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DOES READING WORDS DIFFERING IN AROUSAL LOAD INFLUENCE LOCAL VS. GLOBAL SCOPE OF PERCEPTION?

This article examines how the arousing properties of words influence the local vs. global scope of perception in the Kimchi–Palmer task. It was assumed that arousal is a stimulus property that influences a person's mental state. Suboptimal arousal (low or high) was expected to narrow the visual scope in comparison to optimal (moderate) arousal. Words varying in arousal (three levels) and matched for valence, concreteness, frequency of appearance, and length were read by 20 young adults (8 women and 12 men, M_{age} = 21.85, SD = 1.69). The participants were then asked about their scope of perception using the Kimchi–Palmer task, allowing for differentiation between the priority of processing on local versus global features of compound geometrical figures. The relationship between the arousal level of the words read and the subsequent cognitive scope followed the Yerkes-Dodson law in that stimuli inducing an intermediate arousal level (versus low or high level of arousal inducements) were associated with a broader, more global cognitive scope.

Keywords: word processing; arousal; Kimchi–Palmer task.

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INTRODUCTION

The Perception of Hierarchical Structures

Cognitive scope is important in processing spatial information (cf. van der Helm, 2012) and can be considered at perceptual, attentional, and conceptual levels (Harmon-Jones, Gable, & Price, 2013). One might focus, for example, broadly on the wood, so to speak, or narrowly on each tree (Huntsinger, 2013). Thus, an individual's attention is flexible and may be partly driven by affective state (Basso, Schefft, Ris, & Dember, 1996; Easterbrook, 1959; Finucane, 2011). Scope can be measured by such tasks as the flanker task (Eriksen & Eriksen, 1974), comprising a central target letter flanked by four other letters in congruent (e.g., NNNNN) or incongruent (e.g., NNHNN) conditions, allowing for the measurement of a person's sensitivity to interference caused by flanker stimuli when trying to recognize a central object. A widened focus of attention increases interference and lengthens reaction times to central target stimuli. Such results were evident when positive affect was elicited by listening to music, while the opposite pattern emerged for negative affect elicitation (Rowe, Hirsh, & Anderson, 2007). It is worth noting that the results of experiments involving emotional valence or the manipulation of distinct emotional states can be accounted for by two alternative hypothesis about the underlying mechanisms: (a) spatial broadening (Gasper & Clore, 2002; Rowe et al., 2007) and (b) degree of flexibility (Baumann & Kuhl, 2005; Phaf, 2015). For example, Phaf (2015) demonstrated that the broader cognitive scope in positive affect conditions measured by the flanker task could be better explained by temporal switching and higher flexibility than by spatial broadening.

Another paradigm for measuring the scope of perception is the Navon letter task (Navon, 1977). This task is based on a complex visual array of letter stimuli. Participants are asked to determine whether certain letters appeared as global (big arrays of letters) or local (small arrays of letters). This task was found to prime local versus global processing (Förster, 2012) and to be sensitive to manipulations promoting versus preventing motivational states (Förster & Higgins, 2005) in such a way that global processing results in a promotion focus on advancement, whereas local processing results in a prevention focus on security.

The last task assessing global vs. local scope of perception is the Kimchi and Palmer task (1982), introduced as a method enabling the measurement of scope preference using simple geometrical stimuli (triangles, squares, pentagons, or hexagons). This task requires judgements of similarity between the reference

figure (e.g., a square comprising four small triangles) and two other figures (e.g., a triangle comprising three small triangles for local focus and a square composed of small squares for global focus). To some extent, this task itself is an ambiguous one, because the two figures presented to participants are similar, one on the global level and the other on the local level; thus, what is measured is the participant's preference at the moment of task presentation.

The Effects of Affective States, Approach–Avoidance Motivations, and Motivational Intensity on the Kimchi–Palmer Task

Since the Kimchi–Palmer task was introduced there have been several attempts to identify the factors that alter individuals' scope preference. Emotional state, specifically anxiety, was the first factor shown to have an influence. Dispositionally anxious individuals were quicker to focus on local stimulus features (Derryberry & Reed, 1998), and being in an anxious state enhanced this effect. Also the scope of perception in the Kimchi–Palmer task was found to be sensitive to both scope priming with the modified Navon task (Förster, 2012) and affective state manipulation (negative vs. positive) elicited by recalling sad or happy events from one's own life or by listening to music (e.g., Huntsinger, Clore, & Bar-Anan, 2010). Therefore, perceptual focus or scope appears to be broadened by positive affect and constricted by negative affect (cf. Huntsinger, 2013).

Scope of perception in the Kimchi–Palmer task was also found to be influenced by approach vs. avoidance motivation (Gable & Harmon-Jones, 2008). The influence of approach motivation intensity was investigated in the case of affective states induced by videos presenting humorous cat clips (amusement, low-approach) vs. desserts (desire, high-approach; Gable & Harmon-Jones, 2008). The results of the study showed that positive conditions of a low--approach state generated less broadening of cognitive scope (more local figure option chosen) compared to positive conditions of high approach (more global figure option chosen). What is more, telling participants that the dessert displayed was an actual one they would be able to eat after experiment made the narrowing of cognitive scope even greater (Gable & Harmon-Jones, 2008).

The results from mentioned above allowed researchers to formulate the hypothesis that motivational intensity was responsible for changes in cognitive scope (Harmon-Jones et al., 2013). Motivational intensity can be defined as the strength of the urge to move towards or away from a stimulus (Harmon-Jones, Harmon-Jones et al., 2013). Low motivational intensity was associated with

a broadening of mental scope while high motivational intensity was associated with a narrowing of cognitive scope, irrespective of the valence of the individual's emotional state.

