

ABSTRACT

Title of Document: THE ROLE OF EPISTEMIC MOTIVATION IN
THE LINK BETWEEN AROUSAL AND
FOCUS OF ATTENTION

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Over 60 years of research has led to a law-like acceptance of the Easterbrook (1959) hypothesis. Easterbrook (1959) famously reviewed the evidence on the arousal-attention link and concluded that as arousal increases, the range of cues utilized decreases, and the focus of attention narrows. However, the present set of eight studies suggests that the Easterbrook hypothesis needs to be seriously qualified. Recent developments in the understanding of the role of arousal in information processing suggests that rather than invariably leading to a focus of attention, arousal instead serves as information regarding the urgency and/or importance of active processing strategies (Storbeck & Clore, 2008). Because some processing strategies lead to a broadening of attention, arousal should sometimes be negatively related to a focusing of attention. A first set of four studies investigated the need for closure as it relates to the arousal-attention link. The need for closure refers to the motivation to make quick, firm judgments, and has been shown to lead to the use of fewer available

cues. Because of this, it seems that the need for closure should lead to a tendency to focus one's attention. However, when need for closure is low, individuals tend to process more available cues, broadening attention in order to avoid reaching premature closure. The results indicate that when individuals are high on the need for closure, arousal is positively related to focus of attention, whereas when individuals are low on the need for closure, arousal is negatively related to focus of attention. A second set of four studies investigated the influence of the regulatory modes of locomotion and assessment on the arousal-attention link. Because locomotion is oriented towards movement, it should lead to a focus of attention. Because assessment is oriented towards making evaluations based on comparisons among alternatives, it should lead to a broadening of attention. The results show that when a locomotion mode is active, arousal is positively related to focus of attention, whereas, when an assessment mode is active, arousal is negatively related to focus of attention.

THE ROLE OF EPISTEMIC MOTIVATION IN THE LINK BETWEEN
AROUSAL AND FOCUS OF ATTENTION

By

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Dedication

I dedicate this dissertation to Brian Lakey, who served as my first scientific mentor. His impact on my personal and professional development cannot be overstated. He is the reason I became interested in research, chose a career in academia, and was prepared to begin graduate school. He instilled in me the mindset, passion, and skills necessary to succeed as a scientist. Without him as a central figure in my life, I would not be the person I am today.

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Chapter 1: Introduction

More than 60 years of psychological research has led to the conclusion that heightened arousal leads to a focusing of attention. The Easterbrook hypothesis (1959) famously reviewed the empirical support for the relation between arousal and attention and proposed that arousal is inversely related to the range of cues utilized by the perceiver. That is, as arousal levels increase, attention is focused on a narrower range of available cues. For example, witnesses to a robbery, who are presumably highly aroused, show a “weapon focus,” in which they remember the gun, but cannot remember the robber (Christianson & Loftus, 1987; Loftus, 1979).

In addition to explaining the simple relation between arousal and focus of attention, the Easterbrook hypothesis has been used to explain the Yerkes-Dodson law. The Yerkes-Dodson law maps the relation between arousal and performance as an inverse U-shaped curve. This curvilinear relationship illustrates the performance gains at moderate levels of arousal, but performance losses at very low and very high levels of arousal. The relationship makes sense when considered according to the Easterbrook hypothesis. At low levels of arousal, attention is unfocused, which allows task-irrelevant cues to distract the perceiver, leading to impaired performance. At moderate levels of arousal, attention becomes focused such that task-irrelevant cues are not attended to, leading to improved performance. However, at high levels of arousal, further focusing of attention eliminates some task-relevant cues from attention, again leading to impaired performance.

Despite the wide acceptance of the Easterbrook (1959) hypothesis, there are reasons to believe that it needs to be seriously qualified. According to Easterbrook,

arousal should invariably lead to a focusing of attention. However, it is presently argued that under some conditions it actually leads to a broadening of attention. Recent theoretical and empirical advances in the understanding of the role of arousal suggest that it serves as information regarding the urgency or importance of active goals (Storbeck & Clore, 2008). Departing from the notion that arousal has informative value indicating the magnitude, but not the content, of individuals' epistemic motivations, it is proposed that it should lead to the focusing of attention when the activated processing goal aims at focusing, and to the broadening of attention when the activated processing goal aims at broadening of attention. This general proposition was examined in a series of eight studies investigating epistemic motivations known to influence information processing. Four studies investigated the impact of need for closure and four studies investigated the impact of the regulatory modes of locomotion and assessment on the arousal-attention link.

Empirical Support for the Easterbrook Hypothesis

The Easterbrook (1959) paper seemed to be successful in integrating much prior research, and was followed by even more empirical investigation testing its claims. One of the most impressive aspects of this research program is the number of ways in which arousal has been operationalized. In humans, whether arousal is operationalized according to individual differences in arousal level (Matthews & Brunson, 1979), physiological measurement, psychopharmacological manipulation (Anderson & Revelle, 1994), psychological threat (Bacon, 1974; Wachtel, 1968), anxiety (Tyler & Tucker, 1982; Zaffy & Bruning, 1966), or positive approach affect (Gable & Harmon-Jones, 2008), the same effect is found. That is, across specific

operations, arousal has been found to be positively related to a focusing of attention and negatively related to the range of cues utilized.

The relation between arousal and a focusing of attention found in humans has also been found in animals. As stated by Bunsey and colleagues (Bunsey, Kramer, Kesler, & Strupp, 1990, p. 277-278), manipulations “that increase an animal's level of arousal have been found to exert significant, and surprisingly uniform, effects on cue utilization. Specifically, the administration of CNS stimulants (e.g., Anderson & Hockey, 1977; Callaway, 1959; Callaway & Stone, 1960), exposure to environmental stressors, such as noise or heat (e.g., Broadbent, 1971; Bursill, 1958; Hockey, 1970), and the experimental induction of heightened emotional or motivational states (e.g., Bahrick, Fitts, & Rankin, 1952; Bruner, Matter, & Papaneck, 1955; Cohen, Stettner, & Michael, 1969; Telegdy & Cohen, 1971) have all been shown to narrow the range of cues used by the subject, which is interpreted as an increase in attentional selectivity.”

Most procedures used to measure focus of attention in tests of the Easterbrook hypothesis have employed a dual-task paradigm in which participants are instructed to complete a focal task, while simultaneously reporting instances in which peripheral stimuli are presented. For example, researchers have studied the attention allocated to secondary stimuli in dual-task paradigms using both visual (Bacon, 1974; Matthews & Brunson, 1979; Wachtel, 1968) and auditory (Bacon, 1974) cues. A series of studies showed that while performing a pursuit-meter tracking task, participants in a high arousal condition performed less well on a secondary visual detection task (Bahrick, Fitts, & Rankin, 1952; Bursill, 1958; Wachtel, 1968). Again,

the positive relation between arousal and focus of attention has been consistent, regardless of the specific instruments used to measure focus of attention.

One limitation with the paradigm that is typically used is that the focal task is explicitly more important than the peripheral task. Just as in the ‘weapon focus’ phenomenon where the gun is more important to the individual who could potentially be shot than the details of the robbers face, the focal task is more important than the peripheral stimuli. This creates a situation in which the dominant response is to focus attention in order to perform better on the focal task. In this case, the introduction of high arousal augments this general tendency to focus attention by leading to even greater focusing of attention. It may be the case that arousal is not necessarily leading to the focus of attention, but instead is magnifying the dominant processing strategy in the situation.

Arousal as Information

Although a great body of research has developed supporting the Easterbrook hypothesis, the reason for the arousal-attention link is not known. Recent theorizing on the impact of arousal on cognition has suggested that arousal “provides information about urgency or importance” (Storbeck & Clore, 2008, p. 1824). Arousal has been defined as “nonspecific physiological activation” and “nondirectional alertness” (e.g. Anderson & Revelle, 1994, p. 334). It reflects an abstraction of many lower order physiological mechanisms. Arousal is associated with activation of the sympathetic nervous system, the autonomic nervous system, or the endocrine system (Russell & Barrett, 1999). According to arousal-as-information theory, any of these sources of arousal can serve as a signal regarding urgency and/or

importance (Storbeck & Clore, 2008). Specifically, arousal should suggest how strongly an actor feels about something, and “feeling strongly about something should intensify whatever value is signaled” (Storbeck & Clore, 2008, p. 1827). In summary, arousal-as-information theory argues that “high arousal may intensify reliance on one’s currently active processing strategies” (Storbeck & Clore, 2008, p. 1831).

In support of arousal-as-information theory, research has shown that manipulations of arousal are misattributed to the targets of perception (to which the strength of the attitude is augmented). Dutton and Aron (1974) manipulated arousal by having participants either cross a high suspension bridge or a low bridge. After this manipulation, the male participants were greeted by an attractive female researcher who, as part of the debriefing, gave the participants her phone number. Participants in the high arousal condition were more likely to call the research assistant than participants in the low arousal condition, presumably because they misattributed the arousal they experienced while crossing the bridge with the strength of their attitudes toward the attractive woman. Similarly, individuals aroused by physical exercise have subsequently rated cartoons as funnier (Martin, Harlow, & Strack, 1992) and erotic films as more sexually arousing and enjoyable (Cantor, Zillman, & Bryant, 1975).

Some research has begun to investigate the role of arousal in the adoption and use of processing strategies. However, this research has been limited to the study of processing strategies derived from positive or negative emotional states (e.g., Bless, Clore, Golisano, Rabel, & Schwarz, 1996; Corson & Verrier, 2007; Hamm, Schupp,

& Weike, 2003; Gomez, Stahel, & Danuser, 2004; Storneck & Clore, 2005). For example, happy individuals tend to use a relational processing strategy (i.e., find interrelations among objects), and this effect has been shown to be augmented by inducing a highly (vs. low) arousing happy mood (Corson & Verrier, 2007).

The present research will build on these findings by investigating the role of processing strategies derived from epistemic motivations. While the study of expected processing strategies derived from positive or negative mood states lends support for arousal-as-information theory, a more direct test would manipulate processing strategies explicitly. Toward this aim, the need for cognitive closure and the regulatory modes of locomotion and assessment were manipulated. This allows for a clear test of the hypothesis regarding arousal and processing strategies. One major implication of the arousal-as-information conceptualization is that the Easterbrook Hypothesis may need to be revised. Rather than increasing levels of arousal leading to a focusing of attention, it may lead to a focusing or a broadening of attention, depending on the processing motivation that is active.

