Current Psychology (2023) 42:30412–30421
https://doi.org/10.1007/s12144-022-04087-7

Biased information processing and anxiety coping: differences in attentional and approach patterns towards positive cues in repressors

Anna Exner[1] · **Alla Machulska**[1] · **Tobias Stalder**[1] · **Tim Klucken**[1]

Accepted: 26 November 2022 / Published online: 6 December 2022

Abstract
Individual differences in emotional coping styles are likely to affect information processing on different stages. Repressive coping is assumed to be related to an attentional bias away from threatening information. Possible links to biases in later stages of information processing have not been investigated to date. In the current study, 82 participants completed the visual dot-probe task as a measure of attentional bias and the Approach-Avoidance Task (AAT) as a measure of approach/avoidance bias and classified into coping groups via the Mainz Coping Inventory (MCI). Prevalence of attention bias and approach/avoidance bias were compared between groups. Main results revealed a strong approach tendency toward positive stimuli for repressors and a strong avoidance tendency for sensitizers. No group differences were found for approach bias to negative stimuli or for attention bias. The present findings of strong preferential processing of positive stimuli in repressors may be part of broader information processing alterations, which may also be linked to alterations in emotion processing.

Keywords Repressors · Sensitizers · Dot-probe task · Cognitive bias · Approach-Avoidance Task · Emotional coping · Cognitive coping

Introduction

The way people cope with anxiety or stress provoking situations varies highly between individuals and is assumed to influence responses to threatening situations or valenced stimuli. Whereas coping strategies refer to the situational use of emotional, cognitive, or behavioral techniques to reduce anxiety, coping styles refer to a dispositional preference for specific categories of coping strategies that characterize the person's reactions to anxiety or stress across different situations (Anshel, 2012). Several approaches have been undertaken to provide a meaningful classification of different coping styles, with the model of coping modes by Krohne (1993) being particularly influential. This model postulates a categorization based on the dimensions of cognitive avoidance (CAV) and vigilance (VIG), each of which encompasses different emotional, as well as cognitive coping strategies. These dimensions of coping behavior refer to attentional orienting and information processing in the face of threatening events and have been identified as relevant by numerous studies (e.g., Derakshan et al., 2007; Krohne, 1993; Miller, 1980).

The dimension of CAV involves cognitive processes leading to a withdrawal of attention from threat-related features of a situation, e.g., by applying coping strategies like distracting, trivializing, and/or focusing on positive aspects. It is assumed that a major goal of using CAV is to attenuate aversive internal arousal triggered by the perception of threat-associated stimuli (e.g., Krohne, 1993; Weinberger, 1995). The dimension of VIG, on the other hand, involves attending to threat-related features of a situation and leads to an intense processing of such stimuli, e.g., by applying coping strategies like actively seeking information and/or anticipating possible negative outcomes. An essential goal for using VIG is the reduction of uncertainty, which is a defining characteristic of threatening situations (Krohne, 1993; Krohne et al., 2000). Based on this model, people can be classified into four groups: repressors (high CAV, low VIG), sensitizers (low CAV, high VIG), fluctuating copers (high on both dimensions), and non-defensive copers (low on both dimensions) (Krohne et al., 2000).

Anna Exner and Alla Machulska shared first authorship

✉ Anna Exner
anna.exner@uni-siegen.de

[1] Present Address: Department of Clinical Psychology and Psychotherapy, University of Siegen, Siegen, Germany

Compared with all other coping styles, repressive coping has repeatedly been associated with a decreased awareness of their own physical states (e.g., Myers, 2010; Schwerdtfeger et al., 2006). This assumption is supported by ample evidence indicating that repressors exhibit greater avoidance of internal arousal states, as indicated by a discrepancy between physiological and subjective stress responses: self-reported anxiety is low, whereas the physiological response is strong, compared to the other coping groups (Derakshan & Eysenck, 1997; Derakshan et al., 2007; Kohlmann et al., 1996; Newton & Contrada, 1992). This decreased awareness of their own physical condition is often taken as an explanation for the higher prevalence of stress-related illnesses among repressors (Denollet et al., 2008; Frasure-Smith et al., 2002; Giese-Davis et al., 2006; Mund & Mitte, 2012; Myers, 2010; Schwerdtfeger et al., 2006), which contrasts the tendency toward positive ratings in mental health questionnaires (e.g. coping with bereavement: Coifman et al., 2007; alexithymia: Myers & Derakshan, 2015; adjustment to severe illness: Phipps & Srivastava, 1997).

Several explanations for this discrepancy have been proposed. The four-factor theory by Derakshan and Eysenck (1997) might be the most influential conception and holds that repressors are characterized by cognitive biases in response to threatening information, which may originate from four different sources: (i) the environment as well as the individuals' (ii) physiological state, (iii) behavior, and (iv) long-term memory. If threatening information is perceived in any of these areas, repressors exhibit cognitively biased processing which serves to mitigate the conscious perception of fear. There is a whole range of cognitive biases that can have this effect, including attentional biases (i.e., increased attention to positive stimuli or attenuated attention to negative stimuli), approach/avoidance biases (i.e., approaching positive stimuli and avoiding negative ones), association biases (i.e., increased association of stimuli with positive than with negative associations), and many others. Moreover, according to the combined cognitive biases hypothesis presented by Hirsch et al. (2006), different cognitive biases influence each other and interact. Therefore, it is proposed that cognitive biases should not be examined in isolation, but rather in combination to assess how they work together to maintain psychological effects or even dysfunctions. The investigation of cognitive biases in different coping styles offers a promising opportunity to understand the background of the dissociation between subjective experience and physiology. This, in turn, might be of relevance with regard to understanding the development of physical as well as mental health issues in repressors and thus represents a valuable starting point to improve therapeutic interventions for this group.

