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ORIGIN AND SOURCE OF EMOTION AS FACTORS THAT MODULATE THE SCOPE OF ATTENTION*

The processes of visual attention and stimulus detection are a key stage of perception. In the presented studies we tested the role of the genesis (automatic vs. reflective) and source (internal vs. external stimuli) of emotions in the detection of new stimuli (close to or distant from the fixation point). We expected (1) a narrowing of the field of attention in the case of automatic emotion elicitation or internal sources of emotion; (2) an extension of attention field in the case of reflective processes or external sources of emotion. In Study 1 ($N = 90$) we used explicit presentation of sentences eliciting emotions. In Study 2 ($N = 60$) we used degraded presentation (32 ms + masking) of words charged with affect. The hypotheses were partly confirmed by the data collected. We found that in the case of eliciting emotions with automatic origin or internal source detection times were significantly shorter for stimuli occurring close to the fixation point. In the case of reflective emotion eliciting condition and external emotion source, no significant differences were observed in reaction times between stimuli close to and distant from the fixation point.

Keywords: degraded presentations, scope of attention, intensive vs. extensive attention, taxonomy of human emotions.

For a long time there has been a debate in psychology about the nature of emotion-cognition relationships, on both the neurobiological (e.g., Dolan, 2003; Duncan & Barrett, 2007; Pessoa, 2008; Vuilleumier, 2005) and the psychological (e.g., Bless & Fiedler, 2006; Bower, 1981; Forgas, 1995; Isen, 1990; Kolańczyk, Fila-Jankowska, Pavlovsk-Fusiara, & Sterczyński, 2004; Petty & Cacioppo, 1986) explanation levels. This text aims to present research based on duality of

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mind theories (cf. Gawronski & Creighton, 2013), which were applied in the field of emotion (Jarymowicz, 2009; Jarymowicz & Imbir, 2010, in print; LeDoux, 2012; Zajonc, 1980). It appears that this approach may be important for understanding the nature of the emotion-cognition relationships that shape individual functioning. The described research focuses on the impact of emotions on the early stages of processing associated with attention (its field) and the detection of stimuli.

THE DIVERSITY OF HUMAN EMOTIONS

The theoretical framework for distinguishing emotions adopted in this paper is a taxonomy of human emotions (Jarymowicz & Imbir, 2010, in print). The basic dimension of this taxonomy refers to the origin of emotions: Automatic (reactive to the environment) and Reflective (based on conceptual standards of evaluation). The two types of emotions are separate systems corresponding to duality of mind theories (cf. Gawronski & Creighton, 2013). Another dimension is the source of emotion: Internal (from inside the body) and External (from the surrounding environment; see Table 1). This dimension refers both to research on the biological basis of behavior (the distinction between autogenous regulation mechanisms such as the homeostasis of the organism vs. mechanisms based on responding to the environment: Cacioppo & Gardner, 1999; Cannon, 1929) and to current research related to empathy and the mechanisms of understanding the other person's perspective (an egocentric perspective vs. one exceeding the *self*; cf. Karyłowski, 1982; Reykowski, 1979, 1985; Szuster, 2005).

In the case of **Automatic** evaluative system, which is reflexive and reactive to reality, we distinguish emotions with Internal source in the homeostasis of biological and psychological needs and hedonic/aversive emotional responses to External stimuli affecting the individual (Jarymowicz & Imbir, 2010, in print). The characteristic features of this type of evaluation are the following: (1) its fully automatic (primary) nature, based on vapor-like neural organizations resembling reflex arcs (LeDoux, 2012; Panksepp, 1998, 2007); (2) low plasticity (and high rigidity) in responding to certain key stimuli; (3) a certain developmental plasticity (resulting from the process of secondary automation); (4) emergence without cognitive effort; (5) operation within the experiential code (objects and sensations); (6) high subjective certainty of evaluations. Cognitive processes are not necessary for such emotions to emerge (Zajonc, 1980), although they may to some extent modify the basic pattern of response (cf. cognitive reinterpretation,

automation). These emotions may give an emotional tinge to higher cognitive processes even without the person being aware of their functioning (cf. Murphy & Zajonc, 1993; Ohme, 2007). We are dealing in this case with a **stimulus – emotion – cognition** sequence (Jarymowicz, 2009; Zajonc, 1980).

In the case of **Reflective** evaluative system, the existence of emotions is founded on the processes of evaluation based on the use of articulated standards (Reykowski, 1985). These may include self standards (cf. Higgins, 1987), resulting in a self-centered perspective focusing on individual prosperity (Internal source of emotions), as well as standards exceeding the *self* (axiological), concerning what is good or bad to the community (or even ignoring the egocentric perspective; see Jarymowicz & Imbir, 2010). This type of evaluation is characterized by: (1) huge plasticity resulting from the diversity of evaluation standards; (2) lifelong development; (3) the need to put in great cognitive effort; (4) operation within the conceptual code; (5) low subjective certainty of assessments, resulting from the use of multiple criteria of evaluation. We are dealing in this case with a **stimulus – cognition – emotion** sequence (Jarymowicz, 2012; Zajonc, 1980).

VISUAL ATTENTION AND STIMULI DETECTION

Early stages of perception are very sensitive to the influence of emotions. This is due to the basic functions performed by emotions – surroundings monitoring and the management of other cognitive processes (Tooby & Cosmides, 1990). In their evolutionary history, emotions helped individuals to detect danger and stimulate the body to deal with it in a satisfactory manner. There is evidence that fear sharpens some of the senses, such as sight (Phelps, Ling, & Carrasco, 2006) or hearing (Suga, Xiao, Ma, & Ji, 2002). Inducing emotions also results in physiological changes such as the reorganization of blood circulation (directing blood flow to the muscles instead of the viscera in the case of anger), inhibition of the blink reflex, or change in pupil size (Sosnowski & Jaśkowski, 2008).