The Need for Cognitive Closure

In order to come to a conclusion while engaging in information processing, the knower must eventually terminate the search for information and render a decision or judgment. The motivation to terminate the epistemic process has been termed the need for nonspecific cognitive closure (Kruglanski, 1989). In other words, the *need for closure* reflects a desire for a firm answer to a question, any answer, as compared to confusion and ambiguity (Kruglanski & Webster, 1996). To attain this closure, the person is willing to accept any answer insofar as it affords a conclusion

that is firm. Once a plausible hypothesis has been generated and some evidence is gleaned in support of the hypothesis, the quest has been fulfilled. This motive can stem from diverse origins. For example, time pressure (Kruglanski & Freund, 1983), mental fatigue (Webster, Richter and Kruglanski, 1995), environmental noise (Kruglanski, Webster and Klem, 1993), and alcohol ingestion (Webster, 1993) have all been shown to increase the need for closure. Moreover, the need for closure can be the result of individual differences (Webster & Kruglanski, 1994). Some individuals are simply less tolerant of the uncertainties of the unknown, whereas others may actually enjoy entertaining a great number of scenarios and possibilities before coming to closure (for possible developmental influences, see Mikulincer, 1997). The motivation to continue the epistemic process has been termed the need to avoid nonspecific closure. In this case, non-commitment in the judgmental process is preferred. This can occur when a person fears invalidity in hypothesis testing or when closure may lead to unwanted restrictions in the potential for judgment. Thus, one may desire closure strongly, mildly or not at all, or even want to avoid it.

Because individuals high on the need for closure desire a termination of the epistemic process, they should be motivated to focus their attention on few cues and base their judgment on that limited information. The more information is processed, the longer the judgment task will take, and the greater the chance for inconsistent information to be detected. In line with this assumption, individuals high (vs. low) on the need for closure have been shown to terminate information search more quickly (Dougherty & Harbison, 2007; Kruglanski & Webster, 1996), to generate fewer hypotheses (Mayesless & Kruglanski, 1987), to base judgments on the most

accessible information (Ford & Kruglanski, 1995), to be more confident in their judgments (Mayesless & Kruglanski, 1987), and to experience less regret after making poor decisions (Mannetti, Pierro, & Kruglanski, 2007). In contrast, individuals low on the need for closure (or high on the need to avoid closure) should be motivated to broaden their attention in order to glean as much available evidence as possible. Based on arousal-as-information theory, these tendencies should be augmented under high arousal states. Therefore, arousal should lead to a focusing of attention for individuals high on the need for closure, whereas arousal should lead to a broadening of attention for individuals low on the need for closure.

Regulatory Modes

According to regulatory mode theory, *locomotion* reflects the tendency for the individual to initiate and maintain consistent goal-directed progress without distractions or delays (Higgins, Kruglanski, & Pierro, 2003; Kruglanski et al., 2000). In the locomotion mode, individuals emphasize movement rather than critical evaluation, preferring to stay in a state of perpetual motion. Because of this, individuals high on the locomotion tendency tend to refrain from critical evaluation if stopping to reflect impedes continuous movement. Indeed, research has demonstrated that individuals high on the regulatory mode of locomotion move faster through information processing tasks and consider fewer pieces of information (Kruglanski et al., 2000). Because of this tendency to subordinate information processing to taking action, individuals high on the regulatory mode of locomotion would be motivated to focus their attention in order to direct their movement and to ignore potentially

distracting information. Therefore, arousal should lead to a focusing of attention for individuals high on locomotion.

According to regulatory mode theory, *assessment* reflects the tendency for an individual to evaluate and critically analyze information by comparing one thing to another (Higgins et al., 2003; Kruglanski et al., 2000). High levels of assessment result in greater effort invested in activities that afford comparisons, appraisals, and critical thinking. Assessors prefer to engage in activities that allow them to evaluate, measure, or interpret information (Taylor & Higgins, 2002). For example, individuals high (vs. low) on the assessment regulatory mode scrutinized a passage more carefully and found more errors in the passage during a proofreading task in which they were provided with a ‘master copy’ that was copy edited to be free of errors and a ‘sample copy’ that they were asked to correct to be consistent with the master copy (Kruglanski et al., 2000). Because of this, individuals high on the regulatory mode of assessment should be motivated to broaden their attention, in order to process as many pieces of information as possible, affording many comparisons and evaluations. Thus, arousal should lead to a broadening of attention for individuals high on assessment.

Because the present research is testing for multiple moderators of the attention-arousal link, it is important to note that these moderators are conceptually and empirically distinct. In contrast to previous theories, regulatory mode theory conceptualizes locomotion and assessment as distinct mode of self-regulation (Higgins et al., 2003). A person’s chronic level of assessment is orthogonal to his or her chronic level of locomotion, and thus it is possible for individuals to be high on

both assessment and locomotion, low on both, or high on one and low on the other. Correlations between the scales are typically very low ($r < .15$). In addition, situational manipulations of regulatory mode typically compare a condition in which locomotion is induced to a condition in which assessment is induced (Avnet & Higgins, 2003).

Locomotion and assessment can also be distinguished from the need for closure. Conceptually, the need for closure refers to the tendency to “seize” and “freeze” on the most accessible information. That is, individuals high on the need for closure are motivated to make quick judgments that remain firm over time, allowing them to minimize times of uncertainty. While individuals high on locomotion prefer to move quickly, they are not motivated to avoid uncertainty. They are comfortable with uncertainty and strive for change. Indeed, individuals high on locomotion thrive in situations where uncertainty is high and change is taking place (Kruglanski, Pierro, Higgins, & Capozza, 2007). Rather than being concerned with the speed of closure, locomotors have been shown to prefer a decision-making style that allows them to experience progress throughout the course of information processing, focusing on a single attribute at a time (Avnet & Higgins, 2003). When using a progressive elimination strategy, in which a single attribute is considered at a time, and options are eliminated one at a time based on their standing on each attribute. It seems that this strategy would be too time consuming for an individual high on the need for closure to embrace, yet it is preferred by individuals high on locomotion. Finally, the correlation between the need for closure scale and the locomotion scale is weak ($r = .22$, meaning that less than 5% of their variance is shared; Kruglanski et al., 2000).

Therefore, the need for closure construct can be distinguished from the locomotion construct on both conceptual and empirical grounds.

Individuals high on the need to avoid closure prefer to avoid making a decision. This is different from individuals high on assessment, who prefer to make many comparisons, but who are not motivated to avoid making a decision. In fact, assessment leads to increased attention to the judgment process (Pierro, Orehek, & Kruglanski, in press). Rather than avoiding making a decision, individuals high on assessment prefer specific decision-making strategies, namely those that allow for many comparisons among alternatives (Avnet & Higgins, 2003). Finally, the correlation between need for closure and assessment is weak ($r = .12$, indicating less than 2% shared variance; Kruglanski et al., 2000). Therefore, assessment can be conceptually and empirically distinguished from the need to for closure construct.

Overview of Studies

The present research investigates the potential moderation of the arousal-attention link by processing strategies. Specifically, it was expected that need for closure, locomotion, and assessment would interact with arousal to determine the focus/breadth of attention. These studies employed two commonly-used measures of focus/breadth of attention. Kimchi and Palmer (1982) developed a task in which participants are presented with an image of a larger shape (e.g., square) that is composed of smaller shapes (e.g., triangles). Participants are then asked to determine which of two comparison images is most similar to the target. One of the images is matched in terms of the global information (e.g. shaped as a *square* and composed of squares), while the other is matched in terms of the local information (shaped as a

triangle and composed of *triangles*). Across trials, the more times a participant makes a similarity judgment based on the global composition of the shapes, the broader is the participant's attention. The number of times a participant makes a similarity judgment based on the global information indicates the breadth of his/her attention.

Another commonly used procedure has been Navon's (1977) letters task, in which a large letter is composed of smaller letters. For example, a large T may be composed of smaller Ls. Researchers have assumed that faster reactions to the local information (smaller Ls) represent a focusing of attention, whereas faster responses to the global information (larger T) reflect a broadening of attention (e.g., Tyler & Tucker, 1982). The difference in the reaction times to the global as compared to the local trials reflects a single measure of focus/breadth of attention (Forster, Friedman, Ozelsel, & Denzler, 2005).

A first set of four studies investigated need for closure, while a second set of four studies investigated locomotion and assessment. Based on the analysis above, it was predicted that individuals high on the need for closure would exhibit a positive relationship between arousal and focus of attention, whereas participants low on need for closure would exhibit a negative relation between arousal and focus of attention. Also, individuals high on the regulatory mode of locomotion should exhibit a positive relation between arousal and focus of attention, whereas individuals high on the regulatory mode of assessment should exhibit a negative relation between arousal and focus of attention.

Because the Easterbrook hypothesis is firmly entrenched as a basic psychological principle, it is especially important to meticulously test the proposed alternative. Toward this aim, each variable will be operationalized using multiple methods. Each specific operation undoubtedly includes the measurement or manipulation of additional variables beyond the variable of interest. By using multiple methods, we can be more confident that the variables of interest are driving the effect. One particularly important consideration in the present set of studies has to do with the valence of the arousal manipulations. Past research has found support for the Easterbrook hypothesis for both positively-valenced and negatively-valenced arousal. Across studies, arousal will be manipulated in each way, underscoring the generality of the findings. This detail is also important because one possible alternative explanation would suggest that the valence of the stimuli is driving the effects rather than simply arousal. If the effect is found for both positively and negatively-valenced arousal, then an explanation based on the valence of the arousal would be ruled out.

Another feature of the current studies is that they use both correlational and experimental methods. The correlational studies rely on well-established scales developed to assess the need for closure, regulatory mode, arousal, and focus of attention variables. The disadvantage of these studies is that they do not allow causal inferences to be made about the relations among the variables. The experimental designs build on these studies by allowing for such conclusions to be reached. Studies 1-4 tested the potential moderating of the arousal-attention link by need for

closure. Studies 5-8 investigated regulatory mode as a potential moderator of the link between arousal and attention.