Arousal as an Important Activation Mechanism

Motivational intensity is a concept similar to arousal, with the result that arousal can be a natural confound of this intensity (Harmon-Jones et al., 2013). A high level of motivation often means a high level of arousal, but dissociative states exists, such as amusement, when high arousal accompanies low motivational intensity, which means the two concepts should be treated as distinct (Harmon-Jones et al., 2013). In psychology, arousal is conceived as an individual's perceptions of the energetic level induced by external stimuli (Osgood, Suci, & Tannenbaum, 1957; Lang, 1980; Russel, 2003) or as physiological reaction of the autonomic nervous system (Harmon-Jones et al., 2013) measured by skin conductance, heart rate, or breath depth and manipulated by physical exercises such as bike riding or running. This approach to some extent confuses the physiological consequences of arousal with similar consequences of other processes. Arousal is a state at a particular time and is sometimes called intensity or energy level (Moors, et al., 2013). From a theoretical point of view (Imbir, 2016a; Russell, 2003), arousal is an energetic side of emotion, providing energy and preparing an organism to deal with environmental threats. For example, bike riding consumes energy and engenders physiological changes similar to arousal, but this is not arousal as it was originally conceived (Osgood et al., 1957; Lang, 1980; Russel, 2003). In this work, arousal is defined as the first description and treated as a property of stimulation or objects that can influence the current state of an individual encountering such objects (Russell, 2003). Arousal energy expresses the degree of excitement or activation an individual feels towards a given stimulus (Montefinese, Ambrosini, Fairfield, & Mammarella, 2014), and can be measured in advance in order to find out whether stimuli are perceived as more or less arousing (e.g., Imbir, 2015a; Montefinese et al., 2014; Moors et al., 2013; Osgood et al., 1957). Arousal states vary from calm and sleepy to completely excited (Russell, 2003) and alter cognitive performance in many domains, from the flanker competition in the flanker task (Freitas, Bahar, Yang, & Banai, 2007; Kuhbandner & Zehetleitner, 2011) to cognitive control in the emotional Stroop task (e.g., Nigg, 2000; McKenna & Sharma, 2004) or electrophysiological correlates of words processing (e.g., Hofmann, Kuchinke, Tamm, Võ, & Jacobs, 2009). This led to the conclusion that the arousing properties of stimuli—namely,

arousal load—might influence perceptual cognitive scope (Imbir, 2015b). The physiological exhaustion operationalization of arousal was found not to influence cognitive scope (Gable & Harmon-Jones, 2013), but the consequences of the arousal load of stimuli have been subject to experimental validation only once so far (cf. Imbir, 2015b). Given that arousal load of words influences cognitive control even without explicit reading of the content required by the task, as in the emotional Stroop task, it can be postulated that differences in the arousal level associated with words (Imbir, 2015a) could also influence other cognitive processes, particularly the scope of perception. This is because simply reading or looking at words with a particular arousal load should influence one's state of arousal (cf. Russel, 2003).

Aim and Hypothesis

The aim of this experiment was to investigate how arousal influences performance on a global vs. local focus preference task (Kimchi & Palmer, 1982). Individuals usually display a global preference under conditions of positive affect or low motivational intensity. Those states are both associated with optimal functioning. For this reason, the aim of the present study was to determine the consequences of arousal in order to find out what level of arousal is optimal. Therefore, I predicted that global preference would be the strongest when stimuli with a moderate arousal load were presented and when local stimuli with low and high arousal load were presented. Such a relationship is called reversed U-shaped and can be found between energy/motivation/arousal and performance level in the well-known Yerkes–Dodson (1908) law. This law states that the relationship between energy/motivation/arousal and performance follows an inverted U-shaped curve, implying that moderate levels of arousal, energy, or motivation are optimal for functioning (cf. Imbir, 2015b). This is rather a forgotten expectation, because when the consequences of arousal are investigated researchers often consider two instead of three levels of arousal (see e.g., Van Steenbergen, Band, & Hommel, 2010, for a flanker task) and thus fail to find the effects of arousal. This is simply due to the fact that if both levels chosen are the same distance from the optimum level, the observed performance will be similar and no arousal effect will be reported. In the current experiment, arousal was expected to modulate focus preference according to the Yerkes–Dodson (1908) law.

METHOD

Participants

Sixty participants (30 women) aged 19 to 26 (M = 21.93, SD = 1.93) were involved in the study. They were students of various Warsaw-based universities and participated voluntarily in exchange for small gifts. All participants were right-handed and had normal or corrected-to-normal vision. The whole sample was divided into three groups on the basis of the dominant local vs. global preference measured by means of the Kimchi–Palmer task (post-hoc categorisation of participants). The first group of individuals showed a clear local scope preference (M = .05, SD = .02, range: 0 to .10, N = 19). The second group had a moderate (and thus labile) local–global preference (M = .63, SD = .23, range: .12 to .89, N = 20). The third group showed a clear global preference (M = .94, SD = .03, range: .9 to 1, N = 21). The reason for dividing participants into three groups was that answers in the Kimchi–Palmer task in the case of individuals with clear local or global preference were expected to be characterized by no variance, and the reversed polarity of mean values in those groups could make total results harder to interpret.