Attention provides an orientation mechanism (Posner, 1980; Posner, Snyder, & Davidson, 1980), by which the individual is able to locate important stimuli immediately. In this context, it is crucial for cognitive functioning. It is worth emphasizing the functional convergence of emotion and attention. According to Kolańczyk et al. (2004), they “ensure effective action in the face of major

events” (p. 53). The classic approach to attention in terms of stimuli detection reduces it to the process of facing the object (to a kind of filter which, by intensifying its operation, is capable of ensuring a relatively quick and adequate response of the cognitive system). As Kolańczyk (2011) observes, this does not exhaust the concept of attention and its importance. She distinguishes the Intensiveness–Extensiveness dimension of attention as a clear counterpoint to attention distraction (loss of focus). In Extensive attention states, the mind is able to scan a broad stream of perceptual and semantic data. This does not mean doing it worse, but in a different way. The intensification of attention in terms of stimulus detection (see below) involves its concentration on the area of gaze fixation (around the place that constitutes the fixation point). Consequently, we should observe a shortening of response times to stimuli appearing near the fixation point and/or a lengthening of reaction times to stimuli appearing far from it. The extensification of attention, by contrast, involves its becoming superficial and evenly distributed over a larger area. This should result in longer response times to stimuli appearing close to the fixation point (smoothing-out effect) and/or short reaction times to stimuli appearing far from the fixation point (expansion effect). Kolańczyk (2011, p. 7) lists the following determinants of Extensification: (A) lack of purpose, or (B) a general, distant, or unclear goal. It is possible to translate these determinants into emotional terms, speaking of (A) in the case of an External (general or diffuse) source of emotion and of (B) in situations involving conceptual, multicriterial, and cognitive-based (Reflective) genesis of the emotional process.

AIM AND HYPOTHESES

The presented series of studies aimed at testing hypotheses related to the duality of mind approach to human emotionality (Jarymowicz & Imbir, 2010, in print) in conditions of stimuli detection efficiency measurement. We use the Intensiveness–Extensiveness of attention model (Kolańczyk, 2011) as conceptualization of the field of attention and the stimuli detection paradigm (Kolańczyk et al., 2004) as its operationalization.

Firstly, we expected that (**H 1**) emotions of Automatic origin should narrow (intensify) the field of attention, while emotions of Reflective origin should lead to its extensification. In other words, Automatic emotions should cause a general mobilization and focus on the source of stimulation (Toby & Cosmides, 1990), whereas Reflective emotions (determinant B above), which involve cognitive

processing, increase openness to incoming stimuli. The cause of Reflective emotion is in our mind, so there is no particular point in space to pay special attention to. In addition, the use of many evaluation criteria in the case of Reflective emotions means that we should observe more extensive and at the same locally weaker stimulation of the semantic network (Bower, 1981), which means extension of the memory attention field (responsible for perceptual attention).

Secondly, we expected (**H 2**) effects analogous to those described above for the source (Internal vs. External) of emotions. Being directly related to the subject, emotions with an Internal source should result in a nonspecific narrowing of the field of attention. We encounter this effect in the *cocktail party* phenomenon (in the second stage of the process, when attention is fixed on a message related to the Self). We also encounter it when faced with something that threatens the Self on the biological level (hunger, pain, or a weapon pointed at us) or on the psychological level (criticism). In contrast, emotions with an External source (determinant A above) should result in a nonspecific expansion of the field of attention, related to the search for the External causes of the affective state. This cause does not need to be located at a specific point (e.g. the beauty of the landscape or the evil of the social system).

Thirdly, we expected (**H 3**) mutual interaction of the two variables (emotion origin and source), in which the observed narrowing of the field of attention (Intensification of attention) should be the strongest in the case of Automatic origin and Internal (homeostatic: see Table 1) source of emotion, while the greatest expansion of the field of attention (Extensification of attention) should occur in the case of Reflective origin and External source of emotion (related to axiological standards: see Table 1). At the level of rates, we should find the shortest response times to stimuli appearing near the fixation point and the longest response times to stimuli appearing far from it in case of homeostatic emotions. The opposite was expected for conditions connected with axiological standards (the longest response times to stimuli appearing near the fixation point and the shortest response times to stimuli appearing far from it). At the level of the significance of results, significant difference should be expected in the former case and no significant difference in the latter.

We did not expect effects associated with emotional valence, which, in many theories, is one of the key determinants of subjective emotional experience (Lazarus, 1991). We agree with Russell (2003) in that it is important to look for hidden mechanisms underlying the experience of discrete emotions such as anger, fear, or joy (inaccessible to introspection). We believe that these mechanisms are the origin (emotional system) and the source of emotion (Jarymowicz & Im-

bir, 2010). These two may modulate cognitive functioning in processes such as attention and cognitive control. We expected that the valence of emotions would be secondary to their origins and source and would not modulate the field of attention. This prediction was based on our earlier studies on cognitive control (Imbir & Jarymowicz, 2011a, 2011b, 2013a), suggesting that the origin (but not valence) of emotions is a factor modulating the efficiency of inhibitory control in the emotional Stroop test and oculomotor inhibition in the Antisaccade test.

In studies comparing positive and negative emotions, researchers usually use discrete emotions (fear, joy, etc.) and do not take into account the hidden variables such as their origin. When choosing the study material, they usually compare negative emotions of Automatic origin (the prototype for this type being fear) with positive ones whose origins are either Reflective or ambiguous (e.g., happiness, which may be derived from a good meal or graduation). This combination may result in inconclusive patterns of results. Currently, researchers are starting to take into account the complexity of the origins and sources of emotions.

A pattern of data similar to our result was obtained independently for positive emotions in the Antisaccade test, comparing emotions connected with immediate pleasure vs. pride (cf. Katzir, Eyal, Meiran, & Kessler, 2010). This division corresponds to the origin dimension of emotions (Automatic vs. Reflective).