To test the predictions regarding need for closure, participants in a first study completed a dispositional need for closure scale, a state measure of their arousal, and Kimchi and Palmer's (1982) measure of focus of attention. In order to replicate the findings from this study using an experimental design, a second study manipulated need for closure and positively-valenced arousal, and measured focus of attention (again using the Kimchi and Palmer measure). A third study attempted to extend these results when negatively-valenced arousal was induced. A fourth study attempted to replicate the previous studies and extend their results to a different measure of focus of attention (Navon's letters task).

To test the predictions regarding the regulatory modes of locomotion and assessment, participants in a fifth study completed dispositional measures of locomotion and assessment, a state measure of arousal, and Navon's (1977) letters task as a measure of focus of attention. A sixth study experimentally manipulated locomotion versus assessment and positively-valenced arousal, and measured focus of attention using Navon's (1977) measure. A seventh study manipulated locomotion versus assessment, positively-valenced arousal, and measured focus of attention using Kimchi and Palmer's (1982) measure. An eighth study manipulated locomotion versus assessment, negatively-valenced arousal, and measured focus of attention using Kimchi & Palmer's (1982) measure.

These studies were designed to test the hypotheses using multiple research methodologies in such a way that need for closure, regulatory mode, and arousal are

each both measured and manipulated. The arousal variable was operationalized using both positively-valenced and negatively-valenced stimuli. In addition, arousal was measured and manipulated using both verbal stimuli (i.e., passages and Likert scales) and also nonverbal stimuli (i.e., pictures). Across studies, the valence and the mode of presentation was crossed. Finally, the focus of attention variable was measured using both a reaction time measure (Navon, 1977) and a similarity-based decision task (Kimchi & Palmer, 1982). The focus of attention tasks were crossed with the various other changes to ensure maximum generalizability. An overview of the research design is presented in Table 1.

Table 1. Overview of Research Designs

Study	Arousal Valence	Arousal Stimuli	Moderator	Moderator Operation	Focus of Attention
1	Measured		NFC	Measured	K & P
2	Positive	Passages	NFC	Manipulated	K & P
3	Negative	Pictures	NFC	Manipulated	K & P
4	Negative	Pictures	NFC	Manipulated	Navon
5	Measured		Reg Mode	Measured	Navon
6	Positive	Pictures	Reg Mode	Manipulated	Navon
7	Positive	Pictures	Reg Mode	Manipulated	Navon
8	Negative	Passages	Reg Mode	Manipulated	K & P

If the predicted pattern of results is found across the eight studies, then the Easterbrook hypothesis will need to be revised. Rather than invariably leading to a focus of attention, the link between arousal and attention will depend on the active

processing strategy, with arousal leading to a focusing of attention under high need for closure and high locomotion and leading to a broadening of attention under low need for closure and high assessment. In addition, the arousal-as-information theory (which is currently at odds with the widely accepted Easterbrook hypothesis) will have been supported. In addition, the results would have important implications for the impact of need for closure, locomotion, and assessment, while also suggesting similar implications for other processing strategies. This would mark a significant change to a core aspect of psychological knowledge.

Chapter 2: The Present Research

Study 1

As an initial test of the hypotheses, participants completed measures of their dispositional need for cognitive closure and state arousal level. In addition, participants completed a measure of focus/breadth of attention. Based on the foregoing analysis, an interaction between arousal and need for closure was predicted, such that arousal would be positively related to a focus of attention for those high on the need for cognitive closure, but would be negatively related to focus of attention for those low on the need for closure.

Method

Participants

Fifty-three undergraduates (39 female, 14 male) at the University of Maryland enrolled in psychology courses participated in exchange for course credit. The age of participants ranged from 18 to 28 years, with a mean age of 21.1 years.

Procedure

Participants first completed the need for closure scale, followed by the perceived arousal scale. Participants then completed a measure of focus of attention. The arousal scale was measured second because arousal is conceptualized as sensitive to momentary internal and environmental changes. As such, the greater the proximity to the attention task, the more valid should be its measurement. In contrast, the need for closure scale is conceptualized as a relatively stable trait in which a slight (i.e., a few minutes) difference in the time of administration should not alter scores on the

scale. All measures were completed on a computer in a private room in a psychology laboratory.

Need for Cognitive Closure. Participants completed the need for closure scale (Webster & Kruglanski, 1994), as revised by Roets and Van Hiel (2007). The revised scale substitutes six new items on the decisiveness subscale for eight previously used items. The revised scale contains 41 items to which participants respond on a Likert scale, with response options ranging from 1 (strongly disagree) to 6 (strongly agree). Sample items include, “Any solution to a problem is better than remaining in a state of uncertainty” and “I prefer to be with people who have the same ideas and tastes as myself.” After reverse scoring appropriate items, the mean of the 41 items serves as a composite score, with higher scores indicating greater need for closure. The revised scale has been shown to load on a single factor, and to be reliable (Roets & Van Hiel, 2007). In this sample, Chronbach’s alpha was .85.

Perceived Arousal. Participants completed the 24-item perceived arousal scale (Anderson, Anderson, & Deuser, 1996; Anderson, Deuser, & DeNeve, 1995). This scale measures state arousal, using a self-report Likert scale, anchored at the ends with 1 (very slightly or not at all) and 5 (extremely). Sample items include “drowsy,” “exhausted,” “alert,” and “excited.” After reverse scoring appropriate items, a composite score is computed by averaging across items. Chronbach’s alpha for this scale was .90.

Focus of Attention. Participants completed Kimchi and Palmer’s (1982) local-global processing task. In this task, participants are presented with an image in which a larger shape (e.g. square) is composed of smaller shapes (e.g. triangles).

Participants are then asked to determine which of two comparison images is most similar. One of the images is matched in terms of the global information (shaped as a square, but composed of squares), while the other is matched in terms of the local information (composed of triangles, but shaped as a triangle). Participants completed 16 items, depicted on page 526 of Kimchi and Palmer (1982). The number of items in which a global response was given was used as an indication of the breadth of the perceiver's attention (Gable & Harmon-Jones, 2008).

Results

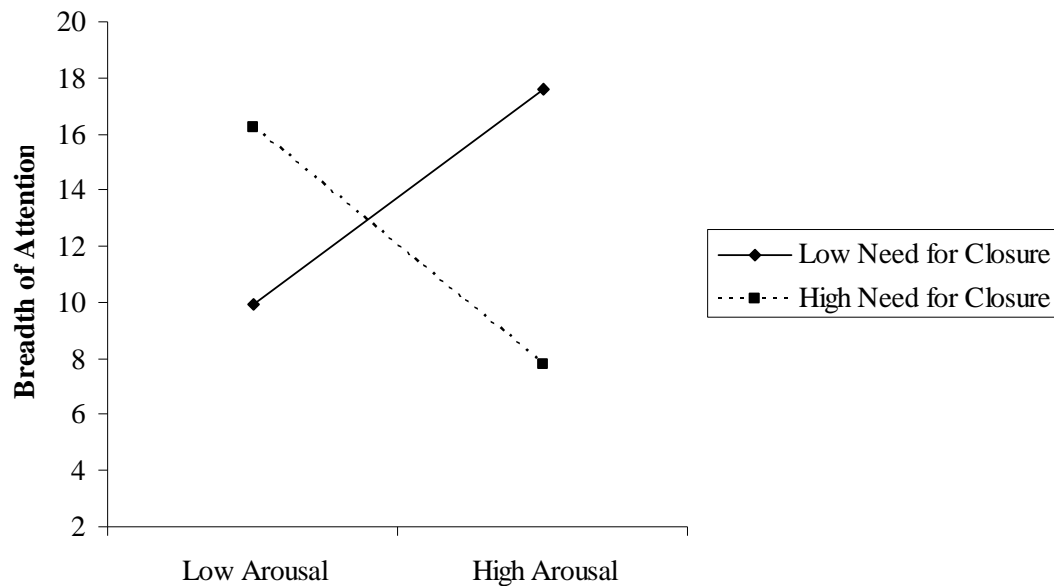
A regression analysis was performed to test the predicted interaction between need for closure and arousal, with both measures entered as continuous variables. Following the recommendation of Aiken and West (1991), the variables were centered, and the interaction terms were based on these centered scores. As shown in Table 2, the analysis revealed a significant interaction between need for closure and arousal ($\beta = -.421, t = 3.29, p = .002$). To decompose this interaction, Aiken and West's (1991) procedure for plotting the lines one standard deviation above and below the mean of the moderator (need for closure) was followed, as shown in Figure 1. To further probe the nature of the interaction effects, between arousal and need for closure, a simple slopes analysis was performed in accordance with Aiken and West's (1991) recommendation. This analysis revealed that the relationship between arousal and breadth of attention was significantly positive for individuals low on need for closure ($\beta = .33, t = 2.0, p = .05$), whereas the relationship between arousal and breadth of attention was significantly negative for individuals high on the need for closure ($\beta = -.41, t = -2.33, p = .024$).

Table 2. Summary of Regression Analysis (Study 1)

Variable	B	SE(B)	β	t	p
Need for Closure	-.89	.86	-.13	-1.04	.31
Arousal	-.22	.68	-.04	-.32	.75
NFC X Arousal	-4.02	1.22	-.42	-3.29	.002

$R^2 = .21$

Figure 1. The effect of need for closure and arousal on breadth of attention (Study 1)



Discussion

The results from Study 1 are consistent with the hypotheses. Individuals dispositionally high on the need for closure exhibited a positive relationship between

arousal and focus of attention, whereas individuals low on the need for closure exhibited a negative relation between arousal and focus of attention. These results provide initial support for the prediction that processing strategy would interact with the level of arousal to determine focus/breadth of attention. Based on the results of this study, it seems that in contrast to the Easterbrook hypothesis, arousal is associated with a broadening of attention for individuals low on the need for closure.

Although the results from the first study are consistent with the predictions, both the arousal and need for closure variables were measured rather than manipulated. The present conceptual framework argues that the need for closure and arousal variables cause the level of focus/breadth of attention. However, Study 1 does not allow us to test such a claim due to the correlational method. Therefore, a second study was designed in order to address this issue. In Study 2, both the need for closure and the arousal variables were experimentally manipulated.

Study 2

The aim of Study 2 is to conceptually replicate the findings from Study 1 using an experimental design. Specifically, need for closure was manipulated by having participants recall times in which they sought closure or times in which they avoided closure. Arousal was manipulated by having participants read arousing passages or neutral passages. Focus/breadth of attention was measured using the same procedure as Study 1.