Materials

Emotional quality of words. A list of 135 words (nouns, 3 x 45 words, cf. Appendix 1) with known affective qualities, chosen from among 4,905 words introduced by the Affective Norms for Polish Words Reloaded (Imbir, 2016b), was used to develop a manipulation of arousal. The affective norms for words in this list were determined using a methodology similar to that used in a previous pilot study of affective norms for words (Imbir, 2015a). For each dimension measured, the participants assessed their first impression of each word with respect to a number of affective dimensions using a nine-point Likert Self-Assessment Manikin (SAM; Lang, 1980). I used these data to select words in three arousal load categories: (1) words that induced little arousal, M = 3.22, SD = 0.24 (see full list in Appendix 1); words that induced moderate arousal, M = 3.85, SD = 0.28 (for example: tribe, labor, appearance), and words that induced high arousal, M = 4.87, SD = 0.41 (e.g., effort, winner, session). In selecting words, I controlled for other factors which could influence local vs. global scope preference, such as valence, concreteness, subjective significance, and lexical properties such as frequency in Polish (Kazojć, 2011) or the number of

letters (i.e., word length). The whole word list and their affective ratings are presented in Appendix 1.

I performed one-way ANOVA with arousal (three levels) as the between-subjects factor to ensure that the words chosen for the manipulation were appropriate. There was a main effect of arousal on arousal ratings: $F(2, 132) = 305.53$, $p < .001$, $\eta^2 = .82$. A simple contrast analysis confirmed the differences between the groups of weakly and moderately arousing words ($F(1, 88) = 128.48$, $p < .001$, $\eta^2 = .59$) and between moderately and highly arousing words ($F(1,88) = 190.22$, $p < .001$, $\eta^2 = .68$).

Similar analyses of the effects of control factor revealed no main effect of valence ($F(2, 132) = 1.47$, $p = .23$, $\eta^2 = .022$; $M = 5.26$, $SD = 0.61$), concreteness ($F(2, 132) = 0.027$, $p = .97$, $\eta^2 = .0001$; $M = 4.08$, $SD = 0.88$), or subjective significance ($F(2, 132) = 0.61$, $p = .55$, $\eta^2 = .009$; $M = 3.76$, $SD = 0.82$). Word frequency data (Kazojć, 2011) were natural log-transformed as the data were right-skewed (words occurring only once in a wide range of Polish texts were overrepresented in the data set). There was no main effect of arousal load groups in the case of word frequency ($F(2, 132) = 1.24$, $p = .29$, $\eta^2 = .02$; $M = 6.38$, $SD = 1.67$). There was also no main effect of arousal load in the case of word length ($F(2, 132) = 0.58$, $p = .56$, $\eta^2 = .009$; $M = 6.36$ letters, $SD = 1.96$).

These analyses confirmed that the manipulation yielded words with three distinct categories of arousal load which did not differ systematically with respect to other factors that might influence local vs. global scope preference, such as frequency of occurrence, word length, valence, concreteness, and subjective significance. Any category differences could confidently be attributed to the intended arousal manipulation. The arousal properties of words were not additionally measured after the procedure of the current experiment, because based on normative studies showing a high level of assessment congruency within affective norm study ($r = .914$ in split-half estimation; Imbir, 2016b) and between different normative studies ($r = .762$ and $r = .732$; Imbir 2015a) it can be assumed that affective norms provide very good estimations of arousal level for the chosen stimuli.

Direct associations between the meaning and scope of words. In order to test the alternative explanation of the obtained results in terms of semantic priming rather than actual scope changes, I measured the direct associations of the meaning of words and their perceived scope in another group of 23 competent judges (16 females and 7 males, aged 20 to 25, $M = 22.22$, $SD = 1.78$). They were supposed to read the words from a list of experimental stimuli presented to them in a random order and to decide if the meaning of each word was associated with

local (single tree) vs. global (whole wood) scope of perception. For this purpose, I designed the Self-Assessment Manikin (SAM) scale (cf. Imbir, 2015; cf. Figure 1). The aim of this scale was to measure the subjective impressions associated with each stimulus—that is, direct and semantically based associations. The description of the scale was based on a metaphor explaining the meaning of scope with the easily accessible example of a perceiving single tree vs. the whole wood.

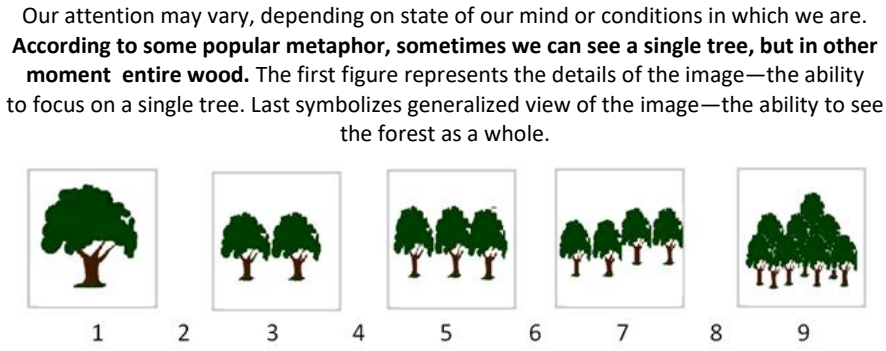

Figure 1. Local–Global associations SAM scale designed to measure the direct associations of words used in the current study.

The scale presented in Figure 1 appeared to be reliable in terms of split-half correlation (r = .81, with Spearman–Brown correction due to the whole sample being split into two subsamples) based on odd and even numbers of questionnaires (cf. Imbir, 2015). In order to check the direct associations of three levels of arousal with scope, I performed a one-way ANOVA analysis with arousal load (low, medium, or high) as an independent variable. No main effect of arousal level was found: $F(2, 132) = 1.44$, $p = .24$, $\eta^2 = .02$. The direct associations for each word are presented in Appendix 1.