Coping style is suspected to influence different points in time in the chain of steps in information processing: From the very early stage of perception of the stimulus and subsequent attentional orienting to behavioral tendencies of approaching or avoiding the stimulus. Previous research into the relationship between coping style and cognitive biases has particularly focused on attentional biases, whereas we are not aware of any study investigating approach/avoidance tendencies on the behavioral level. Results on attention have suggested that repressors first automatically direct their attention toward threatening stimuli in a very short window of time, and then subsequently divert their attention away from these stimuli (see Vigilance Avoidance Theory of Repressive Coping, Derakshan et al., 2007). However, respective results are heterogeneous for certain measures including neural processing (Brosschot et al., 1999; Fox, 1993; Ioannou et al., 2004; Klucken et al., 2010, 2015; Mogg et al., 2000; Schwerdtfeger & Derakshan, 2010). Several studies have utilized the dot-probe task as a measure of attention. During this task, attention to specific stimuli is measured by presenting two stimuli (a target and a reference stimulus) side-by-side for a short duration of time. Thereafter, both stimuli disappear, and a probe is presented in the location of one of the pictures. The reaction times for detecting the position of the probe are supposed to provide information about participants' attentional preferences, i.e., faster reaction times for probes replacing specific stimuli (e.g., thread-related cues) indicating increased attention toward such stimulus categories (MacLeod et al., 1986). Research using the dot-probe task to assess attention toward negative stimuli has yielded mixed results, with some studies reporting a greater diversion of attention away from negative or threatening stimuli in repressors (Fox, 1993; Mogg et al., 2000; Schwerdtfeger & Derakshan, 2010), while others did not (Brosschot et al., 1999; Ioannou et al., 2004; Mogg et al., 2000). Sensitizers have been found to show a different pattern in their attention to negative stimuli, however, the evidence is equally mixed: Some research suggests increased attention to threatening stimuli (Ioannou et al., 2004), whereas other research does not (Franklin et al., 2016; Mogg et al., 2000). To our knowledge only one study analyzed attentional biases towards positive stimuli in relation to coping style, with results suggesting that repressors show more attention for positive stimuli while sensitizers do not show an attentional bias (Franklin et al., 2016).

The absence of studies on approach or avoidance tendencies is surprising as they have been shown to be important in the development and maintenance of several mental disorders (for a review see Loijen et al., 2020; Mogg et al., 2005; Rinck & Becker, 2007): Specifically, there is evidence that in addictive disorders, the presence of an approach bias to substance-related stimuli might be a risk factor for increased future substance use (Loijen et al., 2020), whereas depression has been associated with lower approach to positive stimuli and lower avoidance of negative stimuli (Loijen et al., 2020). In addition, anxiety disorders have been

associated with avoidance tendencies toward threat-related stimuli (Loijen et al., 2020). These implicit action tendencies can be assessed with the Approach-Avoidance Task (AAT; Rinck & Becker, 2007). The AAT measures approach and avoidance tendencies by instructing subjects (in the classic PC-based version) to perform an approach movement (pulling a joystick) or an avoidance movement (pushing away a joystick) in response to pictures presented successively on a computer screen. In general, a shorter reaction time for pulling or pushing a particular image is indicative of an approach or avoidance tendency, respectively, towards this image (Strack & Deutsch, 2004).

The aim of the current study was to assess preferential information processing on different levels of the processing chain for the different coping styles. For this purpose, a dot-probe task is used to measure attentional bias whereas the AAT is employed to measure approach/avoidance bias. Stimuli for both paradigms are general positive and general negative pictures. We hypothesize that repressors show increased attention to positive compared to negative stimuli, whereas sensitizers show a reverse pattern of attention allocation. Further, we expect that repressors show a greater approach tendency to positive stimuli and increased avoidance of negative stimuli, whereas sensitizers would show increased avoidance of positive stimuli and increased approach to negative stimuli. No specific hypotheses are raised concerning the fluctuating and non-defensive groups due to the absence of previous research. However, based on the assumptions from Krohne's (1993) definition of coping styles, it can be suggested that no cognitive biases will be observed in either group. In the fluctuating individuals, the alternating use of vigilant and cognitive avoidant coping might involve an alternating turning towards and away from negative and positive stimuli, whereas in the non-defensive individuals, the tolerance for uncertainty and internal arousal might lead to none of the stimulus categories being avoided or approached intensively. Respective results are reported to ensure that the observed effects for repressors and sensitizers were exclusive to these groups.

Method

Participants

A total of 82 healthy participants took part in the study (18 males; age: M = 21.19, SD = 3.57). Exclusion criteria were insufficient German language skills, uncorrected visual or auditory impairment. In addition, subjects were asked in self-report format if they had currently or previously suffered from mental illnesses, if they were undergoing psychological or psychiatric treatment, or were taking perception-altering medications, which also resulted in exclusion from the study. Nine participants were excluded because of missing information in the coping questionnaire, leaving 73 study participants. Participants received either monetary reimbursement (10€/h) or course credits for participation. The study protocol was approved by the local ethics committee and was conducted in accordance with the Declaration of Helsinki. Participation was voluntary and participants had the right to withdraw their consent to participate at any time.

Procedure

The experiment was part of a larger study on psychometric properties of influential experimental tasks for cognitive bias assessment (Machulska et al., 2022) and conducted in the laboratory of the Department of Clinical Psychology and Psychotherapy at the University of Siegen, Germany. It included three measurements of cognitive bias, which were passed by the participants successively: a visual dot-probe task, an Approach-Avoidance Task (AAT), and an Implicit Association Test (IAT; data not shown here). The order of experimental tasks was counterbalanced across participants. The experiment took place in groups of up to four participants in the same room and lasted for about 60 min. After the laboratory session, participants completed a set of questionnaires, including the German version of the Mainz Coping Inventory (MCI; Krohne et al., 2000), scales on wellbeing (Positive Mental Health, PMH: Lukat et al., 2016), personality traits Neuroticism-Extraversion-Openness–Five-Factor Inventory, NEO-FFI, German version: Borkenau & Ostendorf, 2008; Affective Neuroscience Personality Scales, ANPS, German version: Reuter et al., 2017), and trait anxiety (State-Trait Anxiety Inventory, STAI; German version: Laux et al., 1981; Anxiety Sensitivity Index, ASI-4, German version: Kemper et al., 2010).

Measures

Experimental paradigms

The dot-probe task was programmed and operated in Inquisit 5 Lab software, while the AAT was programmed in Microsoft VisualBasic. For task presentation, a desktop computer (Dell Version 1903) and a 23.8-inch computer monitor with a resolution of 1920 × 1080 pixels were used.