Method

Participants

Seventy-five University of Maryland undergraduates enrolled in psychology courses (50 women, 25 men) participated in exchange for credit in their psychology course. Participants' age ranged from 18 to 24, with a mean age of 20.1.

Procedure

Need for Cognitive Closure. To manipulate need for closure, a modified version of the behavior recall paradigm used by Avnet and Higgins (2003) was used. Avnet and Higgins (2003) manipulated regulatory mode by having participants recall times in which they behaved as assessors or as locomotors (the two possible regulatory modes). To do this, participants were asked to "think back to times in which they ..." followed by an item from the regulatory mode scale. In each condition, three items consistent with the induced regulatory mode were used. In the present study, six items from the need for closure scale were used. In the high need for closure condition, participants recalled times in which they "believed that orderliness and organization are among the most important characteristics of a good student," "quickly became impatient and irritated when I did not find a solution to a problem immediately," and "felt irritated when one person disagreed with what everyone else in a group believed." In the high need to avoid closure condition, participants recalled times in which "Even after you made up your mind about something, you were eager to consider a different opinion," "When thinking about a problem, you considered as many different options on the issue as possible," and "Disliked the routine aspects of your work or studies."

Arousal. To manipulate arousal, participants read passages derived from the Affective Norms for English Text (ANET; Bradley & Lang, 2007) database of

passages pre-tested with respect to level of arousal. Participants in all conditions were told that the passages are being pre-tested for a future experiment, and that we would like them to rate how arousing and positive each picture is using the self assessment manikin (SAM; Lang, 1980). Participants in the *high arousal condition* were presented with sentences pre-tested to be arousing. Participants in the *low arousal condition* were presented with sentences low on arousal. In this study, we used pictures pre-tested to be arousing and positively-valenced in the high arousal condition. Pictures in the low arousal condition were neutral in valence.

Manipulation Check. The rating of their arousal level on the SAM while reading the passages serves as a manipulation check on the efficacy of the arousal manipulation. This measure asks participants to rate on a 9-point scale the extent to which they are feeling aroused. The points are associated with a cartoon image expressing low to high states of arousal and valence.

Breadth of Attention. Participants completed the same local-global processing task as in Study 1 (Kimchi & Palmer, 1982).

Results

Manipulation Check

To check the efficacy of the arousal manipulation, the responses to the SAM arousal scale were analyzed using a 2 (Need for Closure: Low versus High) x 2 (Arousal: Low versus High) between-subjects ANOVA. This analysis revealed a significant main effect for arousal condition, such that participants in the high arousal condition reported significantly higher levels of arousal ($M = 6.55$, $SE = .25$) than did

participants in the low arousal condition ($M = 3.19$, $SE = .27$), $F(1, 71) = 82.41$, $p < .001$. No other significant effects emerged, all F s < 1 .

Breadth of Attention

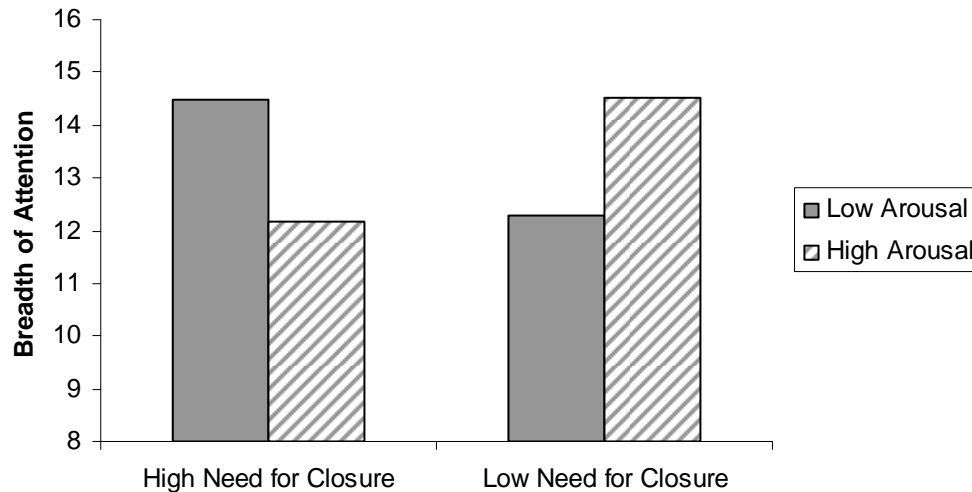
To investigate the influence of the experimental manipulations on breadth of attention, a 2 (Need for Closure: Low versus High) x 2 (Arousal: Low versus High) between-subjects ANOVA was conducted. As shown in Table 3, this analysis revealed a significant interaction between need for closure and arousal, $F(1, 71) = 8.71$, $p < .01$. Under high need for closure, participants in the high arousal condition ($M = 12.16$, $SE = .77$) exhibited lesser breadth of attention than participants in the low arousal condition ($M = 14.47$, $SE = .81$), $F(1, 71) = 4.32$, $p < .05$. Under low need for closure, participants in the high arousal condition ($M = 14.52$, $SE = .73$) exhibited greater breadth of attention than participants in the low arousal condition ($M = 12.28$, $SE = .79$), $F(1, 71) = 4.40$, $p < .05$. These means for each condition are depicted in Figure 2.

Table 3. Summary of Analysis of Variance (Study 2)

Source	SS	DF	MS	F
Need for Closure	.14	1	.14	.91
Arousal	.02	1	.002	.97
NFC x Arousal	96.23	1	96.83	8.71*
Error	789.61	71	11.12	

* $p < .05$

Figure 2. The effect of need for closure and arousal on breadth of attention (Study 2).



Discussion

The data from Study 2 conceptually replicate the results from Study 1 when both the need for closure and the arousal variables were experimentally manipulated. Specifically, it was predicted and found that individuals high on the need for closure exhibited greater focusing of attention under high (vs. low) states of arousal, whereas individuals low on the need for closure exhibited greater broadening of attention under high (vs. low) states of arousal. These results build on those of Study 1 by allowing for the conclusion that need for closure and arousal jointly cause a focusing/broadening of attention.

However, because the arousal manipulation was also positively-valenced, it is possible that the moderation of the arousal-attention link by need for closure is limited to cases in which the arousal is positive. It is possible that the presentation of positive stimuli after the need for closure variables served as an indication that the

need for closure was desirable (Clore et al., 2001). This explanation would undermine the conclusion that need for closure moderates the arousal-attention link. An additional study inducing negatively-valenced arousal would address this issue. This alternative explanation would not apply to cases in which need for closure moderates the link between negatively-valenced arousal and focus/breadth of attention. Therefore, a third study was conducted in which the arousal inducing stimuli were negatively-valenced.

Study 3

Two changes were made in the experimental design in order to increase the confidence in the interpretation of the results thus far. First, the arousal induction was negatively-valenced. Second, the arousal induction utilized pictures rather than passages. This study is therefore seeking to replicate the findings of the first two studies using a third operation of the arousal variable. As in the previous study, need for closure was manipulated using the behavior recall paradigm and focus of attention was measured using Kimchi and Palmer's (1982) task.

Method

Participants

Sixty undergraduate psychology students participated in exchange for course credit. Thirty eight participants were women, and twenty-two participants were men, with participant age ranging from 18 to 29 ($M = 21.2$).

Procedure

Need for Cognitive Closure. Need for closure was manipulated using the same procedure as in Study 2.

Arousal. To manipulate participants' arousal, participants were presented with pictures from the International Affective Picture System (IAPS; Lang, Bradley & Cuthbert, 2005). Participants in all conditions were told that the pictures were being used to clear their mind before performing another cognitive task. Then seven pictures will be presented for 12 seconds each (Orehek, Bessarabova, Chen, & Kruglanski, 2009). Participants in the *high arousal* condition were presented with pictures pre-tested to be arousing. Participants in the *low arousal* condition will be presented with pictures pre-tested to be non-arousing. In this study, the arousing pictures were rated as negatively-valenced in pre-testing.

Breadth of Attention. Participants completed the same local-global processing task as in Studies 1 and 2 (Kimchi & Palmer, 1982).

Results

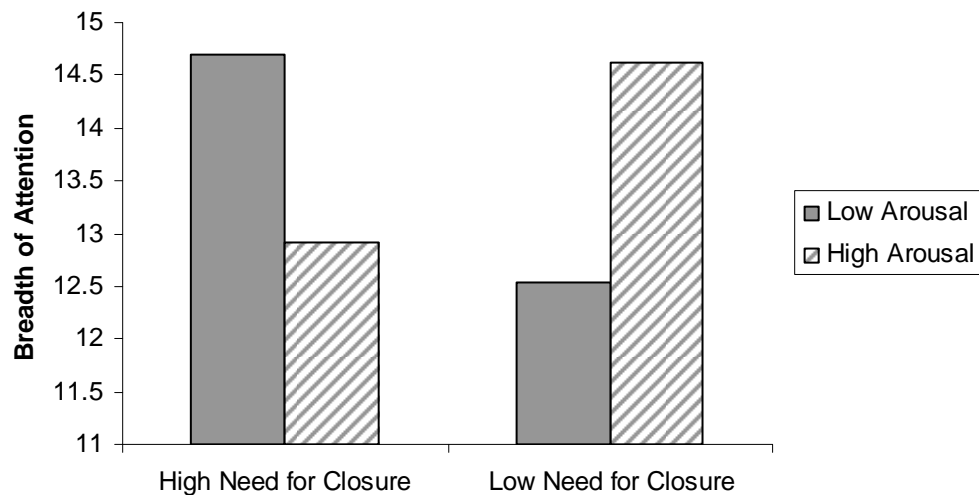
To test the hypotheses regarding breadth of attention, a 2 (Need for Closure: High vs. Low) x 2 (Arousal: High vs. Low) between-subjects ANOVA was conducted. As shown in Table 4, this analysis revealed a significant two-way interaction, $F(1, 56) = 10.92, p < .01$. The cell means are displayed in Figure 3. In the high need for closure condition, participants' attention was broader under low arousal ($M = 14.69, SE = .56$) than under high arousal ($M = 12.92, SE = .62$), $F(1, 56) = 4.41, p < .05$. In the low need for closure condition, participants' attention was broader under high arousal ($M = 14.63, SE = .56$) than under low arousal ($M = 12.53, SE = .58$), $F(1, 56) = 6.68, p < .05$.