STUDY 1

Method

Materials and apparatus. In order to elicit various types of emotions identified in the Taxonomy of Human Emotions (Jarymowicz & Imbir, 2010), we decided to use verbal stimuli in the form sets of sentences (Study 1) or words (Study 2). This decision was influenced by the fact that there are no clear pictorial representations of conceptual Reflective stimuli (see Imbir & Jasielska, 2012). We assumed that a word has three components: (1) the configuration of characters or sounds (as sensory stimuli), (2) the content and its meaning – semantic attributes – and (3) their affective connotations. All of these components are functionally related to one another (Dobrenko & Jarymowicz, 2011; Imbir, 2012; Kurcz, 1987; LeDoux, 1996). Triggering one attribute causes the spreading activation of others. Affective connotation is associated with the emotional memory of feelings and physiological changes accompanying a certain

situation (stored in declarative memory). Recalling the sensory stimulus or its contents (understanding) activates the corresponding affective state of the body, although with less intensity (cf. Holmes, Matthews, Mackintosh, & Dalgleish, 2008; Holmes & Matthews, 2010).

It was decided to block the presentation of entire sets of words or sentences (while maintaining randomness within sets and between sets) in order to: (1) maintain the uniqueness of associations related to a particular category of emotions and (2) gain cumulative reinforcement of effects specific to a given category (Algoma, Chajut, & Lev, 2005). The words used were chosen so that in each set they preserved maximum formal similarity (word length, part of speech, frequency of occurrence). These sets were tested in a pilot study verifying the theoretical accuracy of the selection of examples (competent judges) as well as checking their activation load (Imbir & Jarymowicz, 2011a). They were also frequently used in our previous studies (see Imbir & Jarymowicz, 2011a, 2011b, 2013a, 2013b; Imbir et al., 2012; Jarymowicz et al., 2013; Jasielska & Jarymowicz, 2012), which demonstrated a consistent and repeatable (accuracy) pattern of results using sets of words or sentences dissimilar in composition (e.g., half subsets). For each category (see examples in Table 1) in the present research we presented 9 sentences or 12 words. In control conditions we used a set of 9 neutral sentences (relating to the laws of nature, such as “In winter brown bears fall into a resting state called hibernation” or “It is possible to divide a segment into equal parts using a pair of compasses”) and 24 neutral words (such as jumping, swimming, calculating, logging). Table 1 shows examples of stimulus material.

For the presentation of the stimuli we used E-Prime software, version 1.1. A script was prepared to ensure control of the presented material (maintaining randomness) and record the time of the participants' responses. Experimental materials were presented on a standard laptop with a 17-inch screen. Screen refresh rate ensured the possibility of exposures lasting a minimum of 16 milliseconds. Emotional stimuli were presented in an explicit way for a time period controlled by participants (Study 1 – reading sentences) as well as in a degraded manner (implicit, for 32 ms – Study 2). Participants responded by pressing specially marked keys to change the experimental panels and the highlighted SPACE key to react to target stimuli noticed.

Table 1
Examples of Sentences (Study 1) and Words (Study 2) Used to Elicit Emotions

		Negative		Positive	
		word	sentence	word	sentence
Automatic emotions					
Homeostatic	Disease		The worst diseases are those that develop when you are not aware of it.	Purification	After stress and fear, hushing and calming down puts you into a state of bliss.
	Violence			Recovery	
Hedonic	Stink		Sometimes it is difficult to bear the stench, especially when it stifles you and makes you choke.	Amusement	You experience the first infatuation strongly and remember your feelings long afterwards.
	Stench			Pleasure	
Reflective emotions					
Self standards	Unreliability		Sometimes you behave in a way that makes you embarrassed and ashamed.	Courage	Overcoming difficulties gives us more joy than a bad excuse.
	Cowardice			Dutifulness	
Axiological standards	Bias		It is shocking that people derive satisfaction from the exploitation of others.	Justice	Great examples of cooperation were possible thanks to human loyalty.
	Contempt			Loyalty	

Participants. Study 1 involved 90 participants (39 women and 51 men), students of humanities and social sciences departments of Warsaw's universities. Ten participants (four women and six men) did not meet the conditions for the effectiveness of manipulation (accuracy and intensity of mental representations, see below), and therefore we analyzed data collected from 80 participants. The age of the participants ranged from 19 to 40 years ($M = 24.5$, $SD = 4.15$). They participated in the experiment voluntarily and gratuitously.

Design. The study was conducted in a mixed design ($2 \times 2 \times 2 \times 2$), between subjects: emotional valence (N and P); within subjects: the origin of emotion (evaluative system Aut and Refl), the source of emotions (Int and Ext), and the distance of the stimulus from the fixation point (Close and Distant). Each participant read sentences related to emotions of (1) Automatic or (2) Reflective origin whose source was either (A) Internal or (B) External with one valence, as well as neutral sentences.

Procedure. The study was conducted on an individual basis in a laboratory. Participants were informed that the aim was to test the relationship between emotions and attentional processes. The study began with a short introductory instruction to the experimental program and some pretest screens designed to familiarize the participants with the cognitive task – stimulus detection test (see Figure 1). Participants were randomly assigned to groups in which they read sentences that varied in terms of valence (positive and negative conditions). All participants read neutral sentences (control condition). The procedure proper consisted of five repetitions of the experimental block, presented in a random order, in which (1) nine sentences were presented relating to the origin and source of emotions (in such a way that they were related to only one specific category), which participants were supposed to read and imagine what a person felt like in the situations described. (2) After each sentence, participants were asked to assess the valence of the cited representations and their correspondence with their own experience on a 10-point scale. We analyzed only samples of participants who reported mental representations with the same valence as the sentences read and with intensity above the middle of the scale. Next, (3) 30 trials of the test were presented, in which the task was to focus on the fixation point in the center of the screen and press the SPACE key when a little red square (5×5 mm / 0.2×0.2 in.) appeared in the visual field. The square appeared randomly in places shown in Figure 1. In each of the first six trials, the square always appeared three times close to and three times far from the fixation point. The time of the square's appearance after the end of the previous trial was also a random value ranging from 1000 to 2000 ms (with discrete values every 100 ms).

The results of the remaining 24 trials were not analyzed and treated as a break between the experimental manipulations. After the completion of the test, the program randomly selected another experimental manipulation condition (the kind of sentences read), and so on exhausting the pool of five conditions.