Visual Dot-Probe Task (DPT) The visual dot-probe task measures attentional biases by comparing reaction times to a probe that replaces a positive or a negative picture, after both pictures have been presented simultaneously side-by-side (MacLeod et al., 1986). Each trial started with a fixation cross (500 ms) in the center of the screen. Afterwards, a positive and a negative picture with dimensions of 640 × 479 pixels, gathered from the Geneva Affective Picture Database (GAPED; Dan-Glauser & Scherer, 2011), were presented

simultaneously for 1000 ms in the left and right halves of the screen. Subsequently, both pictures disappeared, and an "X" (the probe) appeared on one side of the screen, replacing either the positive or the negative picture, respectively. Participants were instructed to indicate the position of the probe (right vs. left) as fast and accurately as possible by pressing a key on a response pad (Cedrus Response Pad RB844). 40 pairs of images were presented successively in a random order. In addition, 40 filler trials with 10 different neutral image pairs were presented to avoid habituation effects (Miller & Fillmore, 2010). To calculate the attentional bias score, median reaction times for probes replacing positive pictures were subtracted from median reaction times for probes replacing negative pictures (Becker et al., 2016). Accordingly, a positive attentional bias score can be interpreted as enhanced attention to positive pictures, whereas a negative score can be interpreted as enhanced attention to negative pictures.

Approach-Avoidance Task (AAT) The AAT measures automatic action tendencies for positive and negative stimuli by contrasting reaction times in milliseconds for pull (approach) or push (avoidance) motor movements in response to positive and negative stimuli (Rinck & Becker, 2007). For this purpose, 50 positive and 50 negative pictures depicting people, animals, and nature scenes were selected from the Geneva Affective Picture Database (GAPED; Dan-Glauser & Scherer, 2011) and were presented with dimensions of 332 × 262 pixels one after the other on a computer screen. To avoid training effects, pictures used in the AAT were not identical to those presented in the dot-probe task. In each trial, pictures were either tilted 3° to the left or 3° to the right. Participants were instructed to pull a joystick attached to the computer (Logitech Extreme 3D) towards themselves when the image was tilted to the left. As a result, the image enlarged to 977 × 768 pixels, creating a sense of approaching the image. For images tilted to the right, participants were asked to push the joystick away from them, causing the image to shrink to 111 × 89 pixels and therefore creating a sense of avoiding the image. At the beginning of the experiment, 12 practice trials were performed with neutral images, which were not included into the analyses. Thereafter, each positive and each negative image were presented once in a pull (tilted to the left) and once in a push format (tilted to the right), resulting in 200 trials in total. The approach/avoidance bias score was calculated for each image category by subtracting the median reaction time for pull movements from the median reaction time for push movements (Rinck & Becker, 2007). By doing so, a positive bias score is indicative of an approach bias for a particular image category (i.e., positive, or negative stimuli), whereas a negative bias score implies an avoidance bias for a particular images category. Here, reaction time was defined as the total time from the onset of the response to the execution of the entire movement.

Table 1 Descriptive statistics of the four coping style groups

Coping style	N	Age	Cognitive avoidance	Vigilance
Repressors	19	21.83 (3.67)	14.84 (1.50)	8.12 (2.47)
Sensitizers	21	20.10 (2.04)	8.43 (1.94)	14.33 (1.68)
Non-defensive	23	20.91 (2.92)	10.30 (1.89)	7.78 (2.28)
Fluctuating	10	22.80 (6.48)	14.50 (1.65)	14.20 (2.39)

Mean (standard deviation) of age, COV and VIG scores

Coping style

The German version of the Mainz Coping Inventory (MCI; Krohne et al., 2000) was used to measure coping style. The MCI measures habituated anxiety coping on the two independent dimensions of cognitive avoidance and vigilance. To determine a subject's personal expression of these coping styles, eight different stressful situations with different levels of threat and controllability were described (e.g., 'Imagine that you will have an important examination the next morning'), to each of which five response items with cognitive avoidant behavior and five response items with vigilant behavior were presented. Participants were instructed to rate in a true–false format whether they would exhibit this behavior in the corresponding situation or not (in a public speech scenario e.g.,'I think about what questions might be asked after the speech.' for vigilant coping;'I don't think about the speech anymore.' for cognitive avoidant coping). Habitual tendencies to cognitive avoidance and vigilance were calculated using the subscale for ego-threatening situations as a sum score across the associated items of these situations (true = 1; false = 0), in order to ensure comparability with other studies (Krohne et al., 2000). 15 missing item values were replaced according to the manual by using the rounded-up or rounded-down mean of the specific item reported in the normalization sample (separated by gender of the subjects). Sum scores were used to classify participants into the four coping style categories by dichotomizing the two dimensions of CAV and VIG by median splits (`low': percentile rank below 50% in the current sample; `high': percentile rank above 50% in the current sample) resulting in the four groups further described in Table 1. There were no significant differences between coping style groups in terms of gender distribution ($\chi^2(3) = 1.64$, $p = 0.651$) or average age of group members (Welch's $F(3, 27.42) = 78.53$, $p = 0.243$).

Statistical analyses

Extreme values were defined as scores that are more than 3 times the interquartile range and excluded them from further analysis (DPT: n = 1, AAT: n = 2). In addition, technical

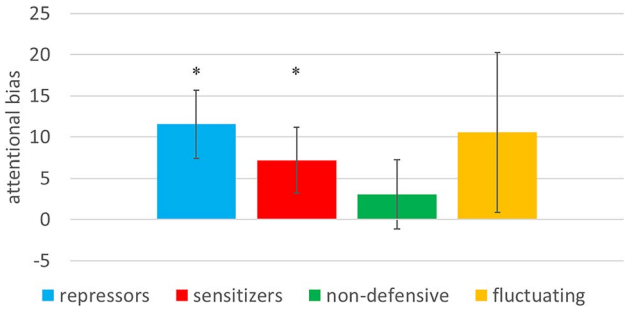

Fig. 1 Estimates of attentional bias derived from the dot-probe task shown for different coping styles. Error bars indicate the SEM. ** $p < 0.01$, * $p < 0.05$