Table 4. Summary of Analysis of Variance (Study 3)

Source	SS	DF	MS	F
Need for Closure	.76	1	.76	.15
Arousal	.40	1	.40	.08
NFC x Arousal	55.36	1	55.36	10.92**
Error	283.84	56	5.07	

** $p < .01$

Figure 3. The effect of need for closure and arousal on breadth of attention (Study 3)



Discussion

The results from Study 3 conceptually replicate the findings from Studies 1 and 2. Whereas Study 2 induced positively-valenced arousal, Study 3 induced negatively-valenced arousal. Consistent with prior research (Bacon, 1974; Gable & Harmon-Jones, 2008; Tyler & Tucker, 1982; Wachtel, 1968; Zaffy & Bruning, 1966),

it seems that both positively-valenced and negatively-valenced arousal have the same effect on focus/breadth of attention. Therefore, it seems that arousal is causing the level of focus/breadth of attention rather than the valence of the stimuli, as would be expected based on previous research. Across the three studies, three operations of the arousal variable and two operations of the need for closure variable have produced the same pattern of findings. Taken together, the first three studies provide strong support for the notion that arousal and need for closure interact to determine focus/breadth of attention.

Yet, each of the first three studies measured focus/breadth of attention with the Kimchi and Palmer (1982) measure. Therefore, it is important to show that this effect can be generalized to another commonly-used measure of focus/breadth of attention. Study 4 was designed to test this possibility. Whereas the Kimchi and Palmer (1982) measure asks participants to make a similarity judgment, Navon's (1977) letter's task, used in Study 4, asks participants to respond as quickly and as accurately about the presence of a letter. In this case, the time it takes participants to locate the stimuli is used to measure focus/breadth of attention. On some trials, focused attention would lead to faster responses, while broadened attention would lead to faster responses on other trials. This way, we can see whether the results extend beyond a judgment in which participants can take as long as they would like to respond.

Study 4

The experimental design used in the fourth study was identical to that of Study 3, except for the measure of focus/breadth of attention. In this Study, the

Kimchi and Palmer (1982) measure was replaced by Navon's (1977) letters task. Need for closure was once again manipulated by having participants recall times in which they sought closure or times in which they avoided closure and arousal was manipulated by having participants view negatively-valenced arousing pictures or neutral pictures.

Method

Participants

Fifty University of Maryland undergraduates enrolled in psychology courses participated (31 women, 19 men). The age of participants ranged from 18 to 28, with a mean age of 20.9. They were compensated in the form of credit in their psychology course.

Procedure

Need for Cognitive Closure. Need for closure was manipulated using the same procedure as in Studies 2 and 3.

Arousal. Arousal was manipulated in the same way as Study 3.

Focus of Attention. As a measure of focus of attention, participants completed Navon's (1977) letters task. As in prior research (e.g. Forster, et al., 2005; Gable & Harmon-Jones, 2008; Tyler & Tucker, 1982), participants were presented with large letters composed of smaller letters. In this task, an orienting + appears on the screen for 500ms, followed by the letter image. Participants are instructed to press one key (left shift) if the image contains a T, but another key (right shift) if the image contains an H. On global trials, a large T or H is composed of smaller Ls or Fs. On local trials, a large L or F is composed of smaller Ts or Hs. As a measure of focus of

attention, the average response latency to global trials is subtracted from the average response latency to local trials, with higher scores representing greater global focus of attention (Forster et al., 2005). Participants completed 48 global trials and 48 local trials. Because responses to incorrect responses would be difficult to interpret, only correct responses were included in data analysis. Following prior research (e.g. Forster, et al., 2005; Gable & Harmon-Jones, 2008; Tyler & Tucker, 1982), responses over three standard deviations from the mean were excluded from analysis in order to limit the influence of outliers.

Results

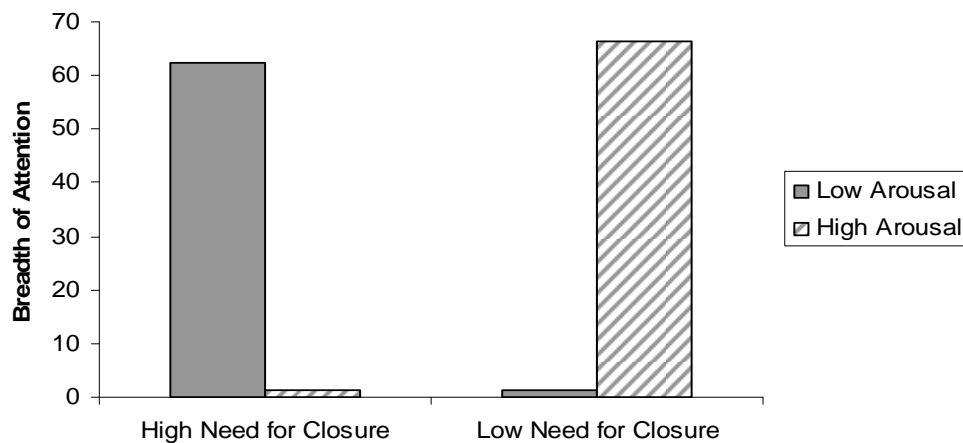
This study employed a 2 (Need for Closure: Low versus High) x 2 (Arousal: Low versus High) between-subjects factorial design. As shown in Table 5, this analysis revealed a significant interaction between need for closure and arousal, $F(1, 46) = 8.77, p < .01$. Under high need for closure, participants in the high arousal condition exhibited lesser breadth of attention ($M = 1.28, SE = 21.59$) than participants in the low arousal condition ($M = 62.32, SE = 19.31$), $F(1, 46) = 4.44, p < .05$. Under low need for closure, participants in the high arousal condition exhibited greater breadth of attention ($M = 66.39, SE = 22.55$) than participants in the low arousal condition ($M = 1.30, SE = 21.59$), $F(1, 46) = 4.35, p < .05$. The means for each cell are can be seen in Figure 4.

Table 5. Summary of Analysis of Variance (Study 4)

Source	SS	DF	MS	F
Need for Closure	51.54	1	51.54	.01
Arousal	50.50	1	50.50	.01
NFC x Arousal	49069.13	1	49069.13	8.77**
Error	275375.28	46	5595.12	

** $p < .01$

Figure 4. The effect of need for closure and arousal on breadth of attention (Study 4)



Discussion

The results from Study 4 extend the findings from the first three studies to a reaction time based measure of focus/breadth of attention. Taken together, the results from the need for closure studies consistently confirm the hypotheses. The hypotheses, derived from arousal-as-information theory (Storbeck & Clore, 2008) and lay epistemic theory (Kruglanski, 1989), suggest an important revision to the

Easterbrook (1959) hypothesis. Rather than a simple, direct link between heightened levels of arousal and a focusing of attention, this link depends on the epistemic motivation of the person. When the processing motivation engenders a focusing of attention, as is the case with high need for closure, then arousal leads to a focusing of attention. However, when the processing motivation engenders a broadening of attention, as is the case with low need for closure (or high need to avoid closure), arousal leads to a broadening of attention. Yet this interaction can be understood according to a simple observation, namely, that arousal signals the urgency or importance of a processing strategy (Storbeck & Clore, 2008). The studies on need for closure are the first to search for such a processing strategy. In all, this pattern of results was found across four studies that employed two operations of the need for closure variable, three operations of the arousal variable, and two operations of the attention variable, utilizing both correlational and experimental designs.

Although such a moderation of the arousal-attention link by need for closure is interesting, the more general point to be made is that processing strategy should interact with arousal to determine whether attention is focused or broadened. This point would be much stronger if the same effect was found for additional processing strategies beyond the need for closure. The next four studies were designed to test such a possibility by investigating the interaction between the regulatory modes of locomotion and assessment and arousal on focus/breadth of attention.

Study 5

Study 5 was designed to investigate the possibility that the findings from the first four studies can be extended to other processing motivations relevant to the

breadth of attention; specifically, the regulatory modes of locomotion and assessment. As in Study 1, the motivational variables (locomotion and assessment) were assessed via an individual difference self-report scale designed to tap relatively stable dispositions. Following this, participants completed the same measure of state arousal as in Study 1. Finally, participants completed Navon's (1977) letters task as a measure of breadth of attention, as used in Study 4.

Method

Participants

Sixty-two undergraduate students (47 female, 15 male) enrolled in a psychology course participated in exchange for course credit. Participants' age ranged from 18 to 30, with a mean age of 20.7.

Procedure

Regulatory Mode. The locomotion and assessment scales (Kruglanski et al., 2000) constitute two separate 12-item self-report measures designed to tap individual differences in these orientations. Specifically, respondents rated the extent to which they agree with self-descriptive statements reflecting *locomotion* (e.g., "By the time I accomplish a task, I already have the next one in mind") or *assessment* (e.g., "I spend a great deal of time taking inventory of my positive and negative characteristics"). Ratings were made on a 6-point Likert scales with the response alternatives anchored at the ends with 1 (*strongly disagree*) to 6 (*strongly agree*). Two composite scores (one for Locomotion and one for Assessment) were computed by averaging across items after appropriate items were reverse scored. Chronbach's alpha for the locomotion scale was .81, and for the assessment scale was .78.

Perceived Arousal. Participants completed the same 24-item arousal scale used in Study 1 (Anderson et al., 1996; Anderson, et al., 1995). In this sample, Chronbach's alpha was .88.

Focus of Attention. Participants completed Navon's (1977) letters task as in Study 4. Again, the average response latencies to global trials were subtracted from the average response latencies to local trials, with higher scores representing greater global focus of attention (Forster et al., 2005).

