long as possible, which served as the baseline self-regulation measure. Participants then completed the self-report measures. Next, participants were randomly assigned to one of the training conditions, and completed the attentional breadth training task in this assigned condition. Following exposure to this training procedure, participants completed the PANAS state scale. Finally, they squeezed the handgrip exerciser again for as long as they could, to measure self-regulation ability following the attentional manipulation. The experimenter who oversaw the pre- and post-attentional manipulation self-regulation measures was blind to the attentional manipulation condition, in order to avoid unintentional variations in the manner in which the handgrip task was administered. At the end of the experiment, all participants were fully debriefed.

RESULTS

Participant characteristics

Questionnaire data. Table 10 gives an overview of means and SDs for all questionnaires, for both training groups. Analyses of attentional control, resilience scores and PANAS state scores after training revealed no differences between groups, all *F*s < 1. Neither did depression scores differ significantly between groups, $F(1, 46) = 2.46$, $p > .05$.

Pre-training Self-regulation task. Groups did not significantly differ in self-regulation task performance before training, $F(1, 46) = 2.71$, $p > .05$, (Table 10). This pre-training self-regulation significantly correlated negatively with BDI-II scores, $r(47) = -.32$, $p = .027$.

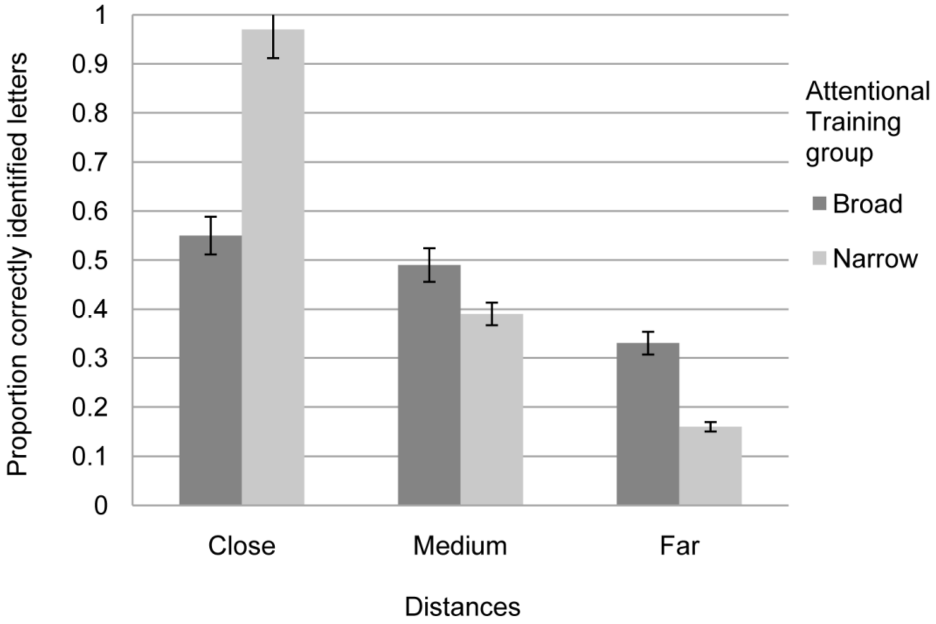
Table 10. Means and SDs for self-report data and the self-regulation task per group.

		Attentional training group			
		Broad		Narrow	
	N	24		23	
	Age	21.96		21.48	
	Gender (F/M)	18/6		18/5	
		M	SD	M	SD
Predisposition	ACS total	51.33	6.40	51.43	7.87
	ACS focusing	22.29	3.88	22.17	4.30
	ACS shifting	29.04	3.51	29.26	4.26
	BDI	4.50	4.97	7.13	6.45
	RS total	78.08	9.19	78.00	8.42
	RS pers. comp.	53.50	6.24	53.57	5.73
	RS acceptance	24.58	3.53	24.43	3.63
Mood state	PA state	32.42	5.92	31.72	6.62
	NA state	13.00	3.60	13.48	3.27
Self-regulation task	Pre (s)	61.33	37.18	44.57	32.42
	Post (s)	60.96	32.84	39.30	26.74

Impact of training on attentional breadth

Accuracy rates on the manipulation checks were submitted to a 3 (Distance: close, middle, far) x 2 (Training Group: broad, narrow) mixed ANOVA. A significant main effect of Distance, $F(2, 44) = 128.88$, $p < .001$, revealed that targets close to the centre were more correctly identified ($M = .75$, $SD = .26$) compared to targets in the middle ($M = .43$, $SD = .16$) and furthest from the centre ($M = .23$, $SD = .16$). There was no main effect of Training Group, $F(1, 45) = 2.39$, $p > .05$. However, there was a significant interaction effect between Distance and Training Group, $F(2,44) = 50.53$, $p < .001$, revealing that accuracy rates on trials on different positions depended on training group (Figure 5). Separate analyses for the 3 distances revealed that participants receiving the training designed to broaden attention identified significantly less targets on the close distance, $F(1, 45) = 75.81$, $p < .001$, more targets on the medium distance, $F(1, 45) = 10.36$, $p < .05$, and more targets on the far distance, $F(1, 45) = 26.67$, $p < .001$, than did participants receiving training condition designed to narrow attention. Hence, the task manipulation led participants to adapt broader versus narrower attentional focus as intended. To explore the evolution of accuracy data on the manipulation checks during the training, manipulation check data were submitted to a 3 (Distance: close, middle, far) x 4 (Block: mean block 1 and 2, block 3 and 4, block 5and 6, block 7 and 8) x 2 (Training Group: broad, narrow) mixed ANOVA. Results did not show a three-way interaction effect between Distance, Block, and Training Group, $F(6, 40) < 1$. However, results showed a significant interaction between Block and Training Group, $F(3, 43) = 4.56$, $p = .007$. A closer inspection of this interaction revealed that in the broad training group, participants identified marginally significantly more targets on the close distance in the last two blocks ($M = .58$, $SD = .23$) of the task compared to the first two blocks ($M = .49$, $SD = .29$), $t(23) = 1.75$, $p = .094$, significantly more targets on the middle distance in the last two blocks ($M = .52$, $SD = .11$), compared to the first two blocks ($M = .44$, $SD = .13$), $t(23) = 4.45$, $p < .001$, and significantly more targets on the far distance on the last two blocks ($M = .35$, $SD = .23$), compared to the first two blocks ($M = .23$, $SD = .19$), $t(23) = 2.93$, $p = .007$. Participants in the narrow training group could not identify more targets on the close distance in the last two blocks ($M = .96$, $SD = .08$) compared to the first two blocks ($M = .95$, $SD = .08$), $t(22) = 1.37$, $p > .05$, tended to identify more targets on the middle distance in the last two blocks ($M = .38$, $SD = .19$), compared to the first two blocks ($M = .33$, *SD* = .18), and did not identify more targets on the far distance in the last two blocks (*M* = .18, *SD* = .17), compared to the first two blocks (*M* = .13, *SD* = .14), $t(23) = 1.39$, $p > .05$.

Figure 5. Proportion means and SDs of accuracy of manipulation as a function of 3 distances and training group.



Impact of training effects on self-regulation

A 2 (Time: pre-training, post-training) x 2 (Training Group: broad, narrow) mixed ANOVA revealed a main effect of Training Group showing that participants in the broad training group scored higher on self-regulation (*M* = 61.15, *SD* = 35) than the narrow training group (*M* = 41.94, *SD* = 33), $F(1, 45) = 4.26$, $p = .045$. However, the training groups did not differ in their self-regulation performance as a function of the attentional training manipulation as was hypothesized, $F(1, 45) = 1.67$, $p > .05$. No main effect of Time was found, $F(1, 45) = 2.22$, $p > .05$. Handgrip performance after the attention manipulation did not correlate with positive and negative state affect for any group, all *ps* > .05, providing no evidence that self-regulation performance was influenced by mood.

DISCUSSION

In experiment 4, we attempted to replicate the study of Hanif et al. (2012), using our new attentional breadth training predicting that participants who received the training condition designed to broaden attention would show enhanced self-regulation performance compared to those who received the training designed to narrow attention. As in experiment 3, manipulation check trials during the training procedure confirmed that the training manipulation influenced attentional breadth as intended. However, we observed no effects of the attentional breadth training manipulation on the subsequent self-regulation task. Hence the findings yielded no evidence that a broader attentional scope resulted in enhanced self-regulation performance.

GENERAL DISCUSSION

In this series of studies, we investigated whether training procedures designed to modify attentional breadth could facilitate attentional movement away from threatening information. This hypothesis is important, because attentional breadth has been theoretically implicated as a factor influencing higher-level processes such as emotion regulation and resilience, in ways that enhance successfully coping with stress (Fredrickson & Branigan, 2005). Broadened attentional scope may be beneficial in stressful situations, by helping people to move attention away from negative information, thereby aiding emotion regulation. Empirically, there are a number of promising findings from recent studies examining this causal hypothesis (Gable & Harmon-Jones, 2012; Hanif et al., 2012). In the current series of studies, we aimed to replicate and extend such work by investigating whether attentional broadening would facilitate attentional shifting away from negative information. Results show that it is possible to experimental modify attentional breadth. However, in a series of 4 experiments, we observed transfer of attentional breadth training neither to another attentional breadth task, nor to measures of attentional bias or self-regulation. These findings are discussed in detail below.

Across our experiments, we consistently observed neither close, nor far transfer effects of attentional breadth training. In experiment 2 and 3, we examined close transfer effects of a broad versus narrow attentional breadth training on attentional breadth, by re-administering an assessment version of the global-local Navon letter task, extensively used in previous research to assess attentional breadth (Gable & Harmon-Jones, 2010b). Both experiments, using different intended methods of manipulating attentional breadth, failed to show close transfer effects on this global-local attentional breadth measurement. The training procedure employed in experiment 1 and 2 consisted of a modified global-local Navon letter task that exposed participants to an experimentally established contingency of 80 versus 20 percent global versus local trials (or vice versa). Previous research has successfully used a similar task variant with global-local hierarchical stimuli to induce a broadened or narrowed attentional scope (Gable & Harmon-Jones, 2012; Hanif et al., 2012). In experiment 3, we used a new attentional breadth training, designed to train attentional breadth in an individually tailored manner by adjusting task-difficulty according to the performance of the individual. We tested this new training procedure by including manipulation checks trials within the task. Results clearly showed that participants in the training condition designed to broaden attention did deploy attention more broadly than those in the training condition designed to narrow attention. However, neither training procedures produce transfer effects to a post-training measure of attentional breadth. One possible explanation for this null-finding could be that the training was insufficient to produce sustained attentional broadening effects. The post-training attentional breadth assessment was administered after an intervening attentional bias assessment task and this may have interfered with the training effect. However, the attentional bias assessment task was very brief (5-7 minutes, relative to training which is 15-20 minutes). Moreover, in previous studies transfer of attentional breadth training to post training assessment measures have been observed (Hanif et al., 2012). Another possible explanation could be that the global-local Navon letter task used to assess attentional breadth pre and post-training is not a suitable task for repeated administration. As the global-local Navon letter task is an easy task, task-repetition may have resulted in ceiling effects during the second registration of the task.

A major interest in this study was to examine whether attentional breadth training would influence attentional bias. However, we consistently failed to find such far transfer effects across 4 experiments using different training procedures of attentional breadth. In experiment 1, 2 and 3, we measured whether attentional breadth training influenced how readily participants could move attention away from threatening images, using a probe paradigm designed for this specific purpose (Fox et al., 2001; Georgiou et al., 2005). Participants were required to move attention away from a central image, to discriminate the identity of peripherally presented target probes. The time needed to identify target probes when the central image was threatening compared to a neutral was used as an index of difficulty moving attention away from threat. Neither the attentional breadth training based on previous research, nor our new attentional breadth training, produced transfer effects that influenced performance of this attentional bias assessment task. We thought it is possible that this may reflect the fact that attentional breadth training contained only neutral material whereas the attentional bias assessment task also contained emotional information. In experiment 4, we tested the hypothesis that variation in attentional breadth is causally related to variation in emotional resilience, by using a self-regulation task as employed in previous research (Hanif et al., 2012) measuring the length of the time that participants were willing to squeeze a handgrip exerciser. The results showed no differences between the attentional training groups on this self-regulation task.