The Kimchi-Palmer task. The classical Kimchi–Palmer task (Kimchi & Palmer, 1982) was used to measure local vs. global scope preference. This task involves presenting a reference figure at the top of a display screen and two comparison figures beneath it. Both the reference and comparison figures can be interpreted on a local or global level. The global figure (triangle, square, pentagon, or hexagon) is composed of small (local) figures (triangles, squares, pentagons, or hexagons). The shapes used in the reference figure are always different

at local and global level (e.g., a big triangle is composed of small squares). One of the comparison figures has local elements that match the local elements of the reference figure, while the other has a global configuration that matches that of the reference figure. In the current study, each small figure was displayed in a size that was defined as a proportion of the screen size: 10% of its width x 10% of its height. The width and height of each large figure was a multiple of the width and height of the small figures that it was made up of (e.g., 20% x 20% of screen size for squares). The distance between the display screen and the participant's head was approximately 50–60 cm (depending on the participant's preferences). The participant's task was to make an instant judgement about which comparison figure was more similar to the reference figure.

Apparatus. Stimuli were presented using a standard laptop computer with a 15-inch screen. The experiment was programmed using E-Prime 2.0 software, which enabled stimuli to be presented in a random order and collected reaction time data.

Design and Procedure

Three groups of words differing in arousal load (low, medium, and high) were used. Each group consisted of 45 nouns. The participants were told that the study was meant to investigate how words influenced the perception of figures. They were instructed that a word would appear on the computer screen for half a second (500 ms). Their task was to read the word and then choose the comparison figure that was the most similar to the figure presented above. They were told that there were no right or wrong answers and that what mattered was their first impressions. The participants completed one practice trial before the experimental procedure. The main experiment consisted of 135 trials (3 x 45 for each condition) presented in a fully random order to avoid a potential sequence of presentation effects. Each trial consisted of: (a) variable presentation (100–500 ms; 25 ms increments) of the central fixation point; (b) a 500 ms presentation of a randomly chosen word in the middle of the screen; (c) the second variable presentation (100–500 ms; 25 ms increments) of the central fixation point; (d) the Kimchi–Palmer task (global match presented randomly on the right or left side) lasted for the time needed for the participant to respond; (e) the third variable presentation (100–500 ms; 25 ms increments) of the central fixation point. After the last fixation point, the next trial was loaded automatically. Reaction times and figure choice (global or local match) were recorded. The experi-

ment ended when the participant had completed all 135 trials. A single trial of the experimental procedure is presented in Figure 2.

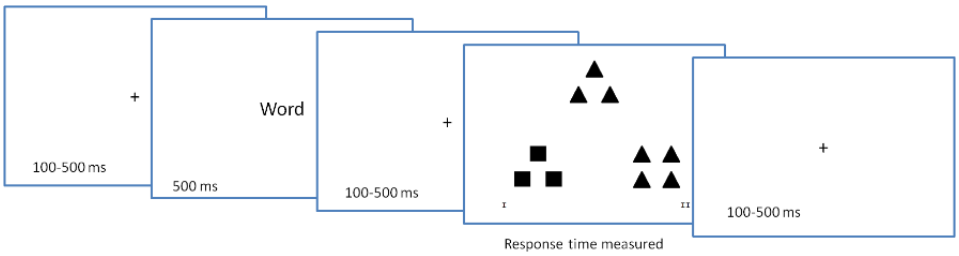

Figure 2. A single trial of the experimental procedure.

RESULTS

I performed a mixed ANOVA analysis with arousal load (low, medium, or high) as a within-subjects factor and dominant scope preference as a between--subjects factor to test the hypothesis about global preference. The dependent variable was the proportion of choices indicating global focus, which potentially varied from 0 (absolute local preference) to 1 (absolute global preference). This proportion was calculated separately for each arousal load condition on the basis of 45 trials, one after each single word presentation.

A statistically significant main effect of arousal was found: $F(2, 56) = 3.36$, $p = .042$, $\eta^2 = .11$. Global preference following the presentation of words was $M = .54$ ($SEM = .019$) for with low arousal load, $M = .55$ ($SEM = .018$) for words with medium arousal load, and $M = .53$ ($SEM = .018$) for words with high arousal load. Contrast analysis revealed that the differences in preference after medium vs. high arousal load words were significant: $F(1, 59) = 5.48$, $p = .035$, $\eta^2 = .09$. A statistically significant main effect of dominant scope preference was found: $F(2, 57) = 215.96$, $p = .001$, $\eta^2 = .88$. The pattern of differences was as expected, with a global preference of $M = .05$ ($SEM = .031$) for participants showing clear local preference, $M = .64$ ($SEM = .031$) for participants showing labile local–global preference, and $M = .94$ ($SEM = .03$) for participants showing clear global preference. All differences were statistically significant (contrast analysis showed all p values to be lower than .001), but will not be interpreted further due to the fact that they were caused by participant selection on the basis

of the dependent variable. There was also a statistically significant interaction for arousal level and dominant scope preference: $F(4, 114) = 4.11$, $p = .003$, $\eta^2 = .13$.