Results

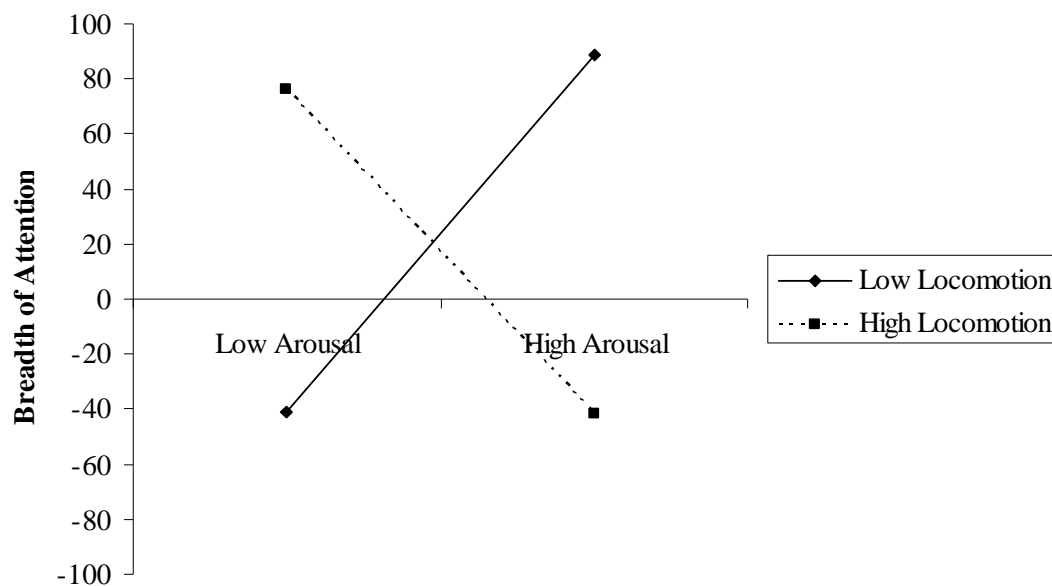
Two regression analyses were performed to test the predicted interaction between regulatory mode and arousal. In the first regression analysis, locomotion and arousal were both entered as continuous variables. The variables were centered, and the interaction terms were based on these centered scores (Aiken & West, 1991). The analysis revealed a significant interaction between locomotion and arousal ($\beta = -.36$, $t = 2.89$, $p = .01$), shown in Table 6. To decompose this interaction, the lines were plotted one standard deviation above and below the mean of the moderator (locomotion). This interaction is depicted in Figure 5. To further probe the nature of the interaction effects between arousal and locomotion, a simple slopes analysis was performed (Aiken & West, 1991). This analysis revealed that the relationship between arousal and breadth of attention was significantly positive for individuals low on locomotion ($\beta = .38$, $t = 2.11$, $p = .04$), whereas the relationship between arousal and breadth of attention was negative for individuals high on locomotion ($\beta = -.33$, $t = -1.93$, $p = .058$).

Table 6. Summary of Regression Analysis for Locomotion (Study 5)

Variable	B	SE(B)	β	<i>t</i>	<i>p</i>
Locomotion	-3.38	12.47	-.03	-.27	.79
Arousal	2.30	14.44	.03	.21	.84
Loc X Arousal	-61.92	21.43	-.36	-2.89	.01

$R^2 = .13$

Figure 5. The effect of locomotion and arousal on breadth of attention (Study 5)



In the second regression analysis, assessment and arousal were both entered as continuous variables. Again, the variables were centered, and the interaction terms were based on these centered scores. Table 7 shows that the analysis revealed a significant interaction between assessment and arousal ($\beta = .36, t = 2.93, p = .01$). To

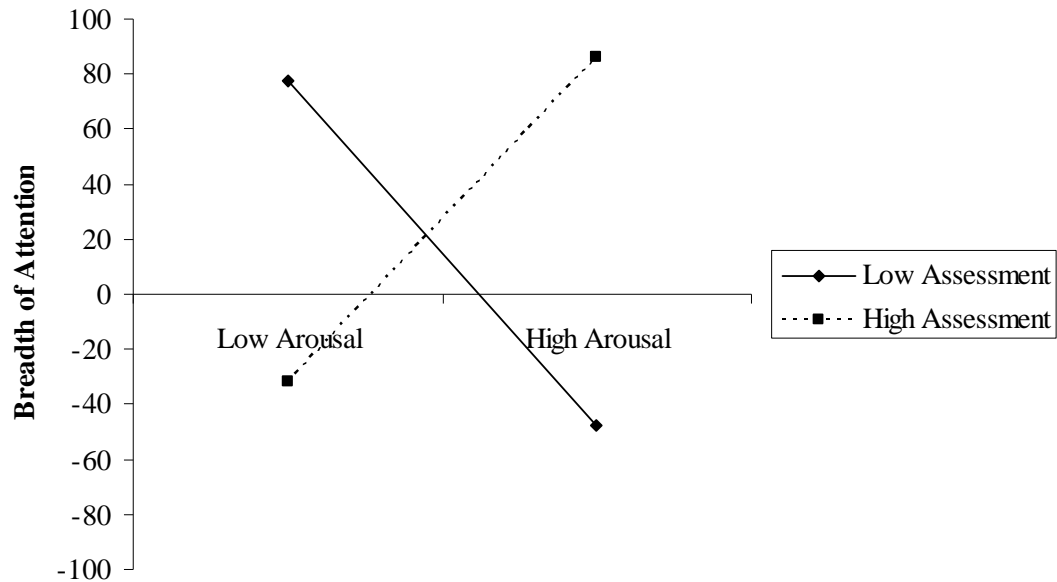
decompose this interaction, as shown in Figure 6, the lines were plotted one standard deviation above and below the mean of the moderator (assessment). To further probe the nature of the interaction effects between arousal and assessment, simple slopes analyses were carried out (Aiken and West, 1991). These analyses revealed that the relationship between arousal and breadth of attention was significantly negative for individuals low on assessment ($\beta = -.35, t = -2.01, p = .049$), whereas the relationship between arousal and breadth of attention was positive for individuals high on assessment ($\beta = .32, t = 1.98, p = .053$).

Table 7. Summary of Regression Analysis for Assessment (Study 5)

Variable	B	SE(B)	β	t	p
Assessment	6.11	14.48	.06	.48	.63
Arousal	-1.67	14.48	-.01	-.12	.91
Assess X Arousal	60.89	20.77	.36	2.93	.01

$R^2 = .14$

Figure 6. The effect of assessment and arousal on breadth of attention (Study 5)



Discussion

The results from Study 5 confirm the predictions with respect to locomotion and assessment. A positive relationship between arousal and focus of attention was found for individuals dispositionally high on the locomotion tendency and low on the assessment tendency. A negative relationship between arousal and focus of attention was found for individuals dispositionally low on the locomotion tendency and high on the assessment tendency. These results provide initial support for the prediction that the regulatory modes of locomotion and assessment would moderate the arousal-attention link. Importantly, they build on the findings from the need for closure studies by providing support for the more general point that processing strategies should interact with arousal to determine focus/breadth of attention.

Although the results of this study provide support for the predictions, the correlational nature of the design prevents any conclusions regarding the causal roles

of regulatory mode and arousal in determining focus/breadth of attention. Therefore, Study 6 was designed in order to test the predicted causal relationship by experimentally manipulating the regulatory mode and arousal variables.

Study 6

An experimental design was used in Study 6 in order to conceptually replicate the findings from Study 5. Specifically, regulatory mode was manipulated using the behavior recall paradigm in which participants recall times when they successfully operated in a locomotion mode or successfully operated in an assessment mode. Arousal was manipulated by presenting participants with positively-valenced arousing pictures or neutral pictures. Focus of attention was again measured using Navon's (1977) letters task.

Method

Participants

Fifty-nine University of Maryland undergraduates enrolled in psychology courses participated in exchange for course credit. Thirty-nine participants were female, and twenty were male. The age of participants ranged from 18 to 28, with a mean age of 21.1.

Procedure

Regulatory Mode. To manipulate regulatory mode, the behavior recall paradigm used by Avnet and Higgins (2003) will be used. Avnet and Higgins (2003) manipulated regulatory mode by having participants recall times in which they behaved as assessors or as locomotors. To do this, participants were asked to “think

back to times in which they ...” followed by an item from the regulatory mode scale. In each condition 3 items consistent with the regulatory mode were used. For the locomotion condition, participants recalled times in which they “acted like a ‘doer,” “finished one project and did not wait long before you started a new one,” and “decided to do something and you could not wait to get started.” In the assessment condition, participants recalled times in which they “compared yourself with other people,” “thought about your positive and negative characteristics,” and “critiqued work done by others or yourself.”

Arousal. Arousal was manipulated using the same general procedures as Studies 3 and 4 by presenting participants with seven pictures from the IAPS for 12 seconds each (Lang, et al., 2005). In contrast to Studies 3 and 4, participants in the high arousal condition were presented with positively-valanced arousing pictures. In the low arousal condition, participants were presented with neutral pictures.

Breadth of Attention. Participants completed the same letter’s task (Navon, 1977) as in Studies 4 and 5.

Manipulation Check. To check the efficacy of the arousal manipulation, participants completed the 24-item perceived arousal scale used in Studies 1 and 5 (Anderson et al., 1996; Anderson, et al., 1995).

Results

Manipulation Check

To check the efficacy of the arousal manipulation, a 2 (Regulatory Mode: Locomotion vs. Assessment) x 2 (Arousal: Low vs. High) between-subjects ANOVA was conducted. This analysis revealed a main effect for arousal condition, $F(1, 55) =$

9.81, $p < .01$. As was expected, participants reported higher levels of arousal in the high arousal condition ($M = 3.09$, $SE = .13$) than in the low arousal condition ($M = 2.50$, $SE = .14$). All other effects were nonsignificant (All F s < 1).