When considering these null-findings it is important to first discuss methodological reasons for the absence of expected findings. Null effects of the attentional breadth manipulation on attentional bias were consistently obtained across both our attentional breadth training procedures, one based on previous research (Gable & Harmon-Jones, 2012; Hanif et al., 2012) (experiment 1 & 2), and the newly introduced in this research (experiment 3 & 4). The latter training did induce attentional broadening effects as indicated by results of the manipulation checks during the training, but attentional broadening did not influence attentional bias. Experiments 1, 2, and 3 did reproduce the well-established finding that participants generally have greater difficulty shifting attention away from emotional compared to neutral information, suggesting sensitivity of our attentional bias task (e.g., Fox et al., 2001). Finally, our attentional breadth modification exerted no impact on self-regulation, another assessment of emotional resilience in experiment 4.

It is important to consider whether our failure to detect any impact of attentional broadening on attentional bias, or on self-regulation, may be due to insufficient power. To ascertain whether this is the case, we calculated whether each experiment achieved sufficient power to detect a potential impact of attention broadening training on the other assessment tasks, using the G*Power 3.1.3 software package (Erdfelder, Faul, & Buchner, 1996). Based on the study of Hanif et al. (2012) which most strongly resembles our studies, partial eta squared estimates of effect size indicated a small effect. Hence, if we conservatively assume a small effect size of $d = .2$ (Cohen, 1988), the power (1 - β) to detect an effect of attentional breadth training on biased attentional responding to negative information, was .36 in experiment 1, .26 in experiment 2 (.55 for experiment 1 and 2 together), .30 in experiment 3, and .27 in experiment 4. The corresponding power when a medium effect is assumed ($d = .5$) amounts to .98 for experiment 1, .91 for experiment 2 (1.00 for experiment 1 and 2 together), .95 for experiment 3, and .92 for experiment 4. Thus, it remains possible that statistical power was insufficient to capture the small effect of attentional breadth training on subsequent attentional bias.

Why did we obtain results that differed from previous published findings? First it is important to note that we did not aim to perform exact replications of previous studies but sought to investigate whether training designed to broaden attention would influence biased attentional responding to threat. A very important issue with experiment 1 and 2 is that the manipulation of attentional breadth was unsuccessful. Although previous research has found attentional breadth training effects using global-local hierarchical stimuli to induce broadened or narrowed focal attention, specific features of our training procedures may partially explain our inability to alter attentional breadth using this approach. Gable and Harmon-Jones (2012) used a trial-by-trial manipulation of attentional breadth through presentation of a global-local Navon letter showing effects on the subsequent affective picture. Hence, it is possible that attentional breadth should be conceptualized as a flexible momentary attentional set that can be altered at a trial-by-trial level but cannot be changed in an enduring manner that persist beyond the intended training procedure itself. In experiment 1, we used a modified global-local task in which we manipulated proportion global versus local trials, in our attempt to change attentional breadth. However, results showed no evidence that the training conditions differentially affected attentional breadth. Perhaps the training procedure may have manipulated flexibility of focal attention rather than attentional breadth. In experiment 2, we used a similar training task, with short stimuli presentation times, and instructed participants to only react to the global or local features of the stimuli depending on training condition, in our attempt to induce a broader or narrower attention. However, a post-measurement of attentional breadth revealed that our training procedure did not affect attentional breadth. Again, perhaps it might have manipulated flexibility of focal attention rather than attentional breadth as after exposure to either training condition a pre-existing speeding of responses on global relative to local trials disappeared.

Given our interest in psychopathology, we were specifically interested in training dispositional attentional broadening because it may influence anxiety or depression (Basso et al., 1996). Other researchers have also tried to manipulate dispositional attentional breadth using a more long-term training procedure. Hanif et al. (2012) manipulated focal attentional bias towards global or local information, by confronting participants with briefly presented hierarchical shapes of which they only had to identify the global shape in the broad attentional training group or the local shape in the narrow training group. This task was found capable of modifying emotional reactivity to a subsequent stressor. However, no post-measurement of attentional breadth was administered in this study. Hence, it is not clear whether this training procedure trained to adopt broadened focal attention or tapped into other attentional mechanisms. Possible, as we have suggested for experiment 2 that used a similar training task to Hanif et al. (2012), the training may have enhanced cognitive flexibility rather than inducing attentional breadth. Notably, in the literature, broadening the focus of attention is associated with enhanced cognitive flexibility (Olivers & Nieuwenhuis, 2005). Furthermore, Hanif et al. (2012) proposed that distributing attention across a broad range of stimuli would prevent the over-investment of attention in maladaptive processes or thoughts.

In experiment 3 and 4, we developed an innovative attentional breadth training aimed to manipulate attentional breadth more effectively. In this manipulation, task-difficulty in the broad training group was tailored individually to the performance of the participant during the training. Manipulation check trials revealed that participants in the condition designed to broaden attention deployed attention more broadly, as reflected in a higher percentage of correctly identified targets presented furthest from fixation in the broad training group, while participants of the narrow training group identified the central targets most accurately. Thus, this new attentional breadth training has shown to manipulate attentional breadth successfully. Yet, a limitation of this task should be noted. Task-difficulty, which is thought to have the propensity to interfere with performance on other tasks, differed slightly between the broad and narrow attentional training conditions. First, in both the broad and narrow training conditions, participants were exposed to identical configurations of stimuli in the beginning of the task. However, participants in the broad focal training group were required to identify stimulus presented furthest from fixation, while participants in the narrow focal training group were required to identify the stimulus closest to fixation. Comparisons of error rates on the training trials between groups revealed that identifying targets presented far from fixation was more difficult than identifying targets close to fixation. Second, when participants in the broad training group achieved an accuracy rate above 80% in the previous block, task-difficulty increased by expanding the focal field wherein stimuli appeared to maximize focal attentional broadening in the following block. In contrast, in the narrow training group, the focal field remained stable during the complete task. Nonetheless, this personalized training also restricted differences in task-difficulty by only increasing task-difficulty when participants seem to perform very well (> 80% correctly identified targets). Furthermore, in experiment 3, the spatial configuration of manipulation check trials depended on training group. In the broad training group, manipulations checks were presented within the same focal field as the training trials, making also manipulation checks more difficult in this group. Therefore, in experiment 4, we chose to keep manipulation checks equal across groups. These manipulation checks may still be perceived as more difficult in the broad training group because focal attention has to be adapted to this more narrow field wherein these stimuli are presented. Nonetheless, in experiment 4, overall performance on these manipulation checks, as reflected in the total amount of correctly identified targets regardless of their spatial position, did not differ between groups. This latter observation in combination with the fact that the spatial positions of correctly identified targets depended on training groups seems to be a strong argument that this training task is able to efficiently manipulate focal attention.

A final important issue concerning the training methodologies, is that although both training tasks aimed to modify attentional breadth, the conceptualization of attentional breadth in these two tasks was very different. In the global-local training task variant, broad or narrow refers to which feature of a stimulus is attended to first. In the new task, broad or narrow refers to a spatial distribution of attention. These may be two completely different aspects of attentional breadth, and the effects of these two types of attentional breadth on attentional bias or self-regulation need not be equivalent. Hence, although the successful modification of attentional breadth as defined in experiment 3 and 4 did not influence attentional bias or self-regulation, this does not mean that successful modification of attentional breadth as defined in experiments 1 and 2 would not have exerted such an influence.

In summary, in this series of studies, we attempted to manipulate attentional breadth to examine whether variability in attentional breadth causally influenced attentional bias and self-regulation. Despite encouraging evidence from previous studies (Gable & Harmon-Jones, 2012; Hanif et al., 2012), we did not find evidence to support this causal hypothesis. These results are important for future theorizing on the role of focal attention, given previous claims concerning the contribution of attentional breadth to emotion regulation and resilience.

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Evidence suggests that mood can influence *orienting of spatial attention* (for a review, see Pessoa, 2008). An often reported finding is that visual attention can selectively enhance processing of mood-congruent information. For instance, depressed patients show a processing bias for negative information (e.g. Williams, Mathews, & MacLeod, 1996).

Another aspect of visual processing that seems susceptible to change as a function of *mood* is the *breadth of attention*. Mood has been shown to modulate attentional breadth in that positive moods broaden, whereas negative moods narrow the breadth of attention (see Fredrickson, 2004). Furthermore, it is proposed that positive moods promote a broad processing style (Gasper & Clore, 2002; Schwarz & Clore, 1983), whereas negative emotions reduce this global tendency (e.g. Derryberry & Reed, 1998; Easterbrook, 1959). Indeed, it has been shown that healthy Western people have a default broad or global processing bias (Kimchi, 1992; Navon, 1977). This default global processing mode is thought to be adaptive, as it allows a rapid evaluation of a large part of the visual field based on low-resolution information, thus placing relatively low demands on processing resources (Navon, 1977). However, this default global processing bias has been found to be reduced in some psychological disorders, including depression (De Fockert & Cooper, 2013).

Interestingly, both positive emotions and a broadened attentional focus are thought to be important factors contributing to *resilience*. The broaden-and-build theory (Fredrickson, 1998, 2001) proposes that positive emotions, by broadening the attentional scope, build durable skills and resources that enhance the chances to cope successfully with stress. Indeed, individuals who experience positive emotions in stressful situations seem more able to disengage attention away from negative material and engage in emotion regulation (e.g. Tugade & Fredrickson, 2004). Thus, positive emotions play a crucial role in the down regulation of stress. Importantly, this down regulation of stress is clearly disrupted in depression. However, little is known about the effects of positive emotions and the breadth of attention on the down regulation of stress in remitted depressed (RMD) individuals.

The *general aim* of this dissertation was to investigate the core principles of the broaden-and-build theory (Fredrickson, 1998, 2001) in healthy as well as in RMD patients, in order to better understand *recurrence of depression*. This theory emphasizes the role of *positive emotions* and the *breadth of attention* and cognition in *resilience*. In this dissertation, we focused on attentional breadth because attention can be considered as at the start of information processing and as such may direct all further information processing such as memory and interpretation (Koster, De Raedt, Goeleven, Franck, & Crombez, 2005).

The broaden hypothesis states that positive emotions broaden the scope of attention. Although there is converging evidence supporting this hypothesis, recent studies and theoretical accounts cast doubt on the reliability of these findings. Because this broadening mechanism is theoretically considered crucial in explaining the association between positive emotions and resilience, our *first aim* was to systematically examine the effects of positive affect on the breadth of attention (*Chapter 1* and *2*). We hypothesized to replicate former research indicating that positive affect impairs selective attention.

Our *second aim* was to investigate the build-hypothesis by examining the effects of the breadth of attention on resilience-related attentional processes in a healthy as well as in a RMD sample. Although depression is related to a narrowed attentional scope (De Fockert & Cooper, 2013), the breadth of attention was not yet investigated in RMD patients. As a narrowed attentional scope is thought to be related to some cognitive control deficits in depression, such as impaired disengagement and cognitive inflexibility (see Whitmer & Gotlib, 2012), and, as control deficits can still be present after remission (e.g. Joormann & Gotlib, 2007), we hypothesized that RMD patients would also display a narrowed attentional scope, and relatedly, would show impaired attentional disengagement and impaired cognitive flexibility, compared with never depressed controls (NDC; *Chapter 3*).

Furthermore, we aimed to investigate whether the scope of attention causally relates to immediate and more long-term resilient/depressive responding to stress in a healthy population. In a first study, we used a prospective longitudinal design to examine whether inter-individual differences in attentional breadth and orienting could predict resilience and factors associated with resilience in response to life events within and outside a stressful period (*Chapter 4*). In a second series of studies, we aimed to manipulate attentional breadth by using a recently developed modification methodology that has shown to influence performance on a subsequent self-regulation task (Hanif et al., 2012). We aimed to replicate that the breadth of attention can be experimentally manipulated, and to extend these findings to resilient responding to aversive stimuli (*Chapter 5*).

In this *discussion*, we start with a summary of our main results related to *three main research questions*: 1) can we replicate the findings of the broadening effect of positive affect on attention in a healthy population; 2) do RMD patients display a narrowed attentional focus compared with NDCs, and does this difference in the attentional scope relate to hypothesized impairments in disengagement and cognitive flexibility in neutral and emotional material; 3) does the attentional scope have a causal status in immediate and more long-term resilience and depression? Next, we will discuss theoretical as well as clinical implications. We will point out several limitations of our studies and conclude with a number of recommendations for future research.

SUMMARY OF THE MAIN FINDINGS

In this section, we summarize the main findings of our studies. Theoretical and clinical implications of our findings will be addressed in the sections following this summary.