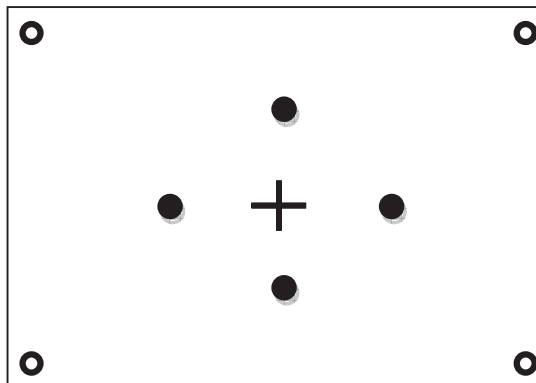


Figure 1. The test screen with indications of possible places where target stimuli appeared – distant from (white) or close to (black) the fixation point.

RESULTS

Analysis of variance with repeated measures in a mixed design $2 \times 2 \times 2 \times 2$ (valence \times origin \times source of emotion \times distance of stimulus) was used in order to verify the hypothesis. Mean reaction time of SPACE key response to the appearance of the square was used as dependent variable. Data were logarithmized (by natural logarithm) and, thus prepared, they were subjected to statistical calculations. The Figures represent raw mean reaction times.

We did not find a statistically significant **main effect of emotional valence**. Average response times of participants who read negative sentences, $M_{(\text{Neg})} = 295$ ms ($SEM = 5.3$), did not differ significantly from those of participants who read positive sentences: $M_{(\text{Pos})} = 298$ ms ($SEM = 5.3$); $F(1, 78) = 0.083$; $p = .8$ (*ns*); $\eta^2 = .001$. We did not find a statistically significant **main effect of emotion origin** (system of evaluation). Average response times to stimuli in conditions of Automatic emotions excitation $M_{(\text{Aut})} = 294$ ms ($SEM = 3.86$) and Reflective emotions excitation $M_{(\text{Ref})} = 299$ ms ($SEM = 4.8$) did not differ significantly: $F(1, 78) = 0.55$, $p = .4$ (*ns*); $\eta^2 = .007$. No statistically significant effect was found in the case of **main effect of emotion source**. Average response

times to stimuli in conditions of Internal source emotion elicitation $M_{(Int)} = 298$ ms ($SEM = 4.5$) and External source emotion elicitation $M_{(Ext)} = 295$ ms ($SEM = 4.2$) did not differ significantly: $F(1,78) = 0.174$; $p = .7$ (ns); $\eta^2 = .002$.

We found a statistically significant **main effect of stimulus distance**. Average response times to stimuli appearing close to the fixation point $M_{(Close)} = 285$ ms ($SEM = 3.8$) and far from it $M_{(Distant)} = 307$ ms ($SEM = 4.7$) differed significantly: $F(1,78) = 33.108$; $p = .001$; $\eta^2 = 0.3$.

We did not find a statistically significant **interaction effect between origin of emotion and stimulus distance**: $F(1,78) = 0.4$; $p = .53$; $\eta^2 = .005$. We found a statistically significant **interaction effect between source of emotion and stimulus distance**: $F(1,78) = 14.457$; $p = .001$; $\eta^2 = .6$. In conditions Internal source emotion elicitation, average response times were $M_{(Int_Close)} = 281$ ms ($SEM = 4.3$) for stimuli presented close to the fixation point and $M_{(Int_Distant)} = 317$ ms ($SEM = 6.3$) for those presented far from it. In External source emotion elicitation conditions, they were $M_{(Ext_Close)} = 292$ ms ($SEM = 4.9$) for stimuli presented close to the fixation point and $M_{(Ext_Distant)} = 301$ ms ($SEM = 4.8$) for those presented far from it. Comparisons revealed no significant differences either between the control condition at close presentation $M_{(Neutr_Close)} = 288$ ms ($SEM = 4.5$) and other close presentation conditions or between the control condition at distant presentation $M_{(Neutr_Distant)} = 320$ ms ($SEM = 5.2$) and other distant presentation conditions. Figure 2 shows the interaction effect between origin of emotion and stimulus distance.

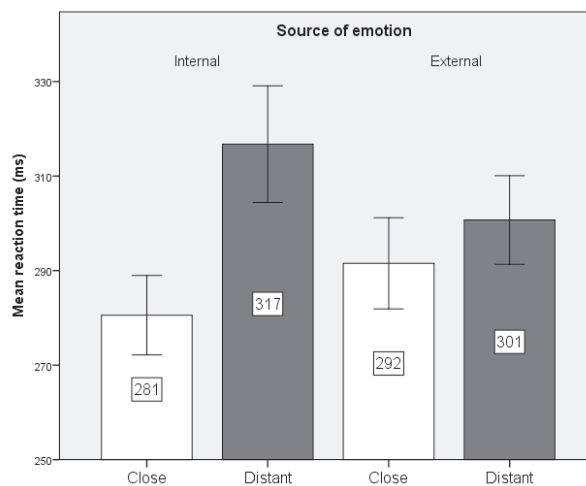


Figure 2. Interactive effect between emotion source and stimulus distance in Study 1. Columns represent the average response time (ms); error bars represent 95% confidence intervals of the mean.

Simple effects analysis using the *t*-test showed that all the effects were statistically significant, as regards both comparison within emotion source $M_{(Int_Close)}$ vs. $M_{(Int_Distant)}$: $t(79) = 6.218$; $p = .001$ and $M_{(Ext_Close)}$ vs. $M_{(Ext_Distant)}$: $t(79) = 2.032$; $p = .046$ and those within stimulus distance ($M_{(Int_Close)}$ vs. $M_{(Ext_Close)}$: $t(79) = 2.123$; $p = .037$; $M_{(Int_Distant)}$ vs. $M_{(Ext_Distant)}$: $t(79) = 2.655$; $p = .01$).