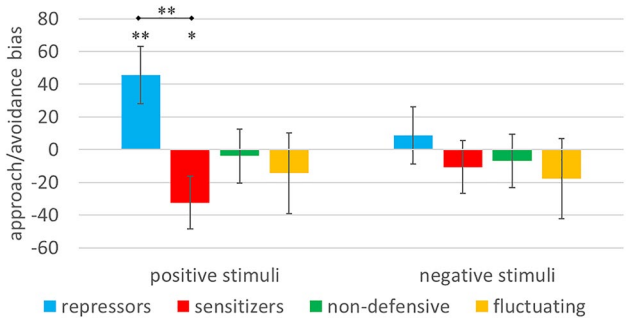

Fig. 2 Estimates of approach/avoidance bias derived from the Approach-Avoidance Task shown for different coping styles. Error bars indicate the SEM. ** $p < 0.01$, * $p < 0.05$

difficulties resulted in the loss of reaction time data for some subjects (DPT: n = 1, AAT: n = 6). To examine cognitive biases for each coping style, different analyses were conducted: For the DPT a one-way ANOVA was conducted with coping style (repressors vs. sensitizers vs. fluctuating vs. non-defensive) as between-subject factor. Additionally, one-sided one-sample t-tests were conducted separately for each coping style separately to examine the extent to which scores differed from zero, i.e., to test whether attentional biases were present. For the AAT, a 2 × 4 ANOVA was conducted with stimulus category (positive vs. negative) as within-subject factor and coping style (repressors vs. sensitizers vs. fluctuating vs. non-defensive) as between-subject factor. Post-hoc tests were run when necessary. SPSS 28 (SPSS 28.0 for Windows, SPSS Inc, Chicago, IL) with an alpha (α)-level of 0.05 was used for all analyses.

Results

Visual Dot-Probe Task (DPT)

Regarding attentional preferences, the one-way ANOVA revealed no significant differences between coping styles ($F(3, 68) = 0.66$, $p = 0.583$, $\eta^2 = 0.028$). One-sample t-tests showed that attentional biases significantly deviated from zero, for both repressors ($t(17) = 2.79$, $p = 0.006$, $d = 0.66$) and sensitizers ($t(20) = 1.79$, $p = 0.044$, $d = 0.39$; Fig. 1), indicating a significant attentional bias towards positive stimuli. The other two groups did not display a significant attention bias towards or away from valenced pictures (non-defensive: $t(22) = 0.73$, $p = 0.237$, $d = 0.15$; fluctuating: $t(9) = 1.09$, $p = 0.153$, $d = 0.34$).

Approach-Avoidance Task (AAT)

Regarding approach/avoidance tendencies, the ANOVA revealed a significant valence × coping style interaction ($F(1, 64) = 2.84$, $p = 0.045$, $\eta_p^2 = 0.118$). No main effects reached significance. Bonferroni-adjusted post-hoc analysis showed a significant difference in bias scores between repressors and sensitizers for positive stimuli only (positive stimuli: $M_{diff} = 78.16$, $p = 0.010$; negative stimuli: $M_{diff} = 19.29$, $p = 1.000$) with an approach tendency for repressors and an avoidance tendency for sensitizers (see Fig. 2). One-sample t-tests confirmed a significant approach tendency towards positive images for repressors (positive stimuli: $t(15) = 3.08$, $p = 0.004$, $d = 0.77$; negative stimuli: $t(18) = 0.43$, $p = 0.336$, $d = 0.10$) and a significant avoidance tendency for sensitizers (positive stimuli: $t(20) = -2.00$, $p = 0.029$, $d = 0.44$; negative stimuli: $t(20) = -0.54$, $p = 0.297$, $d = 0.12$). The remaining two groups did not display a significant approach/avoidance bias towards or away from valenced pictures (positive stimuli: non-defensive: $t(20) = -0.37$, $p = 0.359$, $d = 0.08$; fluctuating: $t(9) = -0.69$, $p = 0.253$, $d = 0.22$; negative stimuli: non-defensive: $t(19) = -0.53$, $p = 0.303$, $d = 0.12$; fluctuating: $t(8) = -0.57$, $p = 0.293$, $d = 0.19$).

Discussion

The present study was the first to examine the presence of cognitive biases on different stages of the information processing chain from the direction of attention to action tendencies in individuals of different habitual coping styles. Our results revealed evidence for a significant attentional bias in both repressors and sensitizers characterized by increased attention towards positive stimuli, but no group differences in the magnitude of attention bias. With respect to the automatic action tendencies, we were able to reveal a significant approach tendency for repressors and a significant avoidance tendency for sensitizers for positive stimuli, whereas no significant approach/avoidance bias for negative stimuli emerged for any of the coping groups.

When contrasting positive and negative images in the dot-probe task, our results showed a preferential processing of positive stimuli as opposed to negative ones for repressors as well as for sensitizers. For repressors, these results are in line with current research: a decreased attention for negative stimuli

(Fox, 1993; Franklin et al., 2016; Mogg et al., 2000) and an increased attention for positive stimuli have previously been observed (Franklin et al., 2016). Nevertheless, there are also studies that were unable to find such effects, both for negative (Brosschot et al., 1999; Fox, 1993; Ioannou et al., 2004; Mogg et al., 2000) as well as positive stimuli (Brosschot et al., 1999; Ioannou et al., 2004). The reason why the present study did find attentional biases toward positively valanced cues while others did not may be multifaceted. Since the only other study using general valenced pictures instead of words or faces also reports a significant effect (Franklin et al., 2016), it could be supposed that complex visual cues cause a stronger attentional bias in repressors or at least make it more visible. In addition, it is conceivable that the chosen contrast between positively and negatively-valenced stimuli may have contributed to the present pattern of results. This approach differs from the majority of previous studies, which have contrasted valenced stimuli with neutral stimuli (Fox, 1993; Franklin et al., 2016; Ioannou et al., 2004; Mogg et al., 2000).

For sensitizers, the preferential attention toward positive over negative stimuli that was observed in the present study does not seem to be entirely consistent with the current literature, since most previous evidence of significant attentional biases suggested effects in the opposite direction, i.e., a preferential attention allocation toward negative stimuli (Brosschot et al., 1999; Fox, 1993; Ioannou et al., 2004; Klucken et al., 2010) and an avoidance of positive stimuli (Franklin et al., 2016; Ioannou et al., 2004; Klucken et al., 2010). The evidence is equally inconsistent as for repressors, with a majority of studies reporting null-findings (Brosschot et al., 1999; Fox, 1993; Franklin et al., 2016; Mogg et al., 2000). The present study used picture stimuli, which are known to allow a faster categorization than words (Guenther et al., 1980; Potter & Faulconer, 1975; Seifert, 1997). This may have left the present participants more time after initial categorization to turn their attention to the respective stimulus, which may make it possible to observe a stronger attentional bias than with text stimuli and thereby generating larger effects in attentional bias. Another explanation relates to the selection of positive and negative stimuli. In most studies, preferential processing of negative stimuli was exclusively found for socially threatening stimuli, whereas no attentional bias was observed for physically threatening stimuli in most cases (Brosschot et al., 1999; Fox, 1993). Thus, in contrast to the generally negative images that were used as negative stimuli in the present study, it might be necessary to also include socially threatening stimuli in order to observe preferential processing of negative stimuli.