The Effects of Positive Affect on Attentional Breadth

In a *first research line*, we investigated the effects of positive mood on attentional breadth. Hence, a *first research question* was whether we could replicate the broadening effects of positive mood induction procedures (MIPs) on the attentional focus. Whereas we investigated direct effects of positive affect on attentional breadth in *Chapter 1*, we examined indirect effects by including one of the factors that is thought to mediate this association in *Chapter 2*.

In *Chapter 1*, we conducted 4 experiments in a student population, each using a similar design in which we induced positive versus neutral or negative mood states, using different well-validated MIPs. After the MIPs, attentional breadth was measured with either a modified Eriksen flanker task (Rowe, Hirsh, & Anderson, 2007), the Attention Network Test (ANT; Fan, McCandliss, Sommer, Raz, & Posner, 2002), or a global-local Navon letter task (Navon, 1977). However, we could not find any evidence for an attentional broadening effect caused by a positive MIP on these tasks. In the modified flanker task, a positive MIP, as compared with a neutral and negative MIP, did not result in more pronounced interference effects for distant flankers. Moreover, a positive MIP was not found to influence visual attention as assessed by the selective and orienting networks of the ANT, compared with a neutral and negative MIP. Unexpectedly, a positive MIP tended to influence global-local preference as measured with the global-local Navon letter task, although not in the expected direction. That is, a positive MIP tended to narrow the attentional focus compared with a neutral MIP. These unexpected findings led us to further examine factors that might influence the link between affect and attentional breadth.

Therefore, in *Chapter 2*, we conducted a replication and extension of the Huntsinger (2012) study which found that affect merely influences whether people do or do not act according to the momentarily dominant tendency to focus broadly or narrowly. Similar to Huntsinger (2012), we hypothesized positive and negative affect to confer positive or negative value on the earlier experimentally primed perceptual global versus local orientation, with positive affect enhancing and negative affect inhibiting this primed orientation. We examined the interaction effect of these manipulations on a modified flanker task (Rowe et al., 2007). Results revealed the expected interaction between the primed perceptual focus and MIP in the flanker condition with the highest flanker eccentricity, supporting the idea that affect flexibly determines the attentional scope in interaction with the currently accessible attentional orientation. However, this interaction effect was not found in flanker conditions with lower flanker eccentricity. In the most difficult condition without spacing between the flankers, positive mood was related to the commonly found broadening effect on selective attention.

In summary, results of *Chapter 1* and *2* revealed that positive affect did not consistently broaden attentional scope. Depending on several mediating variables, positive affect exerted a broadening, a narrowing, or no effect on the scope of attention.

The Link between Attentional Breadth and Resilience

In a *second research line*, we examined the link between attentional breadth and resilience-related attentional processes. A *second research question* concerned the investigation of the attentional scope in RMD individuals and the relation with other attentional processes that are thought to contribute to resilience in *Chapter 3*. Then, we addressed a *third research question* concerning the causal status of the attentional scope by conducting a longitudinal study that investigated effects on long-term resilience factors in *Chapter 4*, and by examining the effects of a manipulated attentional scope on immediate resilience-related attentional processes in *Chapter 5*, using student samples.

Attentional breadth and resilience in remitted depression

In *Chapter 3*, we provided a comprehensive investigation of resilience-related attentional processes in a RMD and a never depressed control (NDC) sample, predicting that RMD individuals would be characterized by reduced attentional breadth, and impaired disengagement and flexibility for neutral and/or negative information, compared with NDCs. In contrast to our predictions, results revealed no robust group differences for each of the attentional processes. Despite the absence of group differences in overall affective flexibility, the RMD group reacted slower to negative relative to positive images compared with the NDCs, and, RMD individuals showed more difficulties in switching between different classification rules in positive pictures relative to negative pictures, while for NDCs the reverse was found. Although we could not confirm robust group differences in these resilience-related attentional processes, we found some indications that a broadened attentional scope might foster resilience-related attentional processes as it facilitated attentional disengagement from aversive information and flexibility in neutral information. Moreover, in the RMD group, a broadened attentional scope was associated with higher self-reported resilience. Also, a larger amount of previous depressive episodes was associated with more impaired flexibility for neutral information.

On the causal status of attentional breadth on resilience

In *Chapter 4*, we conducted a longitudinal prospective study in a large sample of undergraduate students to examine the causal status of perceptual attention on resilience factors over an 18 month period. We investigated whether breadth and flexibility of perceptual attention, as assessed by the selective and orienting networks of the ANT (Fan et al., 2002), in interaction with emotional life events, could predict self-reported stress-resilience in a stressful period, and self-reported emotional well-being after 18 months.

Overall results revealed that efficient spatial orienting of attention may, to some extent, foster beneficial effects of positive events on well-being (e.g. lower depressive symptoms), while unexpectedly, greater breadth of attention seemed to elevate depression risk.

In *Chapter 5*, we conducted 4 experiments, using similar designs, all in student samples. We investigated the causal status of attentional breadth on resilience-related attentional processes by directly manipulating the breadth of attention towards either a broad or a narrow attentional focus and investigating effects on emotional attention tasks that were administered immediately after the training procedures. We used training procedures that were based on previous research (Hanif et al., 2012), as well as a novel attentional breadth training task. We examined whether the induced broad versus narrow attentional scopes altered attentional responding to emotional information, and whether it would generalize to alternative measures of attentional breadth. Results revealed that it is possible to manipulate attentional breadth. However, we observed no transfer of training to another attentional breadth task, and we did not find any effect of such training on attentional responding to emotional stimuli, or any impact of the attentional breadth training on another resilience-related factor (e.g. self-regulation). Nevertheless, pre-training data indicated that higher levels of attentional breadth are associated with a smaller attentional bias in aversive information and with less depressive symptoms. However, these correlations could not be replicated in a follow-up experiment.

In summary, in *Chapter 3* and *4*, we examined the link between the breadth and flexibility of the default perceptual focus and resilience-related attentional processes in RMD as well as in healthy individuals, whereas in *Chapter 5*, we experimentally manipulated attentional breadth to evaluate the effects of a momentarily primed attentional focus on immediate resilience-related processes. Results in *Chapter 3* revealed that RMD individuals are neither characterized by a robust narrowed attentional scope, nor by impaired disengagement from, or reduced flexibility for neutral and emotional material, compared with NDCs. Both in *Chapter 3* and *5*, individual differences in attentional breadth were related to individual differences in disengagement from aversive material, in a way that a broadened attentional focus facilitated resilient responding to stressful information. However, this latter finding could not be replicated in another experiment described in *Chapter 5*. Next, in *Chapter 3*, we found attentional breadth to be positively related to attentional flexibility, whereas in *Chapter 4*, we found the reverse as breadth and orienting of attention measurements were negatively correlated. Finally, *Chapter 5* indicated that it is possible to manipulate the momentary attentional focus. However, the primed attentional scopes did not differentially affect resilience-related attentional processes, or attentional breadth.

THEORETICAL IMPLICATIONS

The Effects of Positive Affect on Attentional Breadth

Based on the findings brought together in *Chapter 1* and *2*, should we reject the hypothesis that positive affect broadens the scope of attention? Despite the amount of null-results in *Chapter 1* that seem to reject or even contradict this hypothesis, we can currently not conclude that positive affect does not broaden the attentional focus given a number of reasons.

First, we have shown in *Chapter 2* that positive affect can indeed broaden the attentional scope, but that other mediating factors might play an important role in this association. In this chapter, we were able to replicate the findings of Huntsinger (2012), by showing that positive mood can regulate perception by providing experiential feedback about the value of the currently accessible processing focus. However, this result was only found in the flanker condition with the highest flanker eccentricity. We also found that current mood had an influence on the flanker compatibility effect in the flanker condition with the smallest eccentricity, regardless of perceptual priming. In this condition, participants in a positive mood showed a broadened scope. These results suggest that other moderating variables may interact with the flexible link between affect and attention. We proposed an explanation for this unexpected finding by stating that task-difficulty may obscure the primed focus, erasing its effect. Another explanation could be found in the characteristics of the stimuli that were used in the local priming task. It is possible that this spatial focus, although intended to serve a narrow focus, was still too broad to be beneficial for the selective attention task. Hence, it seems that the attentional scope is determined by several other variables.

Another variable that is also thought to influence the association between positive mood and the breadth of attention is the motivational intensity of affect. Affect that is low in motivational intensity is thought to broaden, while affect that is high in motivational intensity is thought to narrow the attentional focus (Gable & Harmon-Jones, 2010). This could possibly explain our unexpected finding in *Chapter 1*, where a positive MIP that consisted of imaging a positive autobiographical memory narrowed the attentional focus. Possibly, this MIP elicited positive affect that was high in motivational intensity, thereby narrowing the attentional focus.

Conclusion

We can conclude that at a theoretical level, the present findings are not in line with the broaden hypothesis of the broaden-and-build theory (Fredrickson, 1998, 2001) that positive affect is associated with a broadening of attention. However, our findings do not rule out that positive affect can serve an important role in broadening attention in principle (e.g. Fredrickson & Branigan, 2005; Gable & Harmon-Jones, 2010). The present findings lend support for the idea that affect does not have a direct and static influence on attentional scope, but determines the attentional scope in interaction with other factors such as the dominant accessible focus, the motivational intensity of affect, and task-difficulty. Nevertheless, it is clear that these effects are limited to specific conditions and that the influence of positive affect on attention is mediated and moderated by additional, insufficiently understood processes that require further study.

The Link between Attentional Breadth and Resilience

Key to the proposal that positive emotions are associated with resilience and well-being, is that positive emotions broaden the scope of attention and cognition (Fredrickson, 1998, 2001). Based on our findings in *Chapter 3, 4,* and *5*, can we confirm the crucial role of breadth of attention in psychological resilience and well-being? Although the absence of totally robust or consistent findings, results suggest that breadth, but also flexibility of spatial attention might help explaining variability in resilience and well-being.

First, in *Chapter 3* and *5*, we found a higher breadth of attention to be related to facilitated disengagement from aversive information, an attentional process that is thought to contribute to resilience, in a RMD, a NDC, and a student sample. However, in *Chapter 5*, we could not replicate this correlation in a follow-up experiment. In both *Chapter 3* and *5*, we measured attentional breadth with a global-local Navon letter task (Navon, 1977). From this task, an attentional breadth score was computed, which reflected ready perception of global compared to local targets, by subtracting mean reaction times (RTs) on the global trials from those of the local trials. Hence, a higher score means a greater breadth of attention. After this attentional breadth assessment task, an attentional disengagement task in which participants were required to disengage attention away from a neutral, positive, or aversive central cue, and to redirect attention to the peripherally presented targets, was administered (Fox, Russo, Bowles, & Dutton, 2001). From this task, an attentional disengagement score for positive and aversive information was calculated by subtracting RTs on the neutral trials from those on the positive or aversive trials, respectively. In *Chapter 3* and *5*, the attentional breadth score was negatively associated with an attentional bias for aversive information, $r(51) = -.30$, $p = .034$, $r(107) = -.24$, $p = .014$, revealing that a higher attentional breadth was associated with faster disengagement from aversive information in a RMD, NDC, and student sample, supporting the idea that the default attentional focus can account for a proportion of the variance in resilient responding to aversive information. However, in a following experiment in *Chapter 5*, we could not replicate this association in another student sample. It is possible that we could not replicate this rather small correlation because of a smaller sample size ($N = 54$), compared with the sample ($N = 107$) in which we did find the correlation in *Chapter 5*. One could argue that we did find this rather small correlation in *Chapter 3*, using a comparable small sample size ($N = 54$). However, high variability in performance on the different tasks in the RMD as well as the NDC group enhanced the chance to find correlational effects.