We did not find a statistically significant **interaction effect between origin of emotion, source of emotion, and stimulus distance**: $F(1, 78) = 0.098$; $p = .73$, $\eta^2 = .001$. In order to fully explore Hypothesis 3, an additional simple effects analysis using the *t*-test was carried out for each of the conditions separately. In the case of Automatic origins of emotion, we found significant differences within the Internal (Homeostatic) source of emotion: $M_{(Hom_Close)} = 275$ ms ($SEM = 4.4$) vs. $M_{(Hom_Distant)} = 310$ ms ($SEM = 6$): $t(79) = 5.942$; $p = .001$, and non-significant within the External (hedonic) source of emotion: $M_{(Hed_Close)} = 290$ ms ($SEM = 6.3$) vs. $M_{(Hed_Distant)} = 302$ ms ($SEM = 6.1$): $t(79) = 1.896$; $p = .062$. Contrasts within stimulus distance revealed that differences were significant for close pre-sentation: $M_{(Hom_Close)}$ vs. $M_{(Hed_Close)}$: $t(79) = 2.033$; $p = .045$, and non-significant for distant presentation: $M_{(Hom_Distant)}$ vs. $M_{(Hed_Distant)}$: $t(79) = 0.969$; $p = .3$.

In the case of Reflective origins of emotion, we found significant differences within the Internal source of emotion (associated with self standards): $M_{(Self_Close)} = 286$ ms ($SEM = 6.3$) vs. $M_{(Self_Distant)} = 322$ ms ($SEM = 9.8$): $t(79) = 3.854$; $p = .001$, and non-significant within the External source of emotion (associated with axiological standards): $M_{(Axio_Close)} = 292$ ms ($SEM = 6.8$) vs. $M_{(Axio_Distant)} = 297$ ms ($SEM = 6.1$): $t(79) = 0.912$; $p = .36$. Contrasts within stimulus distance revealed that differences were non-significant for close presentation: $M_{(Self_Close)}$ vs. $M_{(Axio_Close)}$: $t(79) = 0.774$; $p = .44$, and significant for distant presentation $M_{(Self_Distant)}$ vs. $M_{(Axio_Distant)}$: $t(79) = 2.475$; $p = .015$.

DISCUSSION

It turned out that the results of Study 1 confirmed Hypothesis 2 and, partially, Hypothesis 3, but did not confirm Hypothesis 1. Response times to stimuli appearing close to the fixation point were faster than the corresponding reaction times to stimuli presented far from the fixation point. This result is not surprising. It is worth noting that the nature of the excited emotions had significance for the task. In the case of emotions with Internal source, either homeostatic or related to self standards, we could observe exactly the same effect. It can be

a sign of intensification of attention (Kolańczyk, 2011). In the case of emotions with External source, either hedonistic or related to axiological standards, the effect disappears. Response times to stimuli that arise far from the fixation point are indeed longer than response times to stimuli appearing close to it, but these differences are not statistically significant. Perhaps we are dealing with extensification of attention (longer response times to stimuli close to the fixation point and shorter ones in the case of stimuli distant from it).

Hypothesis 3 is not supported by the significance of the interactive effect. However, some evidence suggests that it might be right. For homeostatic emotions, simple effects analysis points to significant differences in response times between stimuli that arise close to and far from the fixation point. Such differences are not found in the case of emotions connected with axiological standards. However, there is no evidence to suggest an intensification of the effect in relation to other conditions. Besides, it is worth noting that in the case of emotions of Automatic origin we can see an extension of reaction times to stimuli appearing close in conditions of hedonic versus homeostatic emotion elicitation. In the case of emotions of Reflective origin, an analogous effect involves shorter response times to stimuli appearing far from the fixation point in conditions of axiological standards versus self standards emotion elicitation. This last result points to the possible role of the Reflective system (in particular the emotions connected with axiological standards) in the extensification of attention. Both results may indirectly confirm Hypothesis 3.

The experiment's procedure should also be noted. Participants first read series of sentences and then did trials of the stimulus detection task. The results were analyzed for the first six trials of the test after experimental manipulation. Additional analyses showed that for samples 7 to 30 the variation observed in the immediate aftermath of experimental manipulation disappeared.

STUDY 2

Method

Participants. Study 2 involved 60 students from various faculties of the University of Warsaw (36 women and 24 men). Mean age was 21.9 years ($SD = 1.5$). Participants took part in the study as volunteers. Two persons (women) were excluded from analyses because of positive awareness and recognition of target stimuli reported in the test after the procedure. Therefore, we analyzed data col-

lected from 58 individuals. For all of them Polish was the mother tongue. None had defects of vision (other than those corrected using glasses or contact lenses).

Design. Within-participant design was applied ($2 \times 2 \times 2 \times 2$), with the following factors included: valence (N and P) \times origin (Aut and Refl) \times source of emotion (Int and Ext) \times distance of stimulus from the point of fixation (Close and Distant). Each participant performed the test of visual stimuli detection; each test trial was preceded by a word presented for 32 ms relating to emotions of (1) Automatic or (2) Reflective origins, with (A) Internal or (B) the External source, and with different valence: (I) negative or (II) positive. In the control conditions neutral words were used.

Procedure. The participants first practiced performing the stimuli detection test in 10 trials. They were asked to focus on the point of visual fixation during the intervals and then respond as quickly as possible to the appearing stimulus. As in Study 1, the stimulus was a 5 x 5 mm (0.2 x 0.2 in.) red square. To answer they had to press the SPACE key. The square appeared randomly in a horizontal line relative to the fixation point, in the locations marked on Figure 3. During breaks, in the experimental session, words referring to Automatic and Reflexive emotions were presented. The presentation was designed to show words within a category one after another (in a random order). Also, we randomized the order in which categories of emotions and neutral words were displayed. The experimental part consisted of 120 repetitions of the standard sequence (one exposure of every word), which consisted of: (1) word exposures lasting 32 ms, (2) presentations of the mask, in the form of twelve X letters in a row, displayed for 50 ms, (3) presentations of the fixation point, lasting between 50 and 100 ms (random values differed from each other by 10 ms), (4) trials of the stimuli detection test, and (5) time intervals, varying randomly in length from 500 to 1500 ms (random values differed from each other by 100 ms), during which the fixation point was displayed. Figure 3 presents the test procedure and the version of the detection test that was used.