Breadth of Attention

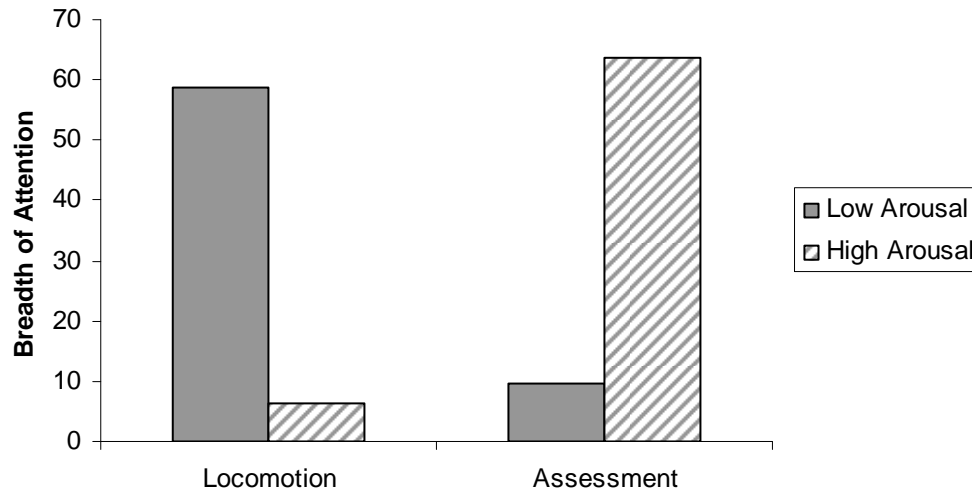
To test the hypotheses regarding breadth of attention, a 2 (Regulatory Mode: Locomotion versus Assessment) x 2 (Arousal: Low versus High) between-subjects ANOVA was conducted. As shown in Table 8, this analysis revealed an interaction between regulatory mode and arousal, $F(1, 55) = 9.47$, $p < .01$. Figure 7 displays the means for each of the four cells. Individuals operating in a locomotion mode exhibited lesser breadth of attention in the high arousal condition ($M = 6.19$, $SE = 16.55$) than the low arousal condition ($M = 58.71$, $SE = 17.09$), $F(1, 55) = 4.87$, $p < .05$. Individuals operating in an assessment mode exhibited greater breadth of attention in the high arousal condition ($M = 63.63$, $SE = 17.09$) than the low arousal condition ($M = 9.78$, $SE = 18.36$), $F(1, 55) = 4.61$, $p < .05$.

Table 8. Summary of Analysis of Variance (Study 6)

Source	SS	DF	MS	F
Regulatory Mode	265.74	1	265.74	.06
Arousal	6.46	1	6.46	.001
Mode x Arousal	41477.77	1	41477.77	9.47**
Error	240999.11	55	4381.80	

** $p < .01$

Figure 7. The effect of regulatory mode and arousal on breadth of attention (Study 6)



Discussion

The data from Study 6 build on the results from Study 5 by experimentally manipulating the regulatory mode and arousal variables. Specifically, it was predicted and found that individuals high on locomotion tend to exhibit greater focusing of attention under high (vs. low) states of arousal, whereas individuals high on assessment exhibit greater broadening of attention under high (vs. low) states of arousal. These first two studies have found the same pattern of findings as was found in the four studies investigating the need for closure as a moderator of the arousal-attention link.

Although the research so far has clearly been consistent with the predictions, it is important to be just as vigilant in testing the influence of regulatory mode as a moderator as it was in testing the need for closure as a moderator. Both studies 5 and 6 on regulatory mode have used the Navon (1977) measure of focus/breadth of

attention. Therefore, a seventh study was designed to test an extension of these findings to the Kimchi and Palmer (1982) measure of focus/breadth of attention.

Study 7

The aim of Study 7 was to conceptually replicate the findings from Study 6 using a different measure of focus/breadth of attention. Specifically, locomotion versus assessment was manipulated using the Avnet and Higgins (2003) manipulation. Arousal was manipulated by presenting participants with positively-valenced arousing pictures or neutral pictures. Focus of attention was measured using Kimchi and Palmer's (1982) local-global measure.

Method

Participants

Sixty-four University of Maryland undergraduates enrolled in psychology courses participated. They received compensation in the form of credit in a psychology course.

Procedure

Regulatory Mode. Locomotion versus assessment was manipulated using the same procedure as in Study 6.

Arousal. Arousal was manipulated in same manner as in Study 6. That is, participants were presented with positively-valenced arousing pictures from the IAPS in the high arousal condition, and neutral pictures in the low arousal condition.

Breadth of Attention. Participants completed the same local-global processing task as in Studies 1, 2, and 3 (Kimchi & Palmer, 1982).

Manipulation Check. To check the efficacy of the arousal manipulation, participants completed the 24-item perceived arousal scale used in Studies 1, 5, and 6 (Anderson et al., 1996; Anderson, et al., 1995).

Results

Manipulation Check

A 2 (Regulatory Mode: Locomotion vs. Assessment) x 2(Arousal: Low vs. High) between-subjects ANOVA was conducted in order to test the influence of the arousal manipulation on self-reported arousal. This analysis revealed a main effect for arousal condition, $F(1, 60) = 4.59, p < .05$. As was expected, participants reported higher levels of arousal in the high arousal condition ($M = 2.94, SE = .13$) than in the low arousal condition ($M = 2.53, SE = .13$). All other effects were nonsignificant (All $F_s < 1$).

Breadth of Attention

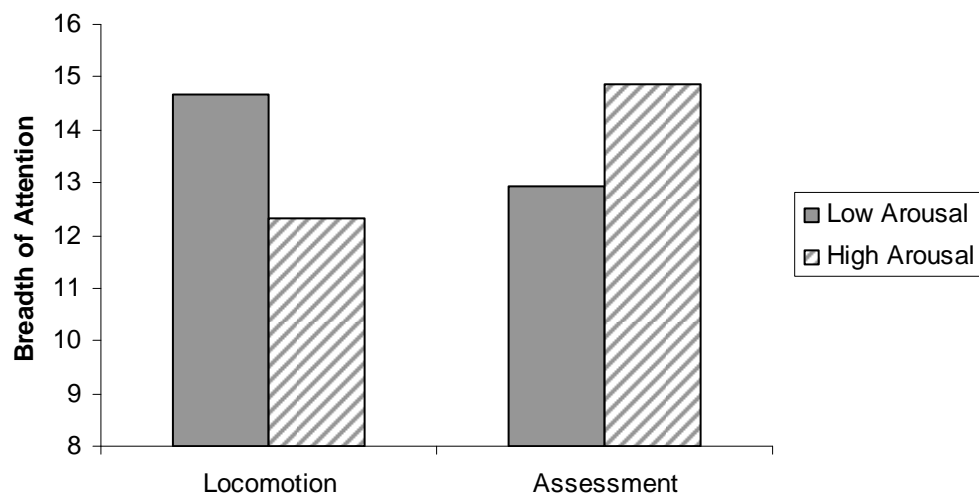
The hypotheses regarding breadth of attention were tested by conducting a 2 (Regulatory Mode: Locomotion versus Assessment) x 2 (Arousal: Low versus High) between-subjects ANOVA. As shown in Table 9, this analysis revealed an interaction between regulatory mode and arousal, $F(1, 60) = 9.67, p < .01$. In the locomotion condition, participants in the high arousal condition exhibited lesser breadth of attention ($M = 12.31, SE = .69$) than participants in the low arousal condition ($M = 14.69, SE = .69$), $F(1, 60) = 5.87, p < .05$. In the assessment condition, participants in the high arousal condition exhibit greater breadth of attention ($M = 14.88, SE = .69$) than participants in the low arousal condition ($M = 12.94, SE = .69$), $F(1, 60) = 3.91, p = .053$. This interaction is shown in Figure 8.

Table 9. Summary of Analysis of Variance (Study 7)

Source	SS	DF	MS	F
Regulatory Mode	2.67	1	2.67	.34
Arousal	.77	1	.77	.10
Mode x Arousal	74.39	1	74.39	9.67**
Error	461.56	60	7.69	

** $p < .01$

Figure 8. The effect of regulatory mode and arousal on breadth of attention (Study 7)



Discussion

The results from this study again supported the predictions regarding regulatory mode and arousal, as they jointly determine focus/breadth of attention, while importantly extending the empirical evidence to an additional measure of

focus/breadth of attention. However, both experimental studies on regulatory mode have used positively-valenced stimuli to induce arousal. Therefore, it remains possible that the effect of arousal in the regulatory mode studies is limited to conditions in which arousal is paired with positive stimuli, or that the positivity of the stimuli is driving the effect rather than the arousal. Thus, an eighth study was designed in which negatively-valenced stimuli were presented. Another limitation with the regulatory mode studies is that both experimental manipulations relied on pictures to induce arousal. Therefore, the eighth study utilized passages to induce arousal, as in the need for closure Studies 2 and 3.

Study 8

In order to build on Studies 6 and 7, two changes were made to the arousal manipulation in Study 8. First, arousal was manipulated using negatively-valenced stimuli rather than positively-valenced stimuli. Second, this arousal manipulation was conducted by having participants read passages rather than view images. Regulatory mode was manipulated by having participants recall times in which they successfully used locomotion strategies or assessment strategies. Focus/breadth of attention was assessed using the Kimchi and Palmer (1982) measure.

Method

Participants

Sixty-four undergraduate students enrolled in psychology courses participated in exchange for course credit. Forty-five participants were women, and 19

participants were men. The age of participants ranged from 18 to 15, with a mean age of 20.1.

Procedure

Regulatory Mode. Locomotion versus assessment was manipulated using the same procedure as in Studies 6 and 7.

Arousal. Arousal was manipulated using the same general procedure as Study 2. That is, participants were presented with passages from the ANET (Bradley & Lang, 2007) pre-tested with respect to level of arousal. In contrast to Study 2, the arousing pictures were negatively valenced. Pictures in the low arousal condition were neutral in valence.

Breadth of Attention. Participants complete the same local-global processing task as in Studies 1, 2, 3, and 8 (Kimchi & Palmer, 1982).

Results

A 2 (Regulatory Mode: Locomotion versus Assessment) x 2 (Arousal: Low versus High) between-subjects ANOVA was conducted in order to test the predictions regarding focus/breadth of attention. As shown in Table 10, this analysis revealed an interaction between regulatory mode and arousal, $F(1, 60) = 8.35, p < .01$. In the locomotion condition, participants in the high arousal condition exhibited lesser breadth of attention ($M = 10.27, SE = .98$) than participants in the low arousal condition ($M = 13.25, SE = .84$), $F(1, 60) = 5.35, p < .05$. In the assessment condition, participants in the high arousal condition exhibited greater breadth of attention ($M = 14.67, SE = .98$) than participants in the low arousal condition ($M =$

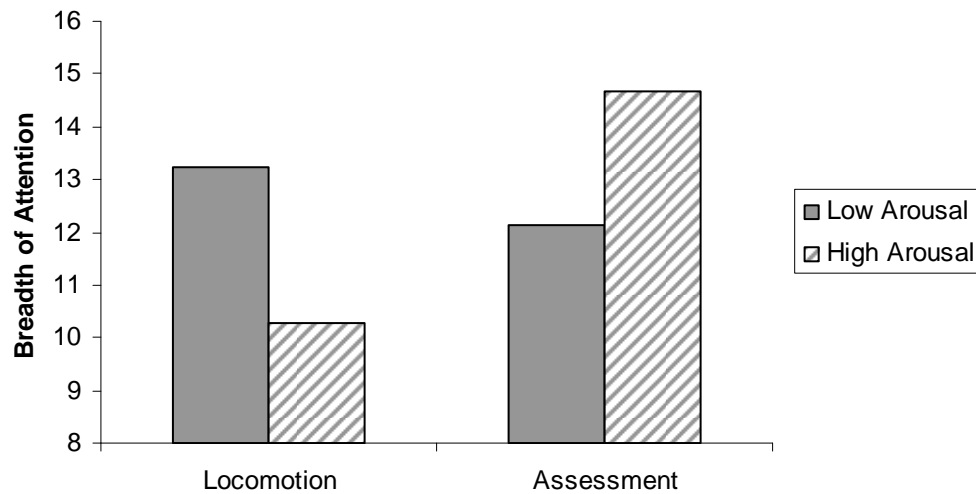
12.14, $SE = 1.00$), although this difference was marginally significant, $F(1, 60) = 3.23, p = .077$. The results from this study are depicted in Figure 9.