Second, besides the hypothesis that, according to the broaden-and-build theory (Fredrickson 1998, 2001), positive emotions broaden people's focus, this theory also states that this broadened attentional focus in turn creates flexibility, which is also thought to contribute to resilience. Hence, next to the breadth of attention, we also considered the flexible orienting of spatial attention in *Chapter 3* and *4*, in a RMD, NDC, and student sample. Remarkably, in *Chapter 3*, higher levels in breadth of attention were associated with higher levels of attentional flexibility, whereas in *Chapter 4*, the reverse was found. In *Chapter 3*, breadth and flexibility of attention were measured with the global-local Navon letter task (Navon, 1977). Attentional breadth was assessed by the difference score between RTs on global versus local trials, whereas attentional flexibility was assessed by the difference between RTs on repetition and switch trials. In *Chapter 4*, attentional breadth and flexibility were measured with the ANT (Fan et al., 2002), by assessing the selective and orienting networks, respectively. A higher selective attention score (RT incompatible – RT compatible), reflects a higher breadth of attention; a higher orienting of attention score (RT centre cue – RT single spatial cue) reflects a faster spatial orienting of attention. In *Chapter 3*, breadth and flexibility of attention were positively correlated when assessed with the global-local Navon letter task, $r(51) = .30$, $p = .033$, whereas these attentional processes were negatively correlated when assessed with the ANT in *Chapter 4*, $r(89) = -.29$, $p = .005$. In *Chapter 3*, higher levels of attentional breadth tended to be positively related to higher trait resilience scores (RS) in the RMD group, $r(23) = .40$, $p = .059$. Moreover, attentional flexibility was nearly significantly correlated with the amount of depressive episodes in the RMD group, in a way that more depressive episodes related to more inflexibility, $\rho(23) = .40$, $p = .052$. As opposed to the findings in *Chapter 3*, the overall findings in *Chapter 4* tended to show that flexibility in spatial attention fostered, to some extent, the beneficial effects of positive events on well-being (e.g. lower depressive symptoms), while greater breadth of attention seemed to have opposite effects.

These opposed findings of effects of attentional breadth on resilience-related processes, might be explained by the different assessments and conceptualizations of attentional breadth. In the global-local Navon letter task (Navon, 1977), a broad or narrow attentional focus refers to which feature of a stimulus is attended to first, whereas in the ANT (Fan et al., 2002), broad or narrow refers to a spatial distribution of attention. These may be two different aspects of attentional breadth, and the effects on resilience-related processes need not be equivalent. In the ANT, the idea of a broader attentional scope in the visuospatial domain is reflected by an impairment of spatial selective attention, whereby ignored information is more fully processed (Lavie, Hirst, de Fockert, & Viding, 2004). However, impaired selective attention might also reflect impaired cognitive control (N. P. Friedman & Miyake, 2004). Impaired cognitive control is also considered as an important vulnerability factor for psychopathology such as depression (for a review, see Joormann &

D'Avanzato, 2010). De Raedt and Koster (2010) proposed that reduced cognitive control may lead to increased vulnerability for depression after recurrent episodes. Moreover, theories of depression have argued that this mood disorder is associated with a narrowed attentional scope (Whitmer & Gotlib, 2012), which should facilitate performance on such selective attention tasks. However, evidence shows that depression is associated with impaired response monitoring and control processes (Vanderhasselt & De Raedt, 2009). Hence, the conceptualization of breadth of attention as impaired selective attention may be more an assessment of cognitive control rather than a measure of the specific breadth of the attentional focus, explaining the opposite findings in *Chapter 3* and *4*.

Not only did we use different conceptualization of attentional breadth, we also have used various methods to assess resilience. According to Block and Kremen (1996), trait resilience can be conceptualized as a stable characteristic that involves the ability to bounce back from negative life events and adapt to both significant negative life events and minor everyday stressors. Indeed, several recent studies have demonstrated that trait resilience is associated with successful psychological and physiological adaptation to stress (Campbell-Sills, Cohan, & Stein, 2006; Fredrickson, Tugade, Waugh, & Larkin, 2003). Therefore, in *Chapter 3* and *5*, we examined a resilience-related attentional process by measuring the ability to easily disengage from stressful information, as the flexible responding to emotional information is thought to be a key mechanism of resilience (Genet & Siemer, 2011). In line with our hypothesis, we found the expected correlation between the breadth of the attentional scope and this operationalization of this resilience-related attentional process in *Chapter 3* and *5*. In these studies, we also measured trait resilience with the self-report resilience scale (RS; Wagnild & Young, 1993) which describes trait resilience as “motivational control and resourceful adaptation as relatively enduring, structural adaptation of personality”. Remarkably, scores on the RS were not related to an immediate stress resilience-related process as measured with the attentional disengagement task. As other researchers have argued (Bonanno & Mancini, 2008), the distinction between the conceptualizations of resilience as a personality trait or as adaptive responding to adversity is critical. They argued that it is meaningless to assess resilience in the absence of adversity. It is possible that someone who reports lower levels of trait resilience may respond resilient when confronted with an acute stressor, explaining why implicit and explicit measurements of resilience and resilience-related processes were not related.

Besides the distinction of implicit and explicit measurements of resilience, we also studied resilience-related processes by exposing participants to immediate stressful information in *Chapter 3* and *5*, thereby measuring resilience factors as an outcome reflecting adaptive functioning in the face of stress, while we examined resilience more as a dynamic process of adaptive functioning that unfolds in the context of substantial and enduring emotional life events over time in *Chapter 4*. According to the broaden-and-build theory (Fredrickson, 1998, 2001), it is stated that positive emotions broaden the attentional scope which, over time, build personal resources and resilience. Indeed, in *Chapter 4*, we could find some indications that the interaction between more enduring positive affect and spatial attention processes might enhance resilience-related factors over time. In contrast, in *Chapter 3* and *5*, we only measured a resilience-related process as an outcome, which might explain our null-results in *Chapter 3* and *5*. In *Chapter 3*, we could not find differences in resilience-related attentional processes between RMD and NDC individuals, while in *Chapter 5*, we could not find differential effects of a manipulated attentional focus on immediate resilient responding to stressful information.

Attentional breadth and resilience in remitted depression

In *Chapter 3*, we did not find evidence for our hypothesis that RMD individuals would be characterized by a robust reduced attentional default focus, nor by reduced resilience-related processes such as impaired disengagement from and flexibility in neutral and affective information, compared with NDCs. Although RMD individuals did not show a robust reduced default global focus, we can not conclude that a reduced default global scope might not be important to understand vulnerability and thus recurrence of depression. As has been described in the section above, within the RMD group we found that a higher breadth of attention was related with higher trait self-reported acceptance of self and life, and higher total trait resilience scores, and, in *Chapter 5*, higher breadth of attention was negatively related with depressive symptoms. Thus, a default global focus might indeed be an important resilience factor in depression. Interestingly, we could also observe high variability in the breadth of the default scope in the NDC group, which scored significantly higher on self-reported trait resilience compared with the RMD group. Hence, the global bias in visual processing that is found to be the default mode in most healthy young Western people (Kimchi, 1992) seems not robust or fixed. The breadth of attentional scope seemed to easily vary between people as well as within people, and may thereby not directly fuel resilience. Indeed, as shown in *Chapter 2*, the attentional focus can easily be changed through subtle contextual factors.

Second, we also found that the ability to flexibly switch between the global and local information processing systems may contribute to resilience, as this switching variable was impaired with the amount of previous depressive episodes in RMD individuals in *Chapter 3*. Moreover, in *Chapter 4*, greater flexibility in spatial attention enhanced the beneficial effects of positive events on depressive symptoms, measured during four consecutive weeks in a stressful period in a large undergraduate sample. Moreover, we replicated this effect of the moderating role of flexibility of spatial attention on depressive symptoms in a follow-up measurement after 18 months. Hence, we think that not only the breadth, but also the flexibility of spatial attention might contribute to resilience and help to understand recurrence of depression.

On the causal status of attentional breadth on resilience

In *Chapter 4* and *5*, we examined the causal role of the attentional scope on resilience by investigating its effects on long-term trait resilience with a longitudinal study design, and on an immediate resilience-related attentional process, by manipulating the attentional scope, respectively. Results of *Chapter 4* revealed that the spatial orienting component of attention contributed positively to long-term resilience-related constructs (e.g. lower depressive symptoms, higher quality of life). However, spatial orienting of attention did not have a direct effect on these variables, but exhibited these effects in interaction with positive life events. Moreover, this component of attention did not only enhance the effects of positive life events on resilience-related constructs, but also showed to buffer, to some extent, the detrimental effects of negative life events during a stressful period, as it enhanced the use of adaptive cognitive emotion regulation strategies when facing a negative event. However, we could not find effects on other self-reported variables such as more long-term trait resilience. Thus, the flexible orienting of attention in interaction with emotional life events might, to some extent, foster resilience-related constructs, but other factors seem to have played a role as well. In this study, breadth of attention seemed to have, in interaction with emotional life events, opposite effects on these long-term resilience-related variables. As explained in the above section, these findings are probably due to the conceptualization of attentional breadth in terms of impaired selective attention, which may mainly reflect impaired cognitive control.

In *Chapter 4*, we investigated the interaction effects between emotional life events and the attentional scope on resilience factors during a stressful period and more long-term trait resilience, whereas in *Chapter 5*, we examined direct effects of attentional breadth on an immediate resilience-related attentional process, by testing whether training procedures designed to modify attentional breadth towards either a narrow or broad focus could either impair or facilitate an attentional process underlying resilience as indicated by impaired or facilitated attentional disengagement from aversive information. However, across four experiments, we could not observe direct differential effects of the training procedures on this resilience-related attentional process. Hence, it might be that the link between positive affect and resilience is not mediated by spatial attention as is proposed in the broaden-and-build theory (Fredrickson, 1998, 2001). Unfortunately, it is also possible that the null-findings obtained in *Chapter 5* are due to methodological issues. Across our experiments, using different attentional breadth training procedures, we consistently failed to show close transfer to another attentional breadth assessment. Hence, it is possible that these training methodologies were simply ineffective. However, manipulation checks within the attentional breadth training that was designed to train attentional breadth in an individually tailored manner by adjusting task-difficulty according to the performance of the individual (experiment 3 and 4, see *Chapter 5*) revealed that this task was training attentional breadth as intended. Yet, these training procedures produced no transfer effects to another post-training measure of attentional breadth. It is possible that the training was insufficiently extensive to produce sustained attentional broadening effects.

Conclusion

At the theoretical level, the present findings only partially support the proposed underlying mediating role of attentional breadth on the association between positive affect and resilience, as proposed by the broaden-and-build theory (Fredrickson, 1998, 2001). Despite the absence of consistent findings, results indicated that variability in breadth, but also in flexibility of spatial attention might, to some extent, contribute to resilience. An important indication for this conclusion was the finding that a default broadened attentional scope was found to foster resilient responding to aversive information in a RMD, NDC, and student sample. Besides the breadth of the attentional focus, we also found that the flexibly orienting of spatial attention might contribute to resilience-related factors in *Chapter 4*. Notably, in this latter study, the components of spatial attention did not exert a direct influence on resilience factors, but interacted with emotional events. Hence, spatial attention might play a moderating rather than a mediating role in the association between affect and resilience. Furthermore, it is important to notice that this spatial scope not only varies substantially between people, but also within people depending on several contextual factors. We showed in *Chapter 2* and *5* that it is possible to manipulate the momentary breadth of attention. However, momentary induced focus did not directly alter resilience-related attentional processes or more long-term attentional breadth in *Chapter 5*. More research is needed to enhance our understanding of the causal relation between the momentary attentional scope and resilience.

With regard to depression, we found that RMD individuals were not characterized by a robust reduced global bias compared with NDCs which was in contrast to our expectations. Remarkably, there was a high variability in the default global focus in both the RMD and NDC group. However, a more default global focus was related to higher trait resilience scores in this group, and was related to higher flexibility of spatial attention, which in turn seemed impaired in RMD individuals with a high level of previous depressive episodes. Moreover, in a student sample, default spatial orienting was found to buffer for the detrimental effects of negative life events on depressive symptoms. Hence, although the absence of robust differences between at risk and healthy samples, these findings indicate that not only breadth, but also the flexibility component of attention might be important factors contributing to resilience, and thus be important in the recurrence of depression.

CLINICAL IMPLICATIONS

During the last decades, literature suggested that positive emotions, via broadening the scope of attention and cognition, build personal resources to resiliently cope with stress (Fredrickson, 1998, 2001). Hence, one of the key objectives that motivated the development of positive psychology was to identify ways of enabling more people to achieve the benefits that accompany positive emotional experience (Seligman, Steen, Park, & Peterson, 2005). Hence, such findings in non-clinical samples are now proposed to translate in clinical science.