To fully understand the interaction obtained, I conducted three additional ANOVAs with arousal load (low, medium, or high) as an independent factor for participants with clear local, labile, and clear global dominant scope preference. Arousal load had a main effect on global preference in the labile preference group of participants: $F(2, 18) = 6.19$, $p = .009$, $\eta^2 = .41$. Global preference was $M = .62$ ($SEM = .055$) after the presentation of words with low arousal load, $M = .67$ ($SEM = .053$) after the presentation of words with medium arousal load, and $M = .61$ ($SEM = .054$) after the presentation of words with high arousal load. Contrast analysis revealed statistically significant differences in preference after low vs. medium arousal load words ($F(1, 19) = 5.33$, $p = .032$, $\eta^2 = .22$) and after medium vs. high arousal load words ($F(1, 19) = 6.39$, $p = .021$, $\eta^2 = .25$). Figure 3 presents these results.

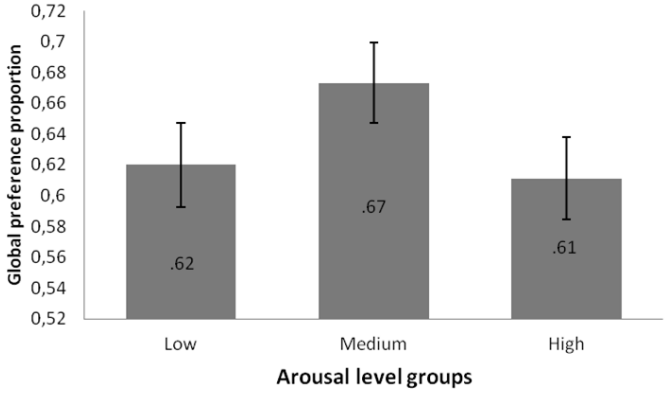

Figure 3. Global scope preference after the presentation of words varying in arousal properties in the group of participants with labile scope preference.

No effects of arousal were found for participants who showed clear local scope preference, $F(2, 17) = 1.968$, $p = .17$, $\eta^2 = .19$ and clear global scope preference: $F(2, 19) = 0.24$, $p = .79$, $\eta^2 = .025$.

I performed another mixed ANOVA analysis with arousal load (low, medium, or high) as a within-subjects factor and dominant scope as a between-subjects factor to investigate the reaction latencies measured in the Kimchi–Palmer task trials. Due to the fact that reaction latency distributions were right-skewed for all

variables, I applied the logarithm-natural transformation of raw data (Heathcote, Popiel, & Mewhort, 1991). No statistically significant main effect of Arousal was found: $F(2, 56) = 0.15$, $p = .86$, $\eta^2 = .005$, but the main effect of dominant scope preference was found to be statistically significant: $F(2, 57) = 5.44$, $p = .007$, $\eta^2 = .16$. The pattern of differences showed that participants with clear local preference reacted in $M = 821$ ms ($SEM = 67$ ms; log-transformed $M = 6.69$), participants showing labile local–global preference reacted in $M = 1106$ ms ($SEM = 65$ ms; log-transformed $M = 6.96$), and participants showing clear global preference responded in $M = 900$ ms ($SEM = 64$ ms; log-transformed $M = 6.74$). Contrast analysis revealed differences between the clear local and labile groups: $F(1, 37) = 13.095$, $p = .001$, $\eta^2 = .26$, as well as between the clear global and labile groups: $F(1, 39) = 5.4$, $p = .025$, $\eta^2 = .12$. No statistically significant interaction of arousal level and dominant scope preference was found: $F(4, 114) = 0.813$, $p = .52$, $\eta^2 = .028$.

Three additional ANOVAs with arousal load (low, medium, or high) as an independent factor were analyzed for participants with local, labile, and global dominant scopes. No main effect of arousal load was found for the local scope preference group, $F(2, 17) = .241$, $p = .79$, $\eta^2 = .03$, for the labile scope preference: $F(2, 18) = .85$, $p = .44$, $\eta^2 = .09$, and for the global scope preference: $F(2, 19) = 1.16$, $p = .34$, $\eta^2 = .11$.

DISCUSSION

This study showed that the arousing properties of words displayed with no intentional instruction (processed involuntarily or implicitly) affected the preferred local vs. global scope measured by the Kimchi–Palmer task (Kimchi & Palmer, 1982). The relationship between scope and activation achieved by viewing words followed the Yerkes–Dodson law (Yerkes & Dodson, 1908). Reading weakly arousing words increased participants' tendency to choose a comparison figure that matched the reference figure at the local level, relative to reading moderately arousing words. A similar effect was observed when comparing the effects of reading highly and moderately arousing words. Figure 2 presents the inverse U-shaped relationship between arousal and global preference that was found in this study. The effect is consistent with an earlier study using the same list of words in the context of a flanker task (Imbir, 2015b), which showed the same inverse U-shaped relationship. It is worth noting that the words used in the manipulations were carefully chosen to exclude the possibility that the effects

were due to differences in valence, concreteness, or another mechanism of activation specific to reflective processes, namely subjective significance (Imbir, 2015a). Potential effects of word frequency and length was also controlled for. No effects of independent variables were found for reaction latencies. This suggests that there was no prioritization for any of the two scopes available in the Kimchi–Palmer task.

It is worth noting here that mere viewing of the words differing in terms of arousal, which is a rather weak and subtle manipulation, revealed the flexibility of the scope of perception (Huntsinger, 2013). This was the case for about one third of the experimental sample, while the remaining two thirds showed clear and stable biases towards a local (about half of them) or global (another about of half) scope during the whole experiment. From this point of view, the results of the current study challenge the expectation expressed in many studies that scope would prove to be a very labile mental state (Förster, 2012; Gable & Harmon-Jones, 2008; Harmon-Jones et al., 2013; Huntsinger, 2013). But it is only seemingly a challenge. Taking into account that the current study provided a within-subject schema while other existing studies worked with between--subjects designs and much more pronounced or time-consuming explicit manipulations of an affective or motivational state, the fact that mere viewing of words charged with arousal influenced scope in fact supports the hypothesis postulating the high lability of this mental state. Still, one has to keep in mind that the results cannot be generalized to participants with clear scope preference.