After the procedure, a test of awareness was applied. This test consisted of three questions: (1) Did anything attract your attention during the procedure?, (2) If so: What was it?, (3) If the answer was "Words": Can you recall any? Those who reported having seen words were excluded from analyses.

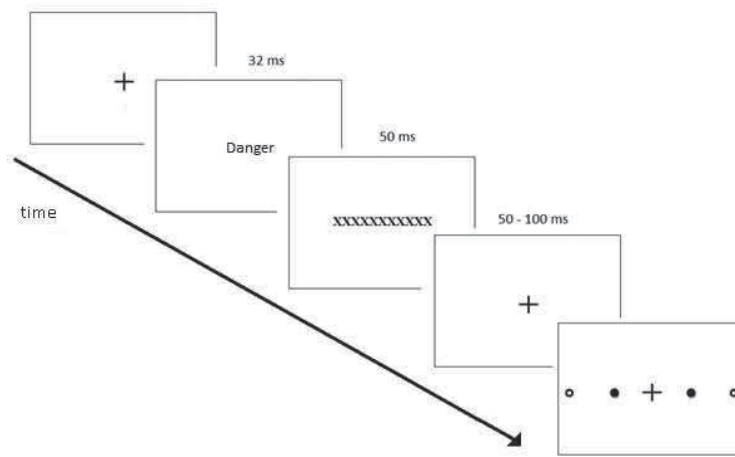


Figure 3. The procedure of Study 2 with indications of where stimuli could appear farther from (white) or closer to (black) the fixation point.

RESULTS

Analysis of variance with repeated measures in within subject design $2 \times 2 \times 2 \times 2$ (valence \times origin \times source \times distance) was used in order to verify the hypothesis, with mean reaction times of SPACE key response to square appearance as the dependent variable. Data were logarithmised (by natural logarithm) and, thus prepared, they were subjected to statistical calculations. Figures represent raw mean reaction times.

We did not find a statistically significant **main effect of emotional valence**. Average response times after negative words: $M_{(Neg)} = 482$ ms ($SEM = 7.63$) were not significantly different from response times after positive words: $M_{(Pos)} = 487$ ms ($SEM = 7.4$), $F(1, 57) = 0.649$; $p = .4$ (*ns*); $\eta^2 = .011$. We did not find a statistically significant **main effect of emotion origin** (evaluative system). Average response times to stimuli in conditions of Automatic $M_{(Aut)} = 481$ ms ($SEM = 7.5$) and Reflective $M_{(Ref)} = 487$ ms ($SEM = 7.5$) emotion elicitation did not differ significantly: $F(1, 57) = 2.643$; $p = .11$ (*ns*); $\eta^2 = .044$.

We found a statistically significant **main effect of emotion source**. Average response times to stimuli in conditions of eliciting emotions with Internal $M_{(Int)} = 480$ ms ($SEM = 7.0$) and External $M_{(Ext)} = 489$ ms ($SEM = 7.6$) sources differed significantly: $F(1, 57) = 5.059$; $p = .028$; $\eta^2 = .074$.

We found a statistically significant **main effect of stimulus distance**. Average response times to a stimulus in conditions of its presentation close to $M_{(\text{Close})} = 480$ ms ($SEM = 7.3$) and far from the fixation point $M_{(\text{Distant})} = 489$ ms ($SEM = 7.4$) differed significantly: $F(1, 57) = 4.583$; $p = .037$; $\eta^2 = .074$.

We found a statistically significant **interactive effect between origins of emotion and stimulus distance**: $F(1, 57) = 6.043$; $p = .017$; $\eta^2 = .096$. Average response times to stimuli in conditions of Automatic emotion elicitation was $M_{(\text{Aut_Close})} = 473$ ms ($SEM = 7.9$) at close presentation and $M_{(\text{Aut_Distant})} = 490$ ms ($SEM = 8.2$) at distant, while the in conditions of Reflective emotion elicitation they were $M_{(\text{Refl_Close})} = 490$ ms ($SEM = 8.23$) at close and $M_{(\text{Refl_Distant})} = 488$ ms ($SEM = 7.7$) at distant stimulus presentation. Comparisons revealed no significant differences either between the control condition at close presentation $M_{(\text{Neutr_Close})} = 476$ ms ($SEM = 11.5$) and other close presentation conditions or between the control condition at distant presentation, $M_{(\text{Neutr_Distant})} = 490$ ms ($SEM = 10.6$) and other distant presentation conditions. Figure 4 shows the interactive effect origin of emotions and stimulus distance.

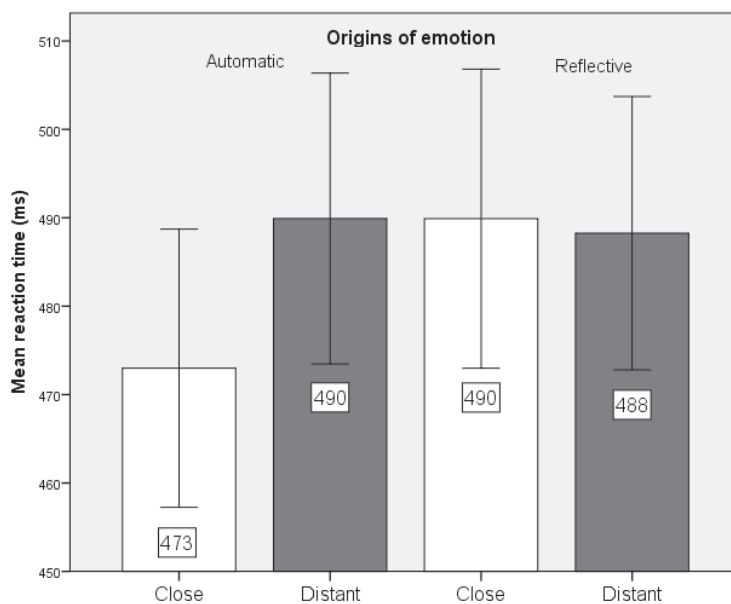


Figure 4. Interactive effect between emotion origin and stimulus distance in Study 2. Columns represent the average response time (ms); error bars represent 95% confidence intervals of the mean.