Interventions that are proposed to enhance positive affects are for instance facilitating positive reappraisal of stressful life circumstances, triggering positive emotions through mental imagery, promoting behaviors (e.g. kind acts) associated with positive emotions, or biasing attention towards positive information (Garland et al., 2010). Regarding this latter proposal, Grafton, Ang, and Macleod (2012) suggested that the use of cognitive bias modification methodologies to induce heightened levels of positive affectivity may be appropriate applications for some affective disorders such as depression because deficient positive affectivity is a hallmark feature of depression. They proposed that an approach that includes a training component that serves to increase selective attention toward positive information may help to combat depression. Indeed, if positive affect increases the breadth of attention and cognition, which in turn builds resilience, such interventions may be fruitful in disorders in which positive affectivity is hampered. However, a recent meta-analysis indicated a small effect size (d = 0.23) of positive psychology interventions on depressive symptoms (Bolier et al., 2013). As we have argued in *Chapter 1* and *2*, positive emotions do not always broaden the attentional scope. This observation has important consequences as this broadening factor is thought to be crucial for resilience. For instance, in *Chapter 2*, we showed that positive emotions only broadened the attentional scope when a global focus was made dominant. However, when a local focus was made dominant, this pattern reversed, thus positive emotions then narrowed the attentional focus. Hence, as depression is thought to be characterized by a narrowed attentional scope (De Fockert & Cooper, 2013), it is possible that these interventions to train attention towards positive information may even enhance the default narrowed scope which is thought to be detrimental for resilience. With regard to recurrence of depression, RMD individuals seemed not characterized by a default narrowed scope compared with NDCs (*Chapter 3*). However, as there is large variability in the default attentional scope, we propose to use interventions that not only enhance positive affectivity, but also promote broad information processing styles.

Interestingly, interventions that have shown to successfully increase the experience of positive emotions have become available in western society, and are implied in prevention strategies of relapse in depression (Fredrickson, Cohn, Coffey, Pek, & Finkel, 2008; Geschwind, Peeters, Drukker, van Os, & Wichers, 2011). For instance, meditation and mindfulness have now shown to be fruitful within clinical psychology (Segal, Teasdale, Williams, & Gemar, 2002; Wallace & Shapiro, 2006). One example of a meditation form that is particularly interested in positive emotions is the loving-kindness meditation (LKM) which involves training one's emotions toward warm and tender feelings in an open-hearted way (Fredrickson et al., 2008). Interestingly, people are not only trained to cultivate positive emotions, but are also instructed to guide these warm and positive feelings to themselves and then to an ever- widening circle of other. Thus, LKM may also cultivate broadened attention beyond cultivating positive emotions. As we found that a broadened attentional scope was related with higher self-reported resilience in RMD individuals (*Chapter 3*), this type of intervention could indeed be beneficial for building resilience in RMD individuals to prevent relapse. Another example is mindfulness meditation, which involves "self-regulation of a metacognitive, attentional state: a nonreactive, non-evaluative monitoring of moment-by-moment cognition, emotion, perception, and sensation without fixation on thoughts of past and future" (Garland et al., 2010). Teasdale et al. (2002) suggested that mindfulness practice disrupts psychopathological schemas and prevents relapse in depression by evoking a metacognitive state in which distressing thoughts and feelings are given less attention, and are considered distant from the self. It is thought that these mental decentered states may facilitate the flexible selection of cognitive appraisals (Garland et al., 2010). Interestingly, as cognitive flexibility was impaired with the number of previous depressive episodes (*Chapter 3*), RMD individuals would especially benefit from these types of interventions which not only target the positive content of thoughts, but also the trigger a broad and flexible processing style. However, at present, it is not yet well understood how these meditation-oriented interventions lead to a reduction and prevention of depressive symptoms (Coelho, Canter, & Ernst, 2007; Kuyken et al., 2008). Recently, a study by De Raedt et al. (2012)

investigated the effects of an eight week mindfulness-based cognitive therapy (MBCT) group training in a RMD sample. With regard to its working mechanisms, they showed a reduced facilitation of attention for negative information and a reduced inhibition of attention for positive information, which was indicative of open attention towards all emotional information. Hence, understanding the mechanisms underlying the change in depressive symptoms, such as the breadth of the attentional focus, is a first step in further optimizing these types of interventions.

LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

The studies presented in this dissertation are not without limitations. In the following section, we address several limitations and propose recommendations for future research.

A first limitation concerns the MIPs that were used to enhance positive affect. Most of the positive MIPs used in our studies are known to have only a brief effect on affect. It is therefore possible that although MIPs were effective during parts of the experiment and thereby exhibited the expected results on the mood manipulation checks, this does not mean that they were strong enough to influence performance on the subsequent tasks, explaining our inconsistent results. However, the same MIPs were used in previously published studies that reported reliable effects of positive MIPs on attention. Moreover, we have used different MIPs in an attempt to create situations with ecologically valid strong positive affect (see Experiment 2, *Chapter 1*). Thus, despite the possibility of short-term effects of positive mood, the discrepant findings between the current and previous studies can not only be due to weak MIPs. In our prospective study (*Chapter 4*), we assessed positive affect by measuring the presence of a relatively major positive life event which exerts more sustained positive affect. Indeed, results showed that these positive life events in interaction with spatial components of attention could, to some extend, predict variance in resilience-related variables (e.g. depression scores), but did not consistently affect all resilience-related variables (e.g. trait resilience). However, in this study, we only measured the presence of relatively major positive life events at 5 time moments over 18 months. Interestingly, it is also known that positive affect can easily fluctuate over a short time period. A recent study that assessed affect at 10 random moments per day over 6 days, showed that subtle individual differences in daily life emotional dynamics can predict future treatment outcome (Wichers, Lothmann, Simons, Nicolson, & Peeters, 2012). Hence, it is possible that our measures were not sensitive enough to capture effects of positive affect. Hence, we think that future research should include measurements of ecologically valid subtle life patterns of emotions and their dynamics to be able to show fine-grained effects of positive affect in relation to attentional breadth and resilience.

Second, in *Chapter 3, 4* and *5*, we assessed attentional breadth as a trait characteristic. Indeed, previous studies showed that dispositional global or local bias can vary between people (see Kimchi, 1992), and that individual global or local biases are stable over time (Dale & Arnell, 2013) suggesting that the preference for global or local information can be seen as a trait characteristic. However, this does not suggest that this bias can not be influenced by other variables such as the current mood state of the participant (e.g. Fredrickson & Branigan, 2005; Gasper & Clore, 2002), or a primed global versus local focus (Huntsinger, 2012), or other variables (see Forster & Dannenberg, 2010). Hence, because of the huge amount of possible moderators influencing global-local processing styles, the absence of robust differences between RMD and NDC individuals in *Chapter 3*, and high variability in the attentional scope between participants, we can not draw conclusions about the role of the default perceptual scope. To examine the default scope, it seems that multiple measurements are required to accurately assess individual differences in the default perceptual scope. Hence, the design that was used in *Chapter 3* in which we expected robust differences in the default perceptual scope between RMD and NDC individuals may not have been sensitive enough to exert group effects. It is worth noting, however, that the Navon letter task (Navon, 1977) which is one of the most well-known and utilized tasks of global-local processing, showed not to be reliable for multiple administrations (see *Chapter 5*). We could not observe any global or local biases anymore in a second assessment of attentional breadth with this task. As the global-local Navon letter task is an easy task, task-repetition may have resulted in ceiling effects during the second registration of the task. Such problems with repeated administration suggest that caution should be taken when using this task multiple times in a single experiment. Hence, given the large variability in RMD individuals to become resilient, it is important to investigate individual trajectories of risk and resilience factors such as attentional breadth over time.

Another important issue for future research concerns the different conceptualizations of perceptual attentional breadth. As already mentioned, studies usually utilize selective attention tasks and global-local processing tasks to measure the breadth of attention. However, these two types of tasks may not measure the same aspect of visual attention. In global-local tasks, a broad or narrow attentional focus refers to which feature of a stimulus is attended to first, whereas in selective attention tasks breadth refers to a spatial distribution of attention. In the selective attention tasks, the idea of a broader attentional scope is reflected by an impairment of spatial selective attention, whereby task-irrelevant information is more fully processed (Lavie et al., 2004). Thus, in this type of tasks, a narrowed attentional scope is adaptive because it will reduce distraction from irrelevant information (e.g. R. S. Friedman & Forster, 2010). In contrast, a broadened attentional scope is detrimental in terms of performance, and might also reflect impaired cognitive control (N. P. Friedman & Miyake, 2004), which is thought to contribute to depression. Hence, the conceptualization of breadth of attention as impaired selective attention may not be the aspect of attentional breadth that is beneficial for resilience. As opposed to selective attention tasks, global-local tasks integrate the nominally irrelevant information in task-relevant information. Thus, in this task, it is measured which feature (global or local) of a stimulus is attended to first. Hence, it is possible that attentional breadth as defined by the spatial distribution of attention is not related to attentional breadth in terms of global or local biases. This could also explain our null-results in *Chapter 5*, in which we successfully trained attentional breadth in terms of spatial distribution, but could not transfer effects to a global-local task. Hence, future research should examine whether these measurements of perceptual attentional breadth measure unique or similar processes, and define a clear assessment of the conceptualization of attentional breadth that may contribute to resilience.

Another important point is that not only the breadth of perceptual attention, but also the flexible orienting of the attentional scope might be an important factor contributing to resilience. Notably, the broaden-and-build theory (Frederickson, 1998, 2001) proposes that positive emotions broaden the breadth of attention and cognition, which in turn enhance flexibility. Indeed, a broadened attentional scope might be beneficial in many tasks, such as creativity, problem-solving, and association tasks. However, a broadened scope is not always adaptive, as it also enhances the influence of distractors, which might be detrimental in cognitive control tasks such as selective attention tasks. Hence, it might be adaptive to be able to flexibly shift to a more narrow attentional scope in order to enhance performance on such tasks. Thus, information processing styles should hinge on the goals people pursue at the moment. Hence, the flexible application of a broad/global versus narrow/local processing style might be beneficial for resilience. Indeed, psychological resilience has been characterized by the flexible adaptation to the changing demands of the environment (Tugade & Fredrickson, 2004). Hence, one could argue that future research should target interventions that train flexibility of attention instead of targeting the breadth of attention. However, it is also possible that first a default broad attentional scope is needed to be able to flexibly switch between different information processing styles. Marguc, Forster, and Van Kleef (2011) showed that when people notice an obstacle to goal pursuit (i.e. failure) they first try to understand the event to see the bigger picture, and then, upon having made global sense of it, the local processing system may take over. Indeed the flexibility of spatial attention might be relevant for resilience as indicated by our results of *Chapter 3* and *4*, future resilience and depression studies may not only investigate the role of breadth but also flexibility of spatial attention. It would be useful to clarify the differences and overlap of the role of the breadth and flexibility of spatial attention on resilience.

Another issue concerns the different conceptualizations of resilience. As mentioned earlier, we have used various methods to assess resilience. In *Chapter 3* and *5*, we measured immediate attentional responding to stress by the ability to adaptively disengage from aversive information. We found the expected correlation between the breadth of the attentional scope and this attentional process that is thought to contribute to resilience in *Chapter 3* and *5*. In these studies, we also measured trait resilience with the self-report resilience scale (RS; Wagnild & Young, 1993) which describes trait resilience as a relatively enduring, structural adaptation of personality. However, scores on the RS were not related to this resilience-related attentional process as measured with the attentional disengagement task. As other researchers already have argued (Bonanno & Mancini, 2008), we think that the distinction between the assessments of resilience as a personality trait or as an adaptive response to adversity is critical. Furthermore, we also studied resilience as an outcome reflecting adaptive functioning in the face of immediate stress, while we examined resilience more as a dynamic process of adaptive functioning that unfolds in the context of substantial and enduring emotional life events in *Chapter 4*. In *Chapter 4*, we could find some indications that the interaction between more enduring positive affect and spatial attention processes might enhance resilience-related factors over time. In contrast, in *Chapter 3* and *5*, we only assessed resilience as an outcome of a resilience-related attentional process, which might explain our null-results in *Chapter 3* and *5*. Hence, it is possible that in RMD studies, resilience should be better conceptualized as a dynamic process by studying enduring stressors and consider resilience as a process unfolding across time.

A last note is that we only considered perceptual attentional breadth in this dissertation and that we can not draw conclusions about other forms of attentional breadth as for instance the cognitive breadth. We focused on attentional breadth because attention can be considered as at the start of information processing and as such may direct all further information processing such as memory and interpretation (Koster et al., 2005). However, we conducted a study which is not included in this dissertation in which we examined effects of conceptual attentional breadth by inducing a divergent thinking style on affect and perceptual attention. We did not find effects of an induced broadened thinking style on affect or perceptual breadth. However, we did not examine whether positive affect broadens cognition.