It seems that an intermediate level of activation facilitates global-level perception. To understand this effect we have to refer to the evolutionary meaning of global vs. local perception. For example, Heerebout and Phaf (2010a, 2010b) showed in an evolutionary simulation that switching between-objects or broad focus is adaptive when an organism is gathering things (e.g., food), while narrow focus is adaptive when an organism is facing a threat (e.g., fleeing from a predator). This is not surprising given the results of previous research showing that negatively valenced manipulation, suggesting an insufficient state of affairs (cf. Huntsinger, 2013), resulted in a narrower attentional focus than positively valenced states (e.g., Derryberry & Reed, 1998; Gable & Harmon-Jones, 2008). Similar effects were found for motivational intensity, which was highest when approach or avoidance was the response to some needs disturbing the optimal state (Harmon-Jones et al., 2013). What do all the above situations have in common? In all of them, optimal conditions are associated with global perception while non-optimal conditions are associated with local perception. In the current study, an intermediate level of arousal was the optimal one. Arousal means

energy level (Moors et al., 2013); this energy allows a person to cope with external stimuli, and its high level underlies approach or avoidance motivation. Low arousal level has been linked with a low intensity of motivation or with sleep (Russell, 2003). Perhaps global scope is a benefit that can be used only when the affective state is optimal in terms of valence (positive), motivational intensity (low), and arousal (medium).

It is worth interpreting the results of the current experiment in the light of the Extensiveness vs. Intensiveness of Attention Model (Kolańczyk, 2011). In this model, extensive attention means being able to scan a broad stream of perceptual and semantic data. Intensive attention involves its concentration on the fixation area of gaze and depth focus on the features of the central object. Emotions are one of the factors altering the state of attention (Imbir, 2013, 2018)—namely, automatic originated emotions narrow the scope of attention, while reflective originated emotions broaden its scope. Since the arousal is a component of emotional reactions to stimuli, one may expect that arousal itself should influence the state of attention. The global preference manifested in the Kimchi–Palmer task may be identified with the extensive state of attention: spatial information from a broader area is processed at once, and so global preference may appear. In that light, arousal (both low and high) is the factor that promotes the intensification of attention, as expected in theory (Epstein, 2003; Kolańczyk, 2011).

The results obtained are, to some extent, different from those of other studies using words as an arousal manipulation in experiments, as in the emotional Stroop test (EST; Nigg, 2000; McKenna & Sharma, 2004). In those studies, arousal level influenced interference control of automated word reading with an explicit task of font color naming in a linear way. More arousal made the reaction times longer due to the nature of the EST task. It measures control over triggering attention by automated reading of the content of stimuli. The more arousing the content is, the more difficult it is to control interference caused by reading, which results in the lengthening of reaction times. The Kimchi–Palmer paradigm does not include the word itself within the task. The word is presented earlier and is not explicitly associated with the task; thus, the activation triggered by the word is rather unspecific and could be generalized beyond the individual's current affective state (Russell, 2003). Some other unpublished data from my lab showed effects similar to those presented in the current manuscript as observed in the flanker task and the anti-saccade task, when words are presented for a brief time before a single trial. In both cases, a reversed U-shaped relationship was found, indicating that an intermediate level of arousal is the optimal one.

The most important contribution of this study is that it compared three instead of two levels of arousal, thus demonstrating the inverse U-shaped relationship between arousal and global preference. The results corroborated the findings of other research (Huntsinger, 2013), showing that local–global scope is flexible and can change from one moment to the next. The use of a within--subjects design made it possible to confirm this within-individual flexibility, but probably some other (probably personality-related) factors influenced the flexibility of the scope of perception thus understood. Data from a group of participants who maintained their initial focus (global or local) throughout the task in the preliminary selection procedure were excluded from the main study.

In conclusion, subtle manipulation of arousal, simply by reading words known to differ in their arousing properties, influences perceptual focus and can be used to encourage people to see either the whole wood or individual trees. Intermediate levels of arousal facilitate global-level perception by encouraging one to see the wood, whereas low and high levels of arousal make the individual trees more salient.

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Appendix 1

Table present list of all words (in Polish version and translated into English) used to create factorial manipulation (3 arousal levels) as well as ratings from ANPW_R—normative study for 4905 Polish words (Imbir, 2016b) concerning arousal, subjective significance, valence, concreteness and lexical variables such as frequency of appearance based on Kazojć (2011) dataset and length (number of letters). On the last column direct associations of scope (1 = local; 9 = global), collected on a group of 23 individuals (16 females) are presented for each word used.