Simple effects analysis using the t -test showed that the differences were significant in the case of Automatic emotion comparisons, $M_{(Aut_Close)}$ vs. $M_{(Aut_Distant)}$: $t(57) = 2.944$; $p = .005$, and non-significant in the case of Reflective emotion comparisons, $M_{(Refl_Close)}$ vs. $M_{(Refl_Distant)}$: $t(57) = 0.266$; $p = .79$. Contrasts within stimulus distance revealed significant differences between conditions of close presentation, $M_{(Aut_Close)}$ vs. $M_{(Refl_Close)}$: $t(57) = 2.272$; $p = .027$, and no significant differences between conditions of distant presentation, $M_{(Aut_Distant)}$ vs. $M_{(Refl_Distant)}$: $t(57) = 0.281$; $p = .78$.

We found a statistically significant **interactive effect between source of emotion and stimulus distance**: $F(1, 57) = 4.662$; $p = .035$; $\eta^2 = .074$. Average response times to stimuli in conditions of Internal emotion source were $M_{(Int_Close)} = 472$ ms ($SEM = 7.3$) at close presentation and $M_{(Int_Distant)} = 488$ ms ($SEM = 7.7$) at distant presentation, while in the case of External emotion source they were $M_{(Ext_Close)} = 490$ ms ($SEM = 8.0$) at close presentation and $M_{(Ext_Distant)} = 490$ ms ($SEM = 8.6$) at distant presentation. Comparisons revealed no significant differences either between the control condition at close presentation $M_{(Neutr_Close)} = 476$ ms ($SEM = 11.5$) and other conditions of close presentation or between the control condition at distant presentation $M_{(Neutr_Distant)} = 490$ ms ($SEM = 10.6$) and other distant presentation conditions. Figure 5 shows the interactive effect between the source of emotion and stimulus distance.

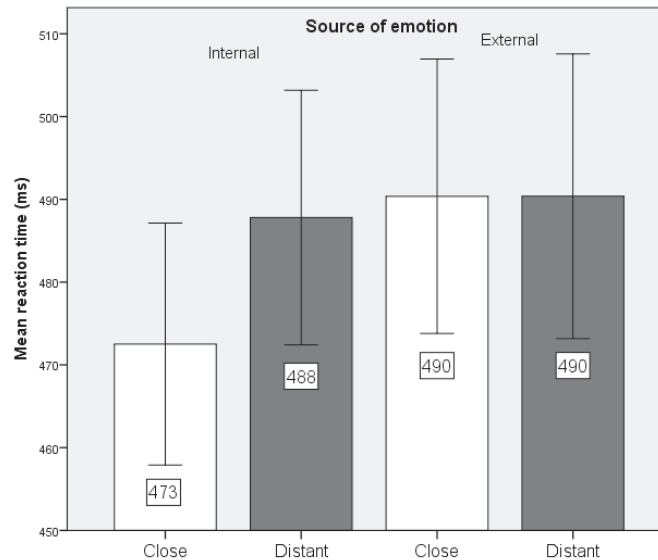


Figure 5. Interactive effect between emotion source and stimulus distance in Study 2. Columns represent the average response time (ms); error bars represent 95% confidence intervals of the mean.

Simple effects analysis using the *t*-test showed that the differences were significant in the case of Internal source of emotion comparisons: $M_{(Int_Close)}$ vs. $M_{(Int_Distant)}$: $t(57) = 3.032$; $p = .004$, and non-significant in the case of External source of emotion: $M_{(Ext_Close)}$ vs. $M_{(Ext_Distant)}$: $t(57) = 0.02$; $p = .98$. Contrasts within stimulus distance revealed that there were significant differences in close stimuli presentation conditions: $M_{(Int_Close)}$ vs. $M_{(Ext_Close)}$: $t(57) = 3.145$; $p = .003$, and non-significant ones in conditions of distant stimuli presentation: $M_{(Int_Distant)}$ vs. $M_{(Ext_Distant)}$: $t(57) = 0.312$; $p = .75$.

We did not find a statistically significant **interactive effect between origin of emotion, source of emotion, and stimulus distance**: $F(1, 57) = 0.31$; $p = .58$, $\eta^2 = .005$. In order to fully explore Hypothesis 3, an additional simple effects analysis using the *t*-test was carried out for each of the conditions separately. In the case of Automatic origins of emotion we found significant differences within the Internal (homeostatic) source of emotion, $M_{(Hom_Close)} = 464$ ms ($SEM = 7.8$) vs. $M_{(Hom_Distant)} = 486$ ms ($SEM = 8.2$): $t(57) = 3.381$; $p = .001$, and non-significant differences within External (hedonic) source of emotion, $M_{(Hed_Close)} = 482$ ms ($SEM = 9.7$) vs. $M_{(Hed_Distant)} = 494$ ms ($SEM = 10.6$): $t(57) = 1.477$; $p = .145$. Contrasts within stimulus distance revealed significant differences for close presentation, $M_{(Hom_Close)}$ vs. $M_{(Hed_Close)}$: $t(57) = 2.132$; $p = .037$, and non-significant differences for distant presentation: $M_{(Hom_Distant)}$ vs. $M_{(Hed_Distant)}$: $t(57) = 0.612$; $p = .543$.

In the case of Reflective origins of emotion we found no significant differences within the Internal source of emotion (associated with the self-standards), $M_{(Self_Close)} = 481$ ms ($SEM = 9.4$) vs. $M_{(Self_Distant)} = 489$ ms ($SEM = 9.5$): $t(57) = 1.08$; $p = .285$, and no significant differences within the External source of emotion (associated with axiological standards): $M_{(Axio_Close)} = 494$ ms ($SEM = 8.6$) vs. $M_{(Axio_Distant)} = 487$ ms ($SEM = 8.7$): $t(57) = 1.019$; $p = .312$. Contrasts within stimulus distance revealed no significant differences for close presentation, $M_{(Self_Close)}$ vs. $M_{(Axio_Close)}$: $t(57) = 1.965$; $p = .054$, and no significant differences for distant presentation $M_{(Self_Distant)}$ vs. $M_{(Axio_Distant)}$: $t(57) = 0.164$; $p = .871$.