GENERAL CONCLUSION

This dissertation project set out to examine the different proposals of the broaden-and-build theory to shed light on factors and attentional mechanisms that contribute to resilience in order to better understand recurrence of depression. In our opinion, the overview of results presented in the current dissertation together with the recent findings in the literature are indicative that the role of positive emotions on the breadth of the attentional focus and resilience is more complex than most theories hold. Although our results did not allow straightforward conclusions, results did indicate that positive emotions relate to the breadth and flexibility of the attentional focus and that these factors may help to reduce the impact of stressors and daily hassles thereby fueling resilience and combatting depressive symptoms. However, it has become increasingly clear that other moderating and mediating factors influence this relationship and require further study.

Our work contributes to the rapidly growing body of psychological literature stressing the potential beneficial effects of positive affect and the breadth of attention on resilience. One major conclusion is that considerable theoretical and empirical work is needed to provide a more accurate and fine-grained analysis of the function of positive mood.

In conclusion, as already indicated long ago by the Greek philosopher Aristotle (Aristotle, 2009), the pursuit of happiness is more than just pleasure: life satisfaction and meaning are important ingredients of "the good life". When stepping back to experience significant life events as meaningful, even the most painful events may become somehow positive and rewarding (Leknes & Tracey, 2008). How exactly people find the bright side, the bigger perspective and meaning in the pain and pleasures of every day life is an essential question that only recently has started to be investigated scientifically (Seligman & Csikszentmihalyi, 2000). Formulating answers to this question is crucial to gain a deep understanding of the intricate link between emotions, well-being, and psychopathology.

"Suffering becomes beautiful when one bears great calamities with cheerfulness,
not through insensibility, but through greatness of mind."
Aristotle

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Depressie wordt omschreven als één van de belangrijkste psychiatrische problemen van de 21ste eeuw (Fryers et al., 2004). Metingen wijzen uit dat 14% van de totale Europese populatie minstens één maal gedurende het leven te maken krijgt met een ernstige depressie (Alonso et al., 2004).

Ondanks de beschikbaarheid van een brede waaier aan farmaceutische en psychologische behandelingen die efficiënt zijn gebleken op korte termijn (zie Dobson et al., 2008), blijkt er een specifiek probleem te bestaan in de preventie van herval. Studies tonen aan dat voorheen depressieve patiënten 70 tot 80% kans hebben om een nieuwe depressieve episode te ontwikkelen (Kessler, Zhao, Blazer, & Swartz, 1997). Daarbovenop blijkt dat het risico om een nieuwe depressieve episode te ontwikkelen verhoogt met het aantal voorgaande episodes (Keller, 2003). Deze gegevens maken van depressie niet alleen een vaak voorkomende psychiatrische ziekte, maar ook een ziekte die bestand is tegen de huidige behandelingsschema's. Gezien deze cijfers rond herval, werden cognitieve risicofactoren die geassocieerd zijn met de ontwikkeling, het behoud en herval van depressie reeds intensief onderzocht. Daartegenover is het onderzoek naar factoren die bijdragen tot weerbaarheid, gedefinieerd als het adequaat en gepast reageren op stress, schaars. Inzicht in de mechanismen onderliggend aan weerbaarheid kan dan ook cruciaal zijn om herval van depressie en de preventie ervan te kunnen begrijpen en is de focus van deze studie.

In deze studie zijn we gestart met onze benadering te kaderen binnen de huidige diathese-stress conceptualisatie van depressie die vooral gebaseerd is op onderzoek naar de risicofactoren geassocieerd met depressie. In het diathese-stressmodel voor depressie wordt aangetoond dat biologische diathese (genetisch risico) in combinatie met ongunstige levensgebeurtenissen kan leiden tot een verhoogde emotionele reactiviteit bij stress (Caspi et al., 2003). Deze verhoogde activiteit kan waargenomen worden op het niveau van verschillende biologische systemen en correspondeert met het niveau van specifieke informatieverwerkingskarakteristieken. Zo werd bijvoorbeeld aangetoond dat depressieve individuen moeilijkheden vertonen om hun aandacht los te maken van negatief materiaal om de aandacht naar meer positief materiaal of taakrelevante informatie te richten (Koster, De Raedt, Goeleven, Franck, & Crombez, 2005; Leyman, De Raedt, Schacht, & Koster, 2007). Het onvermogen om cognitieve controle uit te oefenen wanneer men geconfronteerd wordt met stresserende informatie wordt gereflecteerd in de neiging tot zelf-reflectieve ruminatie bij depressie. Een belangrijke bevinding hierbij is dat ook na de depressieve episode zowel de biologische als de cognitieve factoren nog steeds aanwezig zijn (e.g. Joormann & Gotlib, 2007; Nolen-Hoeksema, 2000; Vanderhasselt & De Raedt, 2009).

Gebaseerd op resultaten van deze studies werd een integratief cognitief-neurobiologische model (De Raedt & Koster, 2010) voorgesteld om de interactie tussen de biologische en cognitieve kwetsbaarheden in kaart te brengen om zo de toegenomen kwetsbaarheid na meerdere depressieve episodes op het niveau van cognitieve processen (vb. aandacht) en cognitieve inhoud (vb. negatief denken) beter te begrijpen. Dit werk heeft grotendeels verstoorde verwerking van *negatief* materiaal als potentiële kwetsbaarheidsfactor voor depressie bestudeerd. Ondanks het tevoorschijn komen van onderzoeksresultaten die suggereren dat depressie geassocieerd is met verminderde verwerking van *positieve* informatie (zie Scher, Ingram, & Segal, 2005), is aan dit aspect van informatieverwerkingsbias tot nu toe weinig aandacht besteed. Gegeven het feit dat cognitieve controle cruciaal is bij emotieregulatie (aandacht moet van negatieve naar meer positieve of taakrelevante informatie verlegd worden), lijkt het mogelijk om de hypothese te stellen dat ook *weerbaarheid* afhangt van zulke mechanismen.

EEN THEORETISCH KADER ROND WEERBAARHEID

Iedereen maakt op één of ander moment in het leven een stresserende gebeurtenis mee. Dit kan gaan van een grote gebeurtenis zoals een sterfgeval van een dierbaar persoon tot de kleinere stressoren zoals financiële moeilijkheden en dagelijkse zorgen. Het is dan ook niet verwonderlijk dat stress over het algemeen geassocieerd wordt met een reeks negatieve gevolgen zoals een verminderd gevoel van welbehagen, verhoogde ziekteprevalentie, post-traumatische stressstoornis, gegeneraliseerde angststoornis en depressie (Dohrenwend & Dohrenwend, 1974; Kendler, Karkowski, & Prescott, 1999). Het is echter niet zo dat iedereen die zelfs met heel hoge stresserende gebeurtenissen te maken hebben zulke negatieve gevolgen vertoont. Integendeel, er is recente evidentie dat veel mensen juist heel weerbaar zijn, ook in extreem stresserende situaties.

Psychologische weerbaarheid wordt gedefinieerd als “de effectieve omgang en aanpassing wanneer men met ontbering en ongeluk geconfronteerd wordt” (Rutter, 2012). Weerbaarheid wordt gezien als een dynamisch en adaptief proces dat het behoud of het efficiënt terugwinnen van een staat van homeostase in stresserende condities bevordert (Rutter, 2012). Gezien deze definitie lijkt weerbaarheid belangrijk bij behoud, herstel en hervalpreventie van psychiatrische stoornissen (Fava & Tomba, 2009). Het kan dan ook van cruciaal belang zijn om de onderliggende mechanismes van weerbaarheid te achterhalen om zo op onderzoek gebaseerde interventies te ontwikkelen die weerbaarheid verhogen. Eén van de karakteristieken die weerbaarheid bevordert is het ervaren van positieve emoties (Seligman, Steen, Park, & Peterson, 2005).

Gedurende het voorbije decennium werd uitvoerig beargumenteerd dat positieve emoties een cruciale rol spelen in psychologische weerbaarheid wanneer men met stresserende gebeurtenissen geconfronteerd wordt. Een centrale theorie rond positieve emoties, the “broaden-and-build” theorie (Fredrickson, 1998, 2001, 2004) integreert emotie- en weerbaarheidstheorieën. Er wordt gesteld dat negatieve en positieve emoties complementaire adaptieve functies alsook cognitieve en psychofysiologische effecten hebben. Een eerste centrale hypothese binnen deze theorie stelt dat negatieve emoties de aandacht en het gedragsrepertoire om specifieke negatieve en/of bedreigende situaties te hanteren vernauwen terwijl positieve emoties net het denk-en-actie repertoire verbreden. Onderzoek bevestigt dat positieve emoties inderdaad de aandachts- en cognitieve focus kunnen verbreden (e.g. Rowe, Hirsh, & Anderson, 2007). Een tweede assumptie van de broaden-and-build theorie stelt dat dit verbrede denk-en-actie repertoire accumuleert over tijd en stabiele persoonlijke psychologische, fysieke en sociale bronnen *bouwt*. Onderzoek toont aan dat positieve emoties duurzame persoonlijke bronnen bouwen die op hun beurt opnieuw positieve emoties uitlokken en bijgevolg leiden tot opwaartse spiralen van welbevinden (Garland et al., 2010). Anderzijds lijken positieve emoties ook als buffer te fungeren bij negatieve stemming en stress door het adaptieve reageren te stimuleren (Fredrickson, Tugade, Waugh, & Larkin, 2003; Tugade & Fredrickson, 2004). Een interessante bevinding hierbij is dat individuen die in staat zijn om positieve emoties te ervaren tijdens stresserende situaties, hun aandacht gemakkelijker kunnen losmaken van negatief materiaal en meer investeren in emotieregulatie (Fredrickson, Mancuso, Branigan, & Tugade, 2000). In stresserende situaties is het vernauwen van de aandacht geassocieerd met een respons die het lichaam klaar maakt voor actie terwijl positieve emoties de cognitieve verwerking verbreden en daarbij de stressrespons teniet doen waardoor het lichaam terugkeer naar een staat van homeostase. Positieve emoties spelen bijgevolg een cruciale rol in het reguleren en herstellen van stress. Echter, deze regulatie van stress is duidelijk onderbroken bij depressie. Ondanks deze vaststelling is tot nog toe weinig geweten over de effecten van positieve emoties en de daarbij onderliggende aandachtsmechanismen bij het reguleren van stress bij voorheen depressieve patiënten.

ONDERZOEKSDOELSTELLINGEN

De algemene doelstelling van dit proefschrift beoogde het systematisch en empirisch onderzoeken van de kernprincipes voorgesteld in de broaden-and-build theorie (Fredrickson, 1998, 2001) in zowel gezonde als voorheen depressieve individuen om herval bij depressie beter te kunnen begrijpen. Deze theorie omvat de rol van positieve emoties en het onderliggende mechanisme van aandachtsbreedte in weerbaarheid en welzijn. Gebruik makend van een cognitief-gedragsmatig perspectief hebben we twee onderzoekslijnen gevolgd om deze kerncomponenten van weerbaarheid in relatie tot depressie te onderzoeken.

In een *eerste onderzoekslijn* hebben we de effecten van een positieve stemming op aandachtsbreedte onderzocht. Zoals eerder beschreven, wordt door affect- en cognitie-modellen aangenomen dat een positieve stemming de aandachtsfocus verbreedt (e.g. Ashby, Isen, & Turken, 1999; Fredrickson, 1998, 2001). Hoewel er heel wat evidentie is die deze hypothese bevestigt lijken recente studies te twijfelen aan de betrouwbaarheid van deze onderzoeksbevindingen (e.g. Rowe et al., 2007). Gezien aandachtsbreedte als het cruciale aandachtsmechanisme beschouwd wordt bij de theoretische verklaring van de associatie tussen positieve emoties en weerbaarheid, plaatsten we als eerste doelstelling om de effecten van positief affect op aandachtsbreedte systematisch te onderzoeken (*Hoofdstuk 1* en *2*). We stelden hierbij de hypothese dat we de bevindingen van vorig onderzoek dat aantoonde dat positief affect selectieve aandacht verlaagt te repliceren.