In terms of behavioral approach/avoidance biases measured by AAT, repressors showed an approach tendency and sensitizers an avoidance tendency towards positive stimuli. These results are in line with previous evidence showing repressors to exhibit an increased attention (Franklin et al., 2016) and sensitizers a decreased attention (Franklin et al., 2016; Ioannou et al., 2004) towards positive stimuli. In contrast to these results, neither repressors nor sensitizers showed a significant approach-avoidance bias for negative stimuli. These results are partly consistent with the literature: While repressors often show less attention (Fox, 1993; Franklin et al., 2016; Mogg et al., 2000) and sensitizers often show more attention (Brosschot et al., 1999; Fox, 1993; Ioannou et al., 2004) for negative stimuli, there are also many studies that did not find these effects (Brosschot et al., 1999; Fox, 1993; Mogg et al., 2000). However, it must be noted that the studies reviewed above focused on attentional biases rather than action tendencies or motor movements. Even though these biases (if present) are frequently interpreted as approach or avoidance tendencies, the possibility to generalize attentional preferences to a preferential processing in terms of action tendencies remains unclear. Thus, it is possible that the early phase of stimulus processing, in which attention is directed toward or away from a stimulus, is less (or less consistently) influenced by coping style than the later behavioral tendency to approach or avoid that stimulus. By using the AAT, we were able to show that it may not be the negative stimuli that make the difference between repressors and sensitizers, but that these groups most strongly differ from each other in terms of their behavioral tendencies towards positive stimuli.

The current finding of no cognitive biases in fluctuating and non-defensive individuals corresponds with assumptions derived from Krohne's (1993) model of coping modes: Fluctuating individuals are expected to exhibit an intolerance to internal arousal and uncertainty, which leads them to employ a fluctuating use of vigilant and cognitive-avoidant coping in dealing with anxiety-evoking situations. This switching between these coping styles might thus result in neither a stable cognitive bias toward nor away from positive or negative stimuli being observable. In future research, these dynamics might be investigated in fluctuating individuals, for example, by manipulating cue-response time intervals in the AAT to assess immediate as well as delayed approach/avoidance biases (Wei et al., 2020). In contrast, the non-defensive individuals are tolerant of uncertainty as well as internal arousal. Thus, there is no reason for these individuals to turn away from certain stimuli or towards others.

There are some limitations in this study that need to be mentioned. The classification according to Krohne (1993) is theoretically sound and commonly used, but previous research in this context has also adapted a coping classification based on individual 'defensiveness' (measured with the Marlowe-Crowne Social Desirability Scale; MCSDS, Crowne & Marlowe, 1960) and 'trait anxiety' (measured with the State-Trait Anxiety Inventory; STAI, Spielberger et al., 1983) with repressors showing low anxiety and high defensiveness and sensitizers showing high anxiety but low defensiveness (Weinberger et al., 1979). Although it has been shown that the group assignment converges between the two methods for repressors and sensitizers

(Krohne et al., 2000), it could be argued that a parallel classification of the sample according to the Weinberger method would have brought additional gain for the remaining two coping styles. It might be interesting for future research to study approach/avoidance biases additionally using this classification to confirm the unique character of repressors' and sensitizers' results. Another limitation might be, that recent research casted doubts regarding the psychometric properties of the dot-probe task, since internal consistency and retest reliability are usually very low (Chapman et al., 2019; Kappenman et al., 2014; Machulska et al., 2022; Rodebaugh et al., 2016). The presented study is in line with these findings, showing a very low internal consistency for the dot-probe task (Spearman-Brown corrected split-half correlation $r = -0.31$; Machulska et al., 2022). The AAT on the other hand has been found to show moderate to good internal consistency and retest reliability (Machulska et al., 2022). Beyond that, it has to be considered that we did not control for arousal in our study, which might be important since arousal can influence visual attention when using picture stimuli (e.g., Sutton & Lutz, 2019). A comparison of the arousal values for the positive and negative stimuli (see Table 2 in the appendix) shows that the negative pictures elicit a significantly higher arousal than the positive pictures. In future research, it might therefore be interesting to match the arousal ratings for the individual pictures to ensure a better comparability of picture categories. Furthermore, when interpreting the results, it is important to consider that the groups used are rather small. However, the group sizes used here correspond to the group sizes used in previous research and should thus be sufficient to find similar effect sizes (Brosschot et al., 1999; Fox, 1993; Klucken et al., 2010; Mogg et al., 2000). Since we only used diagnostic screening questions rather than not a full diagnostic interview, we cannot fully rule out the possibility that some individuals suffering from mental illnesses may have been included in the present sample. However, self-report measures concerning positive wellbeing, personality traits, and trait anxiety indicated that mean scores and standard deviations were comparable to those reported for healthy young samples (Machulska et al., 2022). Nevertheless, future studies should consider more comprehensive assessment of mental health. Finally, it has to be noted that gender was unequally distributed, with more female participants being included in the current sample. However, since the gender distribution does not differ significantly across coping styles, it is not expected that this would substantially bias the results. Nevertheless, a more precise investigation of gender differences of approach/avoidances biases for repressors and sensitizers could be interesting for future research.