Polish word	English translation	Arousal category	Arousal *M*	Significance *M*	Valence *M*	Concreteness *M*	Frequency of appearance	Number of letters	Direct associations of scope
arka	ark	1	3.08	3.32	5.74	3.08	138	4	3.96
aspekt	aspect	1	2.84	3.48	5.30	6.18	555	6	2.52
czyn	deed	1	3.44	5.04	5.66	4.96	1709	4	2.91
dokument	document	1	3.22	4.48	5.30	3.00	1863	8	3.39
echo	echo	1	3.42	3.14	5.64	4.08	2696	4	5.04
emerytura	pension	1	3.42	4.36	4.90	4.18	45	9	5.22
fundusz	fund	1	3.18	3.60	5.72	4.22	308	7	5.52
gamma	gamma	1	3.06	3.30	5.12	4.73	232	5	3.96
gleba	soil	1	3.18	3.34	4.94	2.36	228	5	6.13
godzina	hour	1	3.14	4.50	5.16	5.10	4687	7	3.13
istota	being	1	3.26	5.02	5.50	4.76	4054	6	3.35
jednostka	unit	1	3.00	4.60	5.02	4.08	919	9	1.74
kawałek	chunk	1	2.94	3.52	5.16	3.65	8697	7	2.30
klan	clan	1	3.24	2.70	5.26	3.60	539	4	6.30
kolor	color	1	3.40	3.70	6.04	4.88	3616	5	4.65
krok	step	1	2.96	4.30	5.68	3.14	12259	4	3.26
laik	layman	1	3.24	3.50	4.43	5.02	52	4	3.91
lekcja	lesson	1	3.24	4.70	4.98	3.78	575	6	4.74
mgiełka	haze	1	2.88	3.28	5.88	2.82	494	7	5.09
mieszkaniec	inhabitant	1	3.18	3.46	5.38	2.78	602	11	4.65
mila	mile	1	2.86	2.66	5.46	3.96	781	4	3.35
milczenie	silence	1	3.26	4.31	4.60	4.92	5840	9	4.70
namiot	tent	1	3.56	2.92	6.24	2.04	1206	6	4.04
orbitowanie	orbit	1	3.90	2.70	5.22	4.72	2	11	5.09

osoba	person	1	3.72	5.16	5.82	3.72	5460	5	3.17
pasmo	band	1	3.14	3.02	5.38	3.54	1104	5	4.52
pauza	pause	1	3.08	3.12	5.04	4.92	552	5	3.04
poezja	poetry	1	2.78	4.48	6.06	5.08	955	6	6.35
połysk	shine	1	3.28	3.20	5.80	3.90	407	6	3.65
północ	north	1	3.37	4.16	5.76	4.68	6813	6	4.09
prasowanie	ironing	1	3.20	3.04	4.84	3.36	23	10	5.09
rzemiosło	craft	1	3.36	3.58	5.60	4.50	336	9	5.57
saga	saga	1	3.12	3.32	5.56	4.20	770	4	5.91
seria	series	1	3.26	2.84	5.28	4.70	1180	5	6.48
sfinks	sphinx	1	3.00	2.42	5.62	3.26	176	6	2.57
singiel	single	1	3.84	4.10	4.88	3.74	6	7	2.22
smuga	streak	1	3.32	3.12	4.82	3.30	931	5	3.35
tenor	tenor	1	3.32	2.18	5.44	3.60	353	5	2.96
trasa	route	1	3.42	3.84	5.50	3.04	477	5	5.39
wersja	version	1	2.86	2.58	5.22	5.38	965	6	3.48
woń	odor	1	3.26	4.20	5.44	3.76	2810	3	4.39
wykonywanie	implementing	1	3.28	4.40	5.26	4.96	243	11	4.65
zasada	rule	1	3.16	4.58	5.40	5.38	1241	6	4.09
zdanie	sentence / sense	1	3.30	4.40	5.70	4.52	7177	6	3.87
zero	zero	1	3.00	3.12	4.02	4.42	1693	4	2.43
akcent	accent	2	3.58	3.06	5.58	4.66	1076	6	3.87
Biblia	Bible	2	3.52	5.00	5.68	3.00	378	6	4.48
budżet	budget	2	4.30	4.34	5.32	3.48	243	6	5.00
bufor	buffer	2	3.47	2.78	5.20	3.88	42	5	4.39
chrzest	baptism	2	3.74	3.78	5.72	4.90	309	7	3.00
dystans	distance	2	3.58	4.44	4.84	4.68	1461	7	5.22
firma	business	2	3.82	4.32	5.66	3.06	1505	5	5.43
głębia	profundity	2	3.74	4.36	5.26	5.48	243	6	5.96
gromada	troop	2	3.90	2.78	5.40	3.36	1175	7	6.96
grupa	group	2	3.90	3.90	5.84	3.32	5460	5	6.83
hrabia	count	2	3.58	2.92	5.32	3.28	5345	6	3.04
imam	imam	2	3.59	2.85	5.00	4.14	130	4	2.87
interes	business	2	4.36	3.92	5.86	4.82	3421	7	4.96
jazda	ride	2	4.20	3.62	5.82	3.44	2101	5	4.57
lekarstwo	medicine	2	3.52	4.98	5.40	2.88	1126	9	3.91
loteria	lottery	2	4.10	3.12	5.76	3.46	56	7	5.52