In een *tweede onderzoekslijn* hebben we de tweede assumptie van de broaden-and-build theorie (Fredrickson, 1998, 2001) onderzocht door de effecten van aandachtsbreedte op weerbaarheid te onderzoeken in zowel een gezonde als in een voorheen depressieve populatie. Hoewel depressie gerelateerd wordt aan een vernauwde aandachtsfocus (e.g. De Fockert & Cooper, 2013), werd aandachtsbreedte tot nu toe nog niet onderzocht bij voorheen depressieve individuen. Omdat gedacht wordt dat een vernauwde aandachtsfocus gerelateerd is aan een aantal tekorten in cognitieve controle bij depressie, zoals het minder efficiënt losmaken van de aandacht van negatieve informatie en cognitieve inflexibiliteit (zie Whitmer & Gotlib, 2012), en omdat daarbovenop deze tekorten in cognitieve controle nog aanwezig zijn na remissie (e.g. Joormann & Gotlib, 2007), hebben we de hypothese gesteld dat voorheen depressieve individuen gekenmerkt zouden zijn door een vernauwde aandachtsfocus in vergelijking met een gezonde controlegroep in *hoofdstuk 3*.

Daarnaast hebben we ook onderzocht of aandachtsbreedte causaal gerelateerd is aan zowel directe stress weerbaarheid als weerbaarheid op langere termijn in een studentenpopulatie. In *hoofdstuk 4* hebben we een prospectieve longitudinale studie uitgevoerd die individuele verschillen in zowel de breedte als de flexibiliteit van de aandachtsfocus onderzocht in interactie met emotionele levensgebeurtenissen als voorspeller van weerbaarheid. In een laatste reeks studies die voorgesteld werden in *hoofdstuk 5*, hebben we de breedte van de aandachtsfocus experimenteel gemanipuleerd en de effecten daarvan op directe stress weerbaarheid onderzocht.

OVERZICHT VAN DE BELANGRIJKSTE BEVINDINGEN

De link tussen positief affect en aandachtsbreedte

In een *eerste onderzoekslijn* hebben we de effecten van een positieve stemming op aandachtsbreedte onderzocht. Onze *eerste onderzoeksvraag* beoogde dan ook de replicatie van het effect van een positieve stemmingsinductie op aandachtsbreedte. In *hoofdstuk 1* hebben we directe effecten van een positieve stemming op aandachtsbreedte onderzocht, terwijl we in *hoofdstuk 2* indirecte effecten hebben onderzocht door een factor te includeren waarvan gedacht wordt dat deze de associatie tussen positieve stemming en aandachtsbreedte medieert.

In *hoofdstuk 1* hebben we 4 experimenten opgezet die hetzelfde experimenteel design volgden waarbij we een positieve versus een neutrale of negatieve stemming induceerden bij studenten. Na de stemmingsinducties werd aandachtsbreedte gemeten aan de hand van ofwel een gemodificeerde Eriksen flanker taak (Rowe et al., 2007), de Attention Network Test (ANT; Fan, McCandliss, Sommer, Raz, & Posner, 2002) of een global-local Navon letter taak (Navon, 1977). De gemodificeerde Eriksen flanker taak (Rowe et al., 2007) is een aandachtstaak die selectieve aandacht meet, waarbij een centraal target langs beide zijden geflankeerd wordt door ofwel respons-compatibele (vb. NNNNN) ofwel respons-incompatibele (vb. NNHNN) flankers. Participanten krijgen hierbij de opdracht om zo snel en accuraat mogelijk het centrale target (N of H) te identificeren. De irrelevante en incompatibele flankers interfereren met de respons op het centrale target. Door de flankers op verschillende afstanden (vb. N N H N N) van het centraal target te presenteren, kan onderzocht worden of positieve stemming een effect heeft op visuele aandacht door een verbreding van de aandachtsfocus. Een verbrede aandachtsfocus zou hierbij gereflecteerd worden in verminderde selectieve aandacht voor het centrale target, en effecten zijn dan vooral zichtbaar wanneer dit centrale target omringd wordt door incompatibele flankers. De ANT (Fan et al., 2002) combineert een Eriksen flanker taak (Eriksen & Eriksen, 1974) met spatiale en temporele cues voorafgaand aan een flanker trial (Posner & Petersen, 1990) en meet daarbij drie verschillende componenten van aandacht: waakzame aandacht, spatiaal oriënteren van aandacht, en selectieve aandacht. De global-local Navon letter taak (Navon, 1977) beoordeelt de mate waarin participanten een voorkeur hebben voor globale en holistische informatie of voor lokale en gedetailleerde eigenschappen van een samengestelde stimulus. Een voorbeeld van een stimulus in deze taak bestaat uit een samengestelde visuele figuur van een grote letter (vb. “T”) die opgebouwd is uit kleine letters (vb. “L”). Participanten worden hierbij gevraagd om zo snel en accuraat mogelijk een target letter te identificeren (vb. “T”). De target letter kan dus zowel de globale vorm betreffen in de ene trial als een lokale eigenschap in een andere trial. De breedte van de aandachtsfocus wordt dan gereflecteerd in het verschil in reactietijden voor globale en lokale trials. In tegenstelling tot onze verwachtingen konden we geen evidentie vinden voor een aandachtsverbredingseffect veroorzaakt door positieve emoties op elk van de drie taken. Een positieve stemming resulteerde niet in meer uitgesproken interferentie-effecten voor verre flankers in de gemodificeerde flanker taak (Rowe et al., 2007) in vergelijking met een neutrale en negatieve stemmingsconditie. Een positieve stemming had ook geen invloed op selectieve aandacht gemeten aan de hand van de ANT (Fan et al., 2002) in vergelijking met een neutrale en negatieve stemmingsconditie. In tegenstelling tot onze verwachtingen resulteerde een positieve stemmingsinductie in een vernauwde aandachtsfocus gemeten aan de hand van de global-local Navon letter taak (Navon, 1977) in vergelijking met een neutrale stemmingsconditie. Deze onverwachte bevinding leidde ons tot verder onderzoek naar factoren die de link tussen affect en aandachtsbreedte zou kunnen mediëren.

Ondanks de grote literatuur die beweert dat affect de aandachtsfocus rechtstreeks beïnvloedt, lijken onze nulbevindingen in *hoofdstuk 1* en andere recente onderzoeksbevindingen te suggereren dat de link complexer is dan initieel verondersteld werd. In *hoofdstuk 2* hebben we een replicatie en extensie van een recente studie van Huntsinger (2012) uitgevoerd die aantoonde dat affect vooral beïnvloedt of mensen al dan niet ageren volgens de momentane dominante neiging om de aandacht breed of nauw te focussen. Huntsinger (2012) toonde aan dat affect een informatieve waarde toekent aan een eerder geïnduceerde perceptuele globale of lokale focus. Positief affect zou een positieve waarde toekennen aan de aandachtsfocus die op dat moment actief is, waardoor die focus versterkt wordt. Omgekeerd lijkt negatief affect een negatieve waarde toe te kennen aan de huidige focus, waardoor de momentane focus net geïnhibeerd wordt. Een limitatie aan de studie van Huntsinger (2012) was de afwezigheid van een neutrale stemmingsconditie. Deze conditie is nodig om te bepalen of de momentane focus ook beïnvloed wordt in de afwezigheid van een positieve of negatieve stemming. Volgens de theorie zou een neutrale stemming een neutrale informatieve waarde toekennen aan de momentane aandachtsfocus. Als positieve stemming inderdaad de momentane aandachtsfocus versterkt, dan moeten die effecten ook tot uiting komen in vergelijking met een neutrale stemmingsconditie. Om deze hypothese te testen werd bij de participanten ofwel een globale of lokale aandachtsfocus dominant gemaakt aan de hand van een gemanipuleerde global-local Navon letter taak (Navon, 1977) waarbij participanten in de globale conditie enkel met globale trials geconfronteerd werden terwijl participanten in de lokale conditie enkel lokale trials te zien kregen. Na de perceptuele focusinductie werd bij de participanten ofwel een positieve stemming ofwel een neutrale stemming geïnduceerd. Daarna hebben we de interactie-effecten van de geïnduceerde aandachtsfocus (globaal versus lokaal) met stemming (positief versus neutraal) onderzocht op een gemodificeerde Eriksen flanker taak (Rowe et al., 2007). Resultaten toonden de verwachte interactie tussen aandachtsfocus en stemming aan in de flankerconditie met de hoogste excentriciteit. Wanneer een globale focus geïnduceerd werd vertoonden participanten in een positieve stemming een verbrede aandachtsfocus vergeleken met participanten in een neutrale stemming. Omgekeerd, wanneer een lokale focus geïnduceerd was vertoonden participanten in een positieve stemming een vernauwde aandachtsfocus in vergelijking met participanten in een neutrale stemming. Verder konden we deze interactie niet aantonen in de flanker condities met een lagere flanker excentriciteit. In de conditie met de laagste excentriciteit vonden we dat positief affect gerelateerd was aan een bredere aandachtsfocus. Deze resultaten suggereren dat er nog andere variabelen een rol spelen in de associatie tussen positief affect en de aandachtsfocus en dat verder onderzoek nodig is.

We kunnen besluiten dat de huidige onderzoeksbevindingen de hypothese dat positief affect de aandachtsfocus verruimt niet bevestigen. Ondanks deze bevindingen lijkt het toch dat positief affect een rol kan spelen in het principe van aandachtsverbreding (e.g. Fredrickson & Branigan, 2005; Gable & Harmon-Jones, 2010). De huidige resultaten bevestigen dat positief affect geen directe en statische invloed op de aandachtsfocus uitoefent, maar dat positief affect in interactie met andere variabelen zoals de momentaan beschikbare aandachtsfocus een indirecte invloed op de aandachtsfocus uitoefent. Het blijft echter duidelijk dat deze effecten enkel onder specifieke omstandigheden zichtbaar zijn en dat de link tussen positief affect en de aandachtsfocus gemodereerd en gemedieerd wordt door variabelen die tot op heden onduidelijk zijn en verder onderzoek vereisen.

De link tussen aandachtsbreedte en weerbaarheid

In een *tweede onderzoekslijn* hebben we de relatie tussen de breedte van de aandachtsfocus en weerbaarheid onderzocht. Een *tweede onderzoeksvraag* betrof het onderzoek naar de aandachtsfocus bij voorheen depressieve individuen en de relatie met andere aandachtsprocessen waarvan gedacht wordt dat deze bijdragen tot weerbaarheid in *hoofdstuk 3*. Daarna hebben we een *derde onderzoeksvraag* gesteld naar de causale status van de aandachtsfocus bij weerbaarheid in *hoofdstuk 4* en *5*.

In *hoofdstuk 3* hebben we de belangrijkste aandachtsprocessen die gerelateerd zijn aan weerbaarheid onderzocht in een voorheen depressieve en in een gezonde steekproef. We stelden de hypothese dat voorheen depressieve individuen gekenmerkt zouden zijn door een vernauwde aandachtsfocus, meer moeilijkheden hebben om los te komen van of flexibel te reageren op neutrale en emotionele informatie in vergelijking met de gezonde controlegroep. De aandachtsfocus werd gemeten aan de hand van de eerder beschreven global-local Navon letter taak (Navon, 1977). Na de global-local taak voerden de participanten een emotie interferentie taak uit (Fox, Russo, Bowles, & Dutton, 2001) die aandachtsvertekeningen voor emotionele informatie meet. In deze taak verschijnt telkens een neutrale, positieve of negatieve foto in het midden van het scherm. Kort daarna verschijnt een target op één van vier verschillende spatiale locaties rond deze foto die de deelnemers zo snel en accuraat mogelijk moeten identificeren. De deelnemers moeten dus hun aandacht losmaken van de foto en die heroriënteren naar een spatiaal target. De tijd die nodig is om het target te detecteren indexeert hoe makkelijk deelnemers hun aandacht losmaken van de centrale foto. Tenslotte maakten de deelnemers nog een affectieve flexibiliteitstaak (Malooly, Genet, & Siemer, 2013) die de mogelijkheid tot het flexibel switchen tussen het classificeren van affectieve versus neutrale componenten van positieve en negatieve foto's meet. In tegenstelling tot onze hypotheses toonden onze resultaten geen groepsverschillen voor elk van deze aandachtsprocessen aan. Ondanks de afwezigheid van groepsverschillen vonden we enkele indicaties dat een brede aandachtsfocus kan bijdragen tot weerbaarheid. Resultaten toonden namelijk aan dat een brede aandachtsfocus gerelateerd was aan het makkelijker loskomen van negatieve informatie en met het flexibeler verwerken van neutrale informatie. Daarnaast vonden we dat een bredere aandachtsfocus bij voorheen depressieve individuen gerelateerd was aan meer zelf-gerapporteerde weerbaarheid. Tenslotte vonden we ook dat een hoger aantal voorgaan depressieve episodes geassocieerd was met verminderde flexibiliteit in neutrale informatie.