In summary, the results of this study mildly suggest that the difference between repressors and sensitizers in their preference for certain stimuli is considerably more intense for positive stimuli than for negative stimuli. The higher prevalence of stress-related illnesses in repressors (Denollet et al., 2008; Frasure-Smith et al., 2002; Giese-Davis et al., 2006; Mund & Mitte, 2012; Myers, 2010), which is often attributed to their decreased awareness of their own physical states (e.g., Myers, 2010; Schwerdtfeger et al., 2006), could therefore also be related to this information processing bias towards positive stimuli. In recent years, a new branch of research has developed that not only measures cognitive biases, but seeks to modify them (e.g., Beard, 2011; MacLeod & Mathews, 2012). These attempts of cognitive bias modification are mostly based on reducing negative biases and developing positive biases. The findings presented in this study are highly relevant to such interventions, as they aim to increase positive information processing under the assumption that this would have positive consequences in any case (e.g., positivity approach training: Becker et al., 2016, 2019). The results of the present study suggest that biased information processing per se—whether towards positive or towards negative stimuli – might be related to dysfunctional coping. In this case, a helpful intervention does not necessarily have to be aimed at increasing information processing biases, even if the increase is focused on positive stimuli, but should train a flexible and unbiased processing. Supportive evidence for this account is provided, for example, in PTSD research: Attentional bias modification training towards positive stimuli (even though the bias modification was successful), is frequently found to be less effective than attention control trainings that apply the instruction to direct attention towards threat in 50% and away from threat in the remaining 50% of trials (e.g., Badura-Brack et al., 2015; Lazarov et al., 2019). Moreover, meta-analyses show that the effects reached by cognitive bias modification trainings are at most very small, if not non-significant (Cristea et al., 2015). These results suggest that principled reinforcement of approach to positive stimuli is not beneficial in all cases. Moreover, the present study provides first hints that this might be due to differences in coping behavior. In light of our results, it seems reasonable to assume that it could be important for cognitive bias modification training to determine individual coping styles beforehand and to tailor the training correspondingly. Future studies will have to show whether (1) cognitive biases toward positive stimuli can also be dysfunctional and (2) cognitive bias modification training involving an approach training to negative and an avoidance training of positive stimuli could be useful for repressors.

Methodologically, the divergent results across cognitive bias measures highlight the importance of using multiple procedures in individual studies to reveal possible inconsistencies in the results. Moreover, they underscore the need to examine the entire information processing chain, as biases may arise at many stages besides attentional, which may be significantly more relevant in the context of coping styles. We demonstrated that the AAT is one way to examine behavioral approach or avoidance tendencies toward positive and negative stimuli, and that this consideration of different stages of information processing leads to other findings—the potentially strong importance of positive stimuli.

Appendix

Table 2 Mean (standard deviation) of valence and arousal ratings of the presented picture stimuli according to the Geneva Affective Picture Database (GAPED; Dan-Glauser & Scherer, 2011)

	DPT		AAT	
	Positive	Negative	Positive	Negative
Valence	91.96 (4.14)	14.01 (4.93)	91.62 (3.57)	13.10 (5.81)
Arousal	19.49 (8.33)	64.60 (8.95	20.33 (9.37)	67.70 (6.21)

Funding Open Access funding enabled and organized by Projekt DEAL. This work was funded by a scholarship for doctoral students from the Faculty of Education, Architecture and the Arts of the University of Siegen granted to the first author.

Data availability The data that support the findings of this study are available from the corresponding author upon request.

Declarations

Ethics approval This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the local Ethics Committee of the University of Siegen.

Consent to participate/publish Informed consent was obtained from all individual participants included in the study. Participants signed informed consent regarding publishing their data.

Competing interests The authors have no conflicts of interests to declare.

References

Anshel, M. H. (2012). Coping with Stress. In N. M. Seel (Ed.), *Encyclopedia of the Sciences of Learning* (pp. 818–822). Springer. https://doi.org/10.1007/978-1-4419-1428-6_473

Badura-Brack, A. S., Naim, R., Ryan, T. J., Levy, O., Abend, R., Khanna, M. M., McDermott, T. J., Pine, D. S., & Bar-Haim, Y. (2015). Effect of attention training on attention bias variability and PTSD symptoms: Randomized controlled trials in Israeli and U.S. combat veterans. *The American Journal of Psychiatry, 172*(12), 1233–1241. https://doi.org/10.1176/appi.ajp.2015.14121578

Beard, C. (2011). Cognitive bias modification for anxiety: Current evidence and future directions. *Expert Review of Neurotherapeutics, 11*(2), 299–311. https://doi.org/10.1586/ern.10.194

Becker, E. S., Barth, A., Smits, J. A. J., Beisel, S., Lindenmeyer, J., & Rinck, M. (2019). Positivity-approach training for depressive symptoms: A randomized controlled trial. *Journal of Affective Disorders, 245*, 297–304. https://doi.org/10.1016/j.jad.2018.11.042

Becker, E. S., Ferentzi, H., Ferrari, G., Möbius, M., Brugman, S., Custers, J., Geurtzen, N., Wouters, J., & Rinck, M. (2016). Always approach the bright side of life: A general positivity training reduces stress reactions in vulnerable individuals. *Cognitive Therapy and Research, 40*, 57–71. https://doi.org/10.1007/s10608-015-9716-2

Borkenau, P., & Ostendorf, F. (2008). *NEO-FFI: NEO-Fünf-Faktoren-Inventar nach Costa und McCrae, Manual* (2nd ed.). Hogrefe.

Brosschot, J. F., de Ruiter, C., & Kindt, M. (1999). Processing bias in anxious subjects and repressors, measured by emotional Stroop interference and attentional allocation. *Personality and Individual Differences, 26*(5), 777–793. https://doi.org/10.1016/S0191-8869(98)00173-1

Chapman, A., Devue, C., & Grimshaw, G. M. (2019). Fleeting reliability in the dot-probe task. *Psychological Research Psychologische Forschung, 83*(2), 308–320. https://doi.org/10.1007/s00426-017-0947-6

Coifman, K. G., Bonanno, G. A., Ray, R. D., & Gross, J. J. (2007). Does repressive coping promote resilience? Affective-autonomic response discrepancy during bereavement. *Journal of Personality and Social Psychology, 92*(4), 745–758. https://doi.org/10.1037/0022-3514.92.4.745

Cristea, I. A., Kok, R. N., & Cuijpers, P. (2015). Efficacy of cognitive bias modification interventions in anxiety and depression: Meta-analysis. *The British Journal of Psychiatry, 206*(1), 7–16. https://doi.org/10.1192/bjp.bp.114.146761

Crowne, D. P., & Marlowe, D. (1960). A new scale of social desirability independent of psychopathology. *Journal of Consulting Psychology, 24*, 349–354. https://doi.org/10.1037/h0047358