Discussion

The result described above confirmed two hypotheses (H1 and H2) and partly confirmed Hypothesis 3. We were dealing here with the immediate aftermath of primed emotions (100-150 milliseconds after the disappearance of the word the task appeared) in the form of changes in the field of attention. It turned out that, as in Study 1, participants' reactions to stimuli appearing close to the

fixation point were faster than responses to distant stimuli. As in Study 1, the kind of primed emotion had significance for the task. Participants intensified attention (and reacted more quickly to stimuli close than to those distant) in conditions involving the elicitation of Automatic emotions and those with an Internal source and they extensified it (reacted in a similar time to close and distant stimuli) in conditions involving the elicitation of Reflective emotions and those with an External source.

As in Study 1, Hypothesis 3 is not supported by the significance of the interactive effect. However, simple effects analysis shows significant differences indicating an intensification of attention for homeostatic emotions (Automatic origin and Internal source). In the case of emotions associated with axiological standards (Reflective origin and External source), this effect disappears. Response times to stimuli that appear far from the fixation point are not longer than reaction times to stimuli appearing close to it (at the level of pure means, they become even shorter (!)). Comparing the results of simple effects analysis of average response times in different experimental conditions in Study 2, it is worth noting the repetition of the effect observed in Study 1, involving an extension of reaction times to stimuli appearing close in conditions of hedonic as compared to homeostatic emotion elicitation (with Automatic origins). This also may indirectly point to the validity of Hypothesis 3, but our research does not allow to accept or reject it unequivocally.

GENERAL DISCUSSION

What may be surprising is the difference in average response times between Studies 1 and 2. This can be explained by the nature of the paradigms used. In Study 1, detection task trials followed one after another; nothing except the fixation point appeared on the screen between them. By contrast, in the case of Study 2, a word and the mask appeared on the screen for 82 ms between detection task trials, which involved the resources necessary for the cognitive system to receive the content of the degraded message (see Dobrenko & Jarymowicz, 2011). Another explanation for this difference may be that the inhibition of reaction in Study 2 increased when some stimulus flashed on the screen but did not meet the target red square criteria for reaction. The inhibition of reflex reaction to a new stimulus (not related to the task) in a situation of permanent readiness may have caused the general extension of response times in Study 2.

Another important issue is the difference between Studies 1 and 2 when it comes to the status of Hypothesis 1, concerning the role of emotion origin (the emotional system). In Study 2 (as opposed to Study 1), the hypothesis found no confirmation in the form of the expected interaction effect between emotion origin and target stimulus distance. The reasons for this may be twofold. Firstly, in Study 1 we registered a deferred and vanishing change of the field of attention, which may blur the picture of the true relationship. Study 2 measured the direct change of attention field (within 100 to 150 ms after the disappearance of the degraded verbal stimulus), so its results may be more sensitive to the effect expanding attention field. Secondly, no effects of emotion origin in Study 1 may be associated with a greater degree of processing of received emotional content (imagining the content of sentences). This may provoke a greater intensification of attention. From an evolutionary point of view, focusing attention (on a threatening stimulus) is a simpler procedure for the mind and well-established in the course of evolution (cf. positive-negative asymmetry; Peeters & Czapiński, 1990). Support for this thesis can be found in studies by Kolańczyk (2009, 2011), pointing to the role of extensive attention in creativity.

We should also comment on Hypothesis 3, which was partially supported by the collected data, as we can conclude mainly thanks to simple effects analysis. The polarization of response times between the detection of close and distant stimuli is the case mainly for homeostatic emotions (of Automatic origin and with Internal source) in both studies. The nature of the extensification of attention and its measurement in the operationalization applied does not allow us to confirm or reject this hypothesis unambiguously. Stimuli appearing closer are perceived faster than those appearing far from the fixation point. No significance of this classic effect may testify to the extensification of attention, but the observed phenomenon is not strong enough to exceed the threshold of statistical significance. The reason for this may be, on the one hand, the distance between stimuli that does not allow to observe this relationship, and, on the other hand, the nature of emotions and the unreliability of predictions. The research presented here cannot resolve this issue and further exploration is necessary.

An important question may seem to be the intensity of emotions (their activation load), which is not comparable in the two systems and comprises various components. Preparing the study material, we tested the nature of activation associated with Automatic and Reflective evaluation systems (Imbir & Jarymowicz, 2011a). We checked the level of excitement and subjective regulative significance attributed to words related to both categories. It turned out that, in accordance with the expectations, words relating to Automatic emotions had higher

degrees of excitement attributed to them than words relating to Reflective emotions ($M_{\text{Aut}} = 6.1$ vs. $M_{\text{Ref}} = 5.5$; $F(1, 99) = 63.859$; $p = .001$), but their subjective significance was rated as lower ($M_{\text{Aut}} = 6.06$ vs. $M_{\text{Ref}} = 6.5$; $F(1, 99) = 36.814$; $p = .001$). What is more, excitement attributed to Automatic stimuli should intensify attention, and subjective significance – referring to the multidimensional meaning of this process – should extensify it. We are therefore dealing with two mechanisms that can determine the relationships presented above.

There have been few studies so far combining issues of emotion and attention in a stimuli detection task (cf. Kolańczyk, 2011). A task of detecting stimuli appearing close to and far from the fixation point was used by Mikołajczyk (see: Kolańczyk et al., 2004, p. 68). That experiment demonstrated similar results of a manipulation comparing meditators (extensification of attention) with non-meditators (intensification of attention). In the former group, difference in response times to stimuli close to and distant from the fixation point disappeared. Similar relationships are observed in the studies discussed here. They are caused by a condition much more transitory, namely emotion. We can assume that another factor extensifying the field of attention are emotions. Not all of them, however, but a specific group related to the Reflective system of evaluation and having External sources, often overlooked in experimental studies. Understanding the nature of this phenomenon requires further research.

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