In *hoofdstuk 4* hebben we een prospectieve longitudinale studie uitgevoerd in een grote sample studenten om de causale status van de perceptuele aandachtsfocus op weerbaarheid te onderzoeken over een termijn van 18 maanden. We hebben hierbij zowel de breedte als de flexibiliteit van de spatiale focus onderzocht aan de hand van de eerder beschreven ANT (Fan et al., 2002). We onderzochten of deze componenten van perceptuele aandacht gemeten bij het begin van de studie in interactie met emotionele levensgebeurtenissen tijdens en buiten een stresserende periode, respectievelijk 2 en 18 maanden na de start van de studie, zelf-gerapporteerde weerbaarheid op die momenten kon voorspellen. Algemene resultaten suggereerden dat het flexibel oriënteren van de aandachtsfocus tot op zekere hoogte het effect van positieve levensgebeurtenissen op weerbaarheid kan verhogen (vb. minder depressieve symptomen). In tegenstelling tot onze verwachtingen vonden we het omgekeerde patroon voor de breedte van de aandachtsfocus: een bredere aandachtsfocus gemeten aan de hand van het selectieve aandachtsnetwerk in de ANT, leek in interactie met positieve levensgebeurtenissen juist het risico voor depressie te verhogen.

In *hoofdstuk 5* hebben we 4 experimenten uitgevoerd in studentensamples die allen hetzelfde experimenteel design volgden. In deze reeks studies hebben we de causale status van aandachtsbreedte op weerbaarheid gemeten door deze aandachtsfocus rechtstreeks experimenteel te manipuleren. De focus werd ofwel gemanipuleerd om zo breed ofwel zo nauw mogelijk te zijn. De effecten van deze manipulatie werd onderzocht op verschillende emotionele weerbaarheidstaken die onmiddellijk na de aandachtsfocustraining werden afgenomen. We hebben gebruik gemaakt van verschillende trainingsprocedures om de aandachtsfocus te manipuleren. In de eerste twee experimenten hebben we onze aandachtsfocustraining gebaseerd op een trainingstaak gebruikt in een recent gepubliceerde studie (Hanif et al., 2012), terwijl we voor de laatste twee experimenten een nieuwe aandachtsbreedtetraining hebben ontwikkeld en getest. We onderzochten of de experimenteel geïnduceerde brede versus nauwe aandachtsfocus aandachtsvertekeningen voor emotionele informatie, als een indicatie van weerbaarheid, zou kunnen beïnvloeden. We onderzochten verder ook of de gemanipuleerde aandachtsfocus zou generaliseren naar een andere maat van aandachtsbreedte. Onze resultaten toonden aan dat het mogelijk is om de breedte van de aandachtsfocus te manipuleren. We konden echter geen effecten van deze gemanipuleerde focus vinden op aandachtsvertekeningen voor emotionele informatie, noch op een andere maat van aandachtsbreedte. Ondanks onze nulbevindingen indiceerde data van de metingen voor de aandachtstraining dat een initieel bredere aandachtsfocus gerelateerd is aan het efficiënter losmaken van de aandachtsfocus van negatief materiaal en met minder depressieve symptomen.

Samengevat kunnen we stellen dat de huidige onderzoeksresultaten slechts deels de veronderstelde rol van aandachtsbreedte als mediërend onderliggend mechanisme in de associatie tussen positief affect en weerbaarheid bevestigen. Ondanks de afwezigheid van consistente bevindingen vonden we een aantal indicaties dat variabiliteit in de breedte van de aandachtsfocus, maar ook in de flexibiliteit van het oriënteren van de aandachtsfocus tot op zekere hoogte kunnen bijdragen tot weerbaarheid. Een belangrijke indicatie voor deze conclusie was dat een initieel brede aandachtsfocus het efficiënt loskomen van negatieve informatie kon bevorderen in een voorheen depressieve sample, een gezonde controle groep en in studentensamples. Naast de breedte van de aandachtsfocus vonden we ook dat het flexibel oriënteren van de aandachtsfocus kan bijdragen tot weerbaarheid in *hoofdstuk 4*. In deze studie hadden de verschillende componenten van spatiale aandacht geen directe invloed op weerbaarheid, maar wel een indirecte invloed in interactie met emotionele levensgebeurtenissen. Het is dus mogelijk dat spatiale aandacht eerder een modererende rol dan een mediërende rol speelt bij de associatie tussen affect en weerbaarheid. Resultaten toonden verder dat de spatiale aandachtsfocus niet enkel varieert tussen mensen maar ook binnenin eenzelfde persoon. Zo toonden we in *hoofdstuk 2* en *5* dat het mogelijk is om de momentane aandachtsfocus te manipuleren. Jammer genoeg kon deze gemanipuleerde aandachtsfocus geen invloed uitoefenen op weerbaarheid in *hoofdstuk 5*, waardoor we kunnen stellen dat meer onderzoek nodig is om de causale relatie tussen de momentane aandachtsfocus en weerbaarheid te begrijpen.

Met betrekking tot depressie vonden we dat voorheen depressieve individuen niet gekenmerkt worden door een robuust vernauwde aandachtsfocus in vergelijking met een gezonde controlegroep. Opvallend was wel dat de variabiliteit in aandachtsbreedte tussen mensen in beide groepen hoog was. Ondanks de afwezigheid van groepsverschillen vonden we ook in deze studie een aantal implicaties dat de aandachtsfocus een rol kan spelen bij weerbaarheid. Zo zagen we dat een bredere aandachtsfocus gerelateerd was aan hogere zelf-gerapporteerde weerbaarheid bij voorheen depressieve individuen. Daarbovenop was de breedte van de aandachtsfocus gerelateerd aan de flexibiliteit van de aandachtsfocus die op zijn beurt samenhing met het aantal voorgaande depressieve episodes bij voorheen depressieve individuen. We kunnen dus stellen dat ondanks voorheen depressieve individuen niet gekenmerkt worden door een robuust vernauwde aandachtsfocus, zowel de breedte als flexibiliteit van de aandachtsfocus inderdaad factoren kunnen zijn die bijdragen tot weerbaarheid en bijgevolg ook belangrijk kunnen zijn bij herval van depressie.

IMPLICATIES VAN DE ONDERZOEKSBEVINDINGEN

Bovenstaande bevindingen kunnen belangrijke implicaties hebben, zowel op theoretisch vlak als voor de klinische praktijk. Daarenboven kunnen de bevindingen van dit proefschrift een aanzet zijn tot verder onderzoek naar de impact van positief affect op perceptuele aandacht en bijgevolg naar de impact op weerbaarheid t.o.v. stress.

Zoals eerder beargumenteerd suggereert de literatuur dat positieve emoties via verbrede aandacht en cognitie weerbaarheid kan versterken (Fredrickson, 1998, 2001). Deze onderzoeksbevindingen hebben dan ook bijgedragen tot het ontwikkelen van de positieve psychologie die poogt interventies te ontwikkelen die positief affect kunnen verhogen (Seligman et al., 2005). Voorbeelden hiervan zijn trainingen om negatieve levensgebeurtenissen als meer positief te herbeoordelen, het mentaal leren ophalen van positieve herinneringen, het promoten van gedrag dat geassocieerd is met positieve emoties en het induceren van een aandachtsvertekening naar positieve informatie (zie Garland et al., 2010). Met betrekking tot deze laatste interventie suggereerden Grafton, Ang, and MacLeod (2012) dat het gebruik van cognitieve bias modificatie (CBM) methodologieën die pogen om positieve affectiviteit te induceren geschikte toepassingsmogelijkheden zouden kunnen hebben bij sommige affectieve stoornissen zoals depressie omdat deficiënte positieve affectiviteit een belangrijk kenmerk is van depressie. Ze stelden voor dat een benadering die een trainingscomponent die selectieve aandacht voor positieve informatie omvat zou kunnen helpen bij het bestrijden van depressie. Als positief affect inderdaad de breedte van aandacht en cognitie verhoogt, waarvan op zijn beurt gedacht wordt dat deze bijdragen tot weerbaarheid, dan kan dit soort interventie inderdaad vruchtbaar zijn bij stoornissen waarbij positief affect verminderd is. Resultaten van dit proefschrift in combinatie met recente literatuur tonen aan dat positieve emoties niet altijd de aandachtsfocus verruimen. Deze observatie heeft dus belangrijke implicaties omdat deze verruimde aandachtsfocus verondersteld wordt cruciaal te zijn voor weerbaarheid. We hebben in *hoofdstuk 2* bijvoorbeeld aangetoond dat positieve emoties enkel de aandachtsfocus konden verbreden wanneer ook eerder een brede aandachtsfocus geïnduceerd was. Wanneer echter een nauwe aandachtsfocus dominant was keerde dit patroon om in die zin dat positieve emoties de aandachtsfocus verder vernauwden. Aangezien bij depressie een vernauwde aandachtsfocus kenmerkend lijkt te zijn (De Fockert & Cooper, 2013), is het mogelijk dat deze interventies die selectieve aandacht voor positieve informatie pogen te verhogen misschien zelfs de vernauwde aandachtsfocus die net ongunstig is voor weerbaarheid versterken. Met betrekking tot herval bij depressie lijken de huidige onderzoekresultaten aan te geven dat voorheen depressieve individuen niet per se gekenmerkt worden door een vernauwde aandachtsfocus. Omdat we vaststelden dat er grote verschillen waren tussen mensen in de perceptuele aandachtsfocus suggereren we om interventies die zowel positieve affectiviteit als een brede informatieverwerkingsstijl promoten te verkiezen boven interventies die enkel gericht zijn op het verhogen van positief affect.

Een andere implicatie van de huidige onderzoeksbevindingen betreft de vaststelling dat niet alleen de breedte van de aandachtsfocus, maar ook het flexibel oriënteren van de aandachtsfocus een belangrijke factor kan zijn die bijdraagt tot weerbaarheid. In de broaden-and-build theorie (Fredrickson, 1998, 2001) wordt gesteld dat positieve emoties de breedte van aandacht en cognitie verhogen en dat verbrede aandacht en cognitie op hun beurt flexibiliteit verhogen. Een verbrede aandacht kan inderdaad gunstig zijn in veel verschillende taken zoals creativiteits-, probleem oplossings-, en associatietaken. Het is echter ook zo dat een verbrede aandachtsfocus net ongunstig kan zijn in andere taken zoals cognitieve controle- en selectieve aandachtstaken. Het zou dus ook net adaptief kunnen zijn om de aandachtsfocus flexibel te kunnen aanpassen aan de eisen van de taak. Psychologische weerbaarheid wordt eveneens gedefinieerd als het flexibel aanpassen aan de voortdurend veranderende omgeving (Tugade & Fredrickson, 2004). Bijgevolg kan het ook interessant zijn voor toekomstig onderzoek om interventies te ontwikkelen die eerder flexibiliteit van de aandachtsfocus trainen dan de breedte ervan.

ALGEMENE CONCLUSIE

In dit proefschrift hebben we de verschillende assumpties van de broaden-and-build theorie onderzocht om zo factoren en aandachtsmechanismen die bijdragen tot weerbaarheid te achterhalen en bijgevolg herval bij depressie beter te kunnen begrijpen. Naar onze mening tonen de onderzoeksresultaten die in deze dissertatie gepresenteerd werden in combinatie met resultaten uit recente onderzoeksliteratuur aan dat de rol van positief affect op de aandachtsfocus en bijgevolg op weerbaarheid complexer is dan beschreven wordt in de broaden-and-build theorie. Ondanks dat onze resultaten niet toelaten om sterke conclusies te trekken, kunnen we toch stellen dat positieve emoties onder specifieke omstandigheden gerelateerd zijn aan de breedte en flexibiliteit van de aandachtsfocus en dat deze factoren kunnen helpen om de impact van stressoren te reduceren en bijgevolg kunnen bijdragen tot het bestrijden van depressieve symptomen. Het blijft echter duidelijk dat andere modererende en mediërende factoren een rol spelen en dat verder onderzoek nodig is.

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