Dan-Glauser, E. S., & Scherer, K. R. (2011). The Geneva affective picture database (GAPED): A new 730-picture database focusing on valence and normative significance. *Behavior Research Methods, 43*(2), 468–477. https://doi.org/10.3758/s13428-011-0064-1

Denollet, J., Martens, E. J., Nyklícek, I., Conraads, V. M., & de Gelder, B. (2008). Clinical events in coronary patients who report low distress: Adverse effect of repressive coping. *Health Psychology, 27*(3), 302–308. https://doi.org/10.1037/0278-6133.27.3.302

Derakshan, N., & Eysenck, M. W. (1997). Interpretive biases for one's own behavior and physiology in high-trait-anxious individuals and repressors. *Journal of Personality and Social Psychology, 73*(4), 816–825. https://doi.org/10.1037/0022-3514.73.4.816

Derakshan, N., Eysenck, M. W., & Myers, L. B. (2007). Emotional information processing in repressors: The vigilance–avoidance theory. *Cognition & Emotion, 21*(8), 1585–1614. https://doi.org/10.1080/02699930701499857

Fox, E. (1993). Allocation of visual attention and anxiety. *Cognition & Emotion, 7*(2), 207–215. https://doi.org/10.1080/02699939308409185

Franklin, Z. C., Holmes, P. S., Smith, N. C., & Fowler, N. E. (2016). Personality type influences attentional bias in individuals with chronic back pain. *PLoS ONE, 11*(1), e0147035. https://doi.org/10.1371/journal.pone.0147035

Frasure-Smith, N., Lespérance, F., Gravel, G., Masson, A., Juneau, M., & Bourassa, M. G. (2002). Long-term survival differences among low-anxious, high-anxious and repressive copers enrolled in the Montreal heart attack readjustment trial. *Psychosomatic Medicine, 64*(4), 571–579. https://doi.org/10.1097/01.psy.0000021950.04969.f8

Giese-Davis, J., DiMiceli, S., Sephton, S., & Spiegel, D. (2006). Emotional expression and diurnal cortisol slope in women with

metastatic breast cancer in supportive-expressive group therapy: A preliminary study. *Biological Psychology, 73*(2), 190–198. https://doi.org/10.1016/j.biopsycho.2006.04.003

Guenther, K. R., Klatzky, R. L., & Putnam, W. (1980). Commonalities and differences in semantic decisions about pictures and words. *Journal of Verbal Learning and Verbal Behavior, 19*(1), 54–74. https://doi.org/10.1016/s0022-5371(80)90524-1

Hirsch, C. R., Clark, D. M., & Mathews, A. (2006). Imagery and interpretations in social phobia: Support for the combined cognitive biases hypothesis. *Behavior Therapy, 37*(3), 223–236. https://doi.org/10.1016/j.beth.2006.02.001

Ioannou, M. C., Mogg, K., & Bradley, B. P. (2004). Vigilance for threat: Effects of anxiety and defensiveness. *Personality and Individual Differences, 36*(8), 1879–1891. https://doi.org/10.1016/j.paid.2003.08.018

Kappenman, E. S., Farrens, J. L., Luck, S. J., & Proudfit, G. H. (2014). Behavioral and ERP measures of attentional bias to threat in the dot-probe task: Poor reliability and lack of correlation with anxiety. *Frontiers in Psychology, 5*, 1368. https://doi.org/10.3389/fpsyg.2014.01368

Kemper, C. J., Specht, M., & Volk, S. (2010, October). *Konstruktvalidität und Nutzen eines Verfahrens zur Erfassung der Angstsensitivität (Angstsensitivitätsindex-4) in einer Stichprobe von Patienten mit schlafbezogenen Atmungsstörungen* [Poster Presentation]. 18. Jahrestagung der Deutschen Gesellschaft für Schlafforschung und Schlafmedizin (DGSM). Bremen, Germany.

Klucken, T., Brouwer, A.-M., Chatziastros, A., Kagerer, S., Netter, P., & Hennig, J. (2010). The impact of coping style on gaze duration. *PLoS ONE, 5*(11), e15395. https://doi.org/10.1371/journal.pone.0015395

Klucken, T., Kruse, O., Schweckendiek, J., & Stark, R. (2015). Increased skin conductance responses and neural activity during fear conditioning are associated with a repressive coping style. *Frontiers in Behavioral Neuroscience, 9*, 132. https://doi.org/10.3389/fnbeh.2015.00132

Kohlmann, C.-W., Weidner, G., & Messina, C. R. (1996). Avoidant coping style and verbal-cardiovascular response dissociation. *Psychology & Health, 11*(3), 371–384. https://doi.org/10.1080/08870449608400265

Krohne, H. W. (1993). Vigilance and cognitive avoidance as concepts in coping research. In H. W. Krohne (Ed.), *Attention and avoidance* (pp. 19–50). Hogrefe & Huber.

Krohne, H. W., Egloff, B., Varner, L. J., Burns, L. R., Weidner, G., & Ellis, H. C. (2000). The assessment of dispositional vigilance and cognitive avoidance: Factorial structure, psychometric properties, and validity of the Mainz Coping Inventory. *Cognitive Therapy and Research, 24*(3), 297–311. https://doi.org/10.1023/A:1005511320194

Laux, L., Glanzmann, P., Schaffner, P., & Spielberger, C. (1981). *Das State-Trait-Angstinventar. Theoretische Grundlagen und Handanweisung*. Beltz Test GmbH.