marszałek	marshal	2	4.32	3.20	5.10	2.84	1315	9	2.83
mrugnięcie	wink	2	3.46	3.60	5.78	3.56	92	10	2.43
nawyk	habit	2	3.74	4.46	4.88	5.64	367	5	4.91
obserwowanie	observation	2	3.56	4.28	5.42	4.84	219	12	5.52
odcień	tint	2	3.48	3.14	5.52	4.80	1024	6	5.00
olbrzym	giant	2	4.04	2.70	4.98	3.24	1495	7	3.35
plemię	tribe	2	3.92	3.14	5.32	3.66	1018	6	7.04
poganin	heathen	2	3.66	2.94	4.64	5.10	95	7	4.52
pokaz	show	2	3.88	3.70	5.74	4.12	1035	5	4.57
posag	dowry	2	3.68	3.26	5.58	2.71	332	5	4.00
posiadacz	possessor	2	3.88	3.64	5.82	4.28	212	9	5.17
powieść	novel	2	3.50	3.96	6.08	3.88	2552	7	4.43
praca	labor	2	4.12	5.74	5.90	4.10	6395	5	5.57
profesor	professor	2	4.14	4.74	5.86	3.16	8262	8	3.30
próba	attempt	2	3.76	4.12	5.30	4.90	2756	5	4.26
sabat	Sabbath	2	4.10	2.71	4.56	5.12	913	5	4.91
sługa	servant	2	3.72	3.20	4.32	3.58	1668	5	3.91
swada	zest	2	3.68	3.51	4.77	5.00	19	5	3.78
szczegół	detail	2	3.50	4.48	5.44	4.74	1358	8	2.30
szlachta	nobility	2	4.08	2.78	5.46	3.90	811	8	6.04
ulewa	downpour	2	4.00	3.46	4.18	2.74	495	5	6.17
uwaga	note	2	4.42	5.02	4.88	5.60	3261	5	4.48
waga	weight	2	3.70	3.80	4.72	3.06	429	4	3.83
wpływ	influence	2	3.80	4.47	5.28	5.32	3586	5	5.17
wygląd	appearance	2	4.32	4.66	5.82	4.58	4185	6	5.39
wyłom	breach	2	4.02	3.06	4.42	3.20	278	5	3.22
wymiana	exchange	2	3.68	4.30	5.45	4.46	792	7	4.52
zadatki	smack	2	3.80	3.68	5.32	5.34	94	7	4.78
zaułek	alley	2	4.28	3.64	4.24	2.98	444	6	3.48
alarm	alert / alarm	3	4.48	4.80	4.16	3.42	1646	5	3.52
bieganie	running	3	4.66	4.04	5.94	3.24	90	8	5.39
buntownik	rebel	3	5.54	4.86	4.80	4.24	101	9	2.52
burza	storm	3	5.30	4.48	4.86	3.06	3238	5	6.00
car	tsar	3	4.56	2.36	4.82	2.64	1073	3	2.35
doping	doping	3	5.18	3.30	5.24	4.46	23	6	4.96
duch	spirit	3	4.76	3.24	4.16	5.46	5226	4	4.70
dziewica	virgin	3	5.00	4.18	6.18	3.38	446	8	4.00

ekstrawertyk	extrovert	3	5.17	4.59	5.28	5.64	6	12	4.57
galop	gallop	3	4.56	2.54	5.76	3.62	252	5	5.61
geniusz	genius	3	4.76	5.42	7.22	5.50	936	7	4.04
harem	harem	3	4.74	2.86	5.14	3.75	111	5	6.13
hazard	gamble	3	5.30	3.16	3.96	4.04	292	6	4.91
karykatura	pamphlet / caricature	3	4.20	2.50	5.56	3.88	131	10	3.83
koszary	barracks	3	4.72	2.82	4.44	2.96	384	7	4.74
kryminał	thriller / jail	3	5.06	3.28	4.88	3.54	111	8	4.70
labirynt	maze	3	4.52	3.68	5.16	3.20	1031	8	5.04
lesbijka	lesbian	3	5.06	3.88	4.76	3.96	26	8	3.74
majątek	fortune	3	5.04	5.28	6.54	4.02	2861	7	4.65
maniak	maniac	3	4.92	4.34	4.30	5.20	212	6	2.65
młodzież	youth	3	4.66	3.98	5.68	3.40	1703	8	7.00
mrok	gloom	3	4.48	4.06	4.18	4.24	3909	4	5.96
mutacja	mutation	3	4.64	3.30	4.42	4.34	100	7	3.35
ogień	fire	3	4.80	5.04	5.46	2.80	11105	5	4.61
orgia	orgy	3	5.82	3.48	4.90	4.30	108	5	5.48
parada	parade	3	4.08	2.76	5.64	3.42	190	6	6.52
płomień	flame	3	4.90	4.30	5.92	3.08	2856	7	4.26
poprawka	amendment	3	4.52	4.46	3.90	4.16	121	8	2.48
promieniowanie	radiation	3	4.66	3.76	4.24	4.32	705	14	4.48
salwa	salvo	3	4.70	2.74	5.56	3.51	332	5	5.00
sesja	session	3	5.06	4.54	3.76	4.34	253	5	5.22
smok	dragon	3	4.58	2.80	5.66	4.18	3438	4	2.78
sprint	sprint	3	4.54	3.28	5.68	3.64	38	6	4.00
strzał	shot	3	5.04	3.94	4.56	3.14	3675	6	3.57
szaleństwo	craze	3	6.28	4.48	5.66	6.48	2654	10	4.96
turbo	turbo	3	5.06	3.78	5.76	5.33	30	5	4.13
wampir	vampire	3	4.90	3.00	4.52	4.42	701	6	3.61
władza	authority	3	4.76	5.04	5.18	5.80	2056	6	5.26
wojsko	army	3	4.96	4.16	4.94	2.90	2893	6	6.26
wolt	volt	3	4.31	2.41	5.08	4.44	40	4	3.78
wynik	result	3	4.60	5.16	5.52	4.58	1919	5	3.17
wysiłek	effort	3	5.14	5.10	5.26	4.52	2024	7	5.22
wyścig	race	3	4.70	3.94	5.28	3.58	455	6	4.61
zombie	zombie	3	4.80	2.36	3.94	4.58	185	6	3.39
zwycięzca	winner	3	5.56	5.86	7.42	5.24	336	9	1.87