Lazarov, A., Suarez-Jimenez, B., Abend, R., Naim, R., Shvil, E., Helpman, L., Zhu, X., Papini, S., Duroski, A., Rom, R., Schneier, F. R., Pine, D. S., Bar-Haim, Y., & Neria, Y. (2019). Bias-contingent attention bias modification and attention control training in treatment of PTSD: A randomized control trial. *Psychological Medicine, 49*(14), 2432–2440. https://doi.org/10.1017/S0033291718003367

Loijen, A., Vrijsen, J. N., Egger, J. I. M., Becker, E. S., & Rinck, M. (2020). Biased approach-avoidance tendencies in psychopathology: A systematic review of their assessment and modification. *Clinical Psychology Review, 77*, 101825. https://doi.org/10.1016/j.cpr.2020.101825

Lukat, J., Margraf, J., Lutz, R., van der Veld, W. M., & Becker, E. S. (2016). Psychometric properties of the Positive Mental Health Scale (PMH-scale). *BMC Psychology, 4*, 8. https://doi.org/10.1186/s40359-016-0111-x

Machulska, A., Kleinke, K., & Klucken, T. (2022). Same same, but different: A psychometric examination of three frequently used experimental tasks for cognitive bias assessment in a sample of healthy young adults. *Behavior Research Methods, 6*, 1–20. https://doi.org/10.3758/s13428-022-01804-9

MacLeod, C., & Mathews, A. (2012). Cognitive bias modification approaches to anxiety. *Annual Review of Clinical Psychology, 8*, 189–217. https://doi.org/10.1146/annurev-clinpsy-032511-143052

MacLeod, C., Mathews, A., & Tata, P. (1986). Attentional bias in emotional disorders. *Journal of Abnormal Psychology, 95*(1), 15–20. https://doi.org/10.1037//0021-843x.95.1.15

Miller, M. A., & Fillmore, M. T. (2010). The effect of image complexity on attentional bias towards alcohol-related images in adult drinkers. *Addiction, 105*(5), 883–890. https://doi.org/10.1111/j.1360-0443.2009.02860.x

Miller, S. M. (1980). When is little information a dangerous thing? Coping with stressful events by monitoring versus blunting. In S. Levine & H. Ursin (Eds.), *Health and coping* (pp. 145–169). Plenum.

Mogg, K., Bradley, B. P., Dixon, C., Fisher, S., Twelftree, H., & McWilliams, A. (2000). Trait anxiety, defensiveness and selective processing of threat: An investigation using two measures of attentional bias. *Personality and Individual Differences, 28*(6), 1063–1077. https://doi.org/10.1016/S0191-8869(99)00157-9

Mogg, K., Field, M., & Bradley, B. P. (2005). Attentional and approach biases for smoking cues in smokers: An investigation of competing theoretical views of addiction. *Psychopharmacology (berl), 180*(2), 333–341. https://doi.org/10.1007/s00213-005-2158-x

Mund, M., & Mitte, K. (2012). The costs of repression: A meta-analysis on the relation between repressive coping and somatic diseases. *Health Psychology, 31*(5), 640–649. https://doi.org/10.1037/a0026257

Myers, L. B. (2010). The importance of the repressive coping style: Findings from 30 years of research. *Anxiety, Stress & Coping, 23*(1), 3–17. https://doi.org/10.1080/10615800903366945

Myers, L. B., & Derakshan, N. (2015). The relationship between two types of impaired emotion processing: Repressive coping and alexithymia. *Frontiers in Psychology, 6*, 809. https://doi.org/10.3389/fpsyg.2015.00809

Newton, T. L., & Contrada, R. J. (1992). Repressive coping and verbal-autonomic response dissociation: The influence of social context. *Journal of Personality and Social Psychology, 62*(1), 159–167. https://doi.org/10.1037/0022-3514.62.1.159

Phipps, S., & Srivastava, D. K. (1997). Repressive adaptation in children with cancer. *Health Psychology, 16*(6), 521–528. https://doi.org/10.1037/0278-6133.16.6.521

Potter, M. C., & Faulconer, B. A. (1975). Time to understand pictures and words. *Nature, 253*(5491), 437–438. https://doi.org/10.1038/253437a0

Reuter, M., Panksepp, J., Davis, K., & Montag, C. (2017). *ANPS. Affective Neuroscience Personality Scales – Deutsche Version.* Hogrefe.

Rinck, M., & Becker, E. S. (2007). Approach and avoidance in fear of spiders. *Journal of Behavior Therapy and Experimental Psychiatry, 38*(2), 105–120. https://doi.org/10.1016/j.jbtep.2006.10.001

Rodebaugh, T. L., Scullin, R. B., Langer, J. K., Dixon, D. J., Huppert, J. D., Bernstein, A., Zvielli, A., & Lenze, E. J. (2016). Unreliability as a threat to understanding psychopathology: The cautionary tale of attentional bias. *Journal of Abnormal Psychology, 125*(6), 840–851. https://doi.org/10.1037/abn0000184

Schwerdtfeger, A., & Derakshan, N. (2010). The time line of threat processing and vagal withdrawal in response to a self-threatening stressor in cognitive avoidant copers: Evidence for vigilance-avoidance theory. *Psychophysiology, 47*(4), 786–795. https://doi.org/10.1111/j.1469-8986.2010.00965.x

Schwerdtfeger, A., Schmukle, S. C., & Egloff, B. (2006). Avoidant coping, verbal-autonomic response dissociation and pain tolerance. *Psychology & Health, 21*(3), 367–382. https://doi.org/10.1080/14768320500286203

Seifert, L. S. (1997). Activating representations in permanent memory: Different benefits for pictures and words. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 23*(5), 1106–1121. https://doi.org/10.1037/0278-7393.23.5.1106

Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983). *Manual for the state-trait anxiety inventory*. Consulting Psychologists Press.

Strack, F., & Deutsch, R. (2004). Reflective and impulsive determinants of social behavior. *Personality and Social Psychology Review, 8*(3), 220–247. https://doi.org/10.1207/s15327957pspr0803_1

Sutton, T. M., & Lutz, C. (2019). Attentional capture for emotional words and images: The importance of valence and arousal. *Canadian Journal of Experimental Psychology, 73*(1), 47–54. https://doi.org/10.1037/cep0000154

Wei, X. -Y., Chen, H. -D., Li, X. -W., Li, X. -Y., & Li, W. -J. (2020). Temporal dynamics of smoking-related approach biases: A comparison between male smokers and nonsmokers. *Journal of Studies on Alcohol and Drugs, 81*(2), 190–194. https://doi.org/10.15288/jsad.2020.81.190

Weinberger, D. A. (1995). The construct validity of the repressive coping style. In J. L. Singer (Ed.), *Repression and dissociation: Implications for personality theory, psychopathology, and health* (pp. 337–386). The University of Chicago Press.

Weinberger, D. A., Schwartz, G. E., & Davidson, R. J. (1979). Low-anxious, high-anxious, and repressive coping styles: Psychometric patterns and behavioral and physiological responses to stress. *Journal of Abnormal Psychology, 88*(4), 369–380. https://doi.org/10.1037/0021-843X.88.4.369