Table 10. Summary of Analysis of Variance (Study 8)

Source	SS	DF	MS	F
Regulatory Mode	42.56	1	42.56	2.98
Arousal	.83	1	.83	.06
Mode x Arousal	119.05	1	119.05	8.35**
Error	855.73	60	14.262	

** $p < .01$

Figure 9. The effect of regulatory mode and arousal on breadth of attention (Study 8)



Discussion

The results from Study 8 show once again the interaction between regulatory mode and arousal in causing focus/breadth of attention. Building on the first three regulatory mode studies, this study used negatively-valenced passages to induce arousal. The pattern of results conceptually replicates the results of studies using positively-valenced pictures to induce arousal. Therefore, it seems that arousal is driving the effect, rather than something to do with the valence or specific presentation format of the stimuli.

The aim of the studies on regulatory mode was to extend the findings on need for closure to additional processing strategies, allowing for a more general claim to be made about the interaction between arousal and processing strategy in determining focus/breadth of attention. Specifically, it was predicted and found that individuals high on locomotion would exhibit greater focusing of attention as their level of arousal increases, whereas individuals high on assessment would exhibit greater broadening of attention as their level of arousal increases. The methods employed in these four studies used two operations of the regulatory mode variable, three operations of the arousal variable, and two operations of the focus of attention variable, while utilizing both correlational and experimental research designs. A convergence of results across these operations provides compelling evidence for the hypotheses regarding the interaction between regulatory mode and arousal in causing focus/breadth of attention.

Chapter 3: General Discussion

After six decades of research on the arousal-attention link, psychologists have settled on a law-like principle in which increasing levels of arousal were presumed to lead to greater focusing of attention (originally proposed by Easterbrook, 1959). This principle was important in explaining the Yerkes-Dodson law and many social phenomena. Yet, recent developments in the understanding of the role of arousal in goal pursuit and knowledge formation suggest that arousal may serve as information regarding urgency and importance, ultimately augmenting whatever processing strategy is active (Storbeck & Clore, 2008). Specifically, it was proposed that arousal may not necessarily lead to a focusing of attention, but may instead augment active processing strategies. Because some processing strategies lead to a broadening of attention (while others lead to a focusing of attention), it is possible that increasing arousal may lead to a broadening of attention (while at other times leading to a focusing of attention).

Based on lay epistemic theory (Kruglanski, 1989; Kruglanski & Webster, 1996) and regulatory mode theory (Higgins et al., 2003; Kruglanski et al., 2000), the present research investigated the possibility that the epistemic need for closure and the regulatory modes of locomotion and assessment would moderate the arousal-attention link. The data from eight studies is consistent with this prediction. Arousal has been shown to lead to a focusing of attention when need for closure or locomotion is high, and to a broadening of attention when need for closure is low or when assessment is high.

The central aim of this research was to investigate the possibility that the Easterbrook hypothesis needs to be seriously qualified. The eight studies reported here conclusively show that under some conditions, arousal leads to a broadening of attention (while at other times leads to a focusing of attention). Specifically, arousal seems to augment whatever processing strategy is active. As such, when a processing strategy aimed at broadening is active (need to avoid closure, assessment), then arousal leads to a broadening of attention. This framework is capable of explaining the previous research in support of the Easterbrook hypothesis. The typical study asked participants to engage in one central task, in which they were instructed was the most important demand (e.g. a pursuit meter task). They were then told that they should detect changes to some peripheral stimuli (e.g. a light turns on in their peripheral vision). This type of task induces a processing strategy aimed at focusing of attention due to the instructions in which participants are told that one task is more important than another. This general tendency to focus attention is then augmented under high arousal conditions.

Beyond merely arguing for a revision of the Easterbrook hypothesis, the present results provide evidence in support of arousal-as-information theory (Storbeck & Clore, 2008) that goes beyond the previous tests of the theory. The theory suggests that arousal will serve as information regarding the urgency or importance of active processing strategies. Previous research has shown that arousal increases the influence of positive or negative emotions on information processing tasks (e.g., Bless, Clore, Golisano, Rabel, & Schwarz, 1996; Corson & Verrier, 2007; Hamm, Schupp, & Weike, 2003; Gomez, Stahel, & Danuser, 2004; Storneck & Clore,

2005). Yet this research stopped short of manipulating processing strategies directly. The present research directly manipulated the processing strategies of need for closure, locomotion, and assessment. Consistent with arousal-as-information theory, the effects of each of these processing strategies on focus of attention was increased under conditions of high (vs. low) arousal.

These results of these studies have implications for the understanding of need for closure and the regulatory modes of locomotion and assessment. Based on these results, we can conclude that the impact of a need for closure or a need to avoid closure on information processing is augmented by concurrent arousal. Individuals who are high on the need for closure focus their attention, leading to a processing of fewer available pieces of information, especially when the individual is also aroused.

Similarly, individuals high on the need for closure under high (vs. low) arousal should terminate information search more quickly (Dougherty & Harbison, 2007; Kruglanski & Webster, 1996), generate fewer hypothesis (Mayesless & Kruglanski, 1987), base judgments on the most accessible information (Ford & Kruglanski, 1995), be more confident in their judgments (Mayesless & Kruglanski, 1987), and experience less regret after making poor decisions (Mannetti, et al., 2007). In addition, classic need for closure effects such as an increased reliance on stereotypes (Dijksterhuis, van Knippenberg, Kruglanski, & Schaper, 1996; Kruglanski & Freund, 1983), and increased group centrism (DeGrada, Kruglanski, Mannetti & Pierro, 1999; Kruglanski, Pierro, Mannetti, & DeGrada, 2006; Pierro, Mannetti, DeGrada, Livi & Kruglanski, 2003) should be even stronger when those

individuals are in a high (vs. low) arousal state. Future research could profitably explore these possibilities.

The implications of these results for regulatory mode theory are also important. Based on these results, we can conclude that the impact of locomotion and assessment on information processing is magnified by concurrent arousal.

Individuals who are high on locomotion are oriented towards movement, leading to a focusing of attention, especially under high (vs. low) arousal conditions. Individuals high on assessment are oriented towards the evaluation of alternatives, leading to a broadening of attention, especially when aroused. The usual outcomes of locomotion, such as decreased counterfactual thinking and regret (Pierro et al., 2008) and increased optimism (Kruglanski et al., 2000) should be increased by high (vs. low) arousal levels. Well known outcomes of an assessment orientation, such as sensitivity to criticism from others, which results in anxiety in social interactions (Higgins, et al., 2003) and conformity to social norms (Pierro, Mannetti, Higgins, & Kruglanski, 2002) should be even greater during times of high (vs. low) arousal. Future research could profitably explore these possibilities.

The discovery of multiples moderators of the arousal-attention link (need for closure, locomotion, assessment) increases the confidence with which we can state that the Easterbrook hypothesis should be qualified. It also suggests a more general point that any processing strategy aimed at focusing or broadening should be augmented by arousal, and should show the same pattern of results. For example, the regulatory focus orientations of promotion and prevention (Higgins, 1998) may show a similar pattern. Because individuals high on promotion eagerly approach positive

outcomes, they may focus their attention in order to pursue a desirable end, and this tendency may be increased in high (vs. low) arousal conditions. Because individuals high on prevention attempt to vigilantly prevent bad outcomes from occurring, they may broaden their attention in order to detect any possible threat, and this tendency may be increased when arousal is high (vs. low).

Because the arousal-attention link has been used to explain many social and cognitive phenomena, the work reported here should have far-reaching implications as well. While arousal has been shown to lead to ‘weapon focus,’ it seems that based on the current analysis that arousal may sometimes have the reverse effect. That is, arousal may sometimes lead the perceiver to broadening their attention and to view more information in the context. It is likely the case that individuals in these situations are often high on the need for closure and high on the locomotion orientation, focused on determining what is going on and what to do. Because of this, the arousing aspects of the situation lead to a focusing of attention. The advantage is that they are aware of what the gun is doing. However, the disadvantage is that they are unable to react to other events in the environment and to process information about the person holding the gun. These could be critical pieces of information for the person who wishes to remain safe, determine the best course of action, and/or to intervene in some manner.

However, individuals who are low on the need for closure or high on the assessment orientation should experience a broadening of attention due to the arousing nature of the situation, leading them to take in more information. This could lead them to see the movement of more people, more clues about the nature of

the situation as a whole, and to glean relevant information about the person with the gun. Such a processing strategy could be particularly important to police officers and witnesses who need to take this information into account when re-telling the events and/or deciding whether or how to intervene. For example, a police officer could better be able to determine whether innocent bystanders are going to be in the way should s/he decide to shoot at the person with the gun. Police training could potentially lead to improved thinking strategies in such situations.

In short, the present studies provide compelling evidence that arousal augments currently active processing strategies. Because of this, arousal sometimes leads to a focusing of attention in some cases, but leads to a broadening of attention in other cases. This framework should replace the Easterbrook hypothesis as the best explanation of the attention-arousal link. Because the arousal-attention link has been used to explain phenomena in many domains, much future research could profitably explore whether the present results have implications in such situations. Moreover, such research could suggest possible interventions that would circumvent the negative consequences of focusing attention when broader attention would be helpful. Future research is needed to test the application of this conceptualization to other processing strategies and other measures of attention. One limitation of the current research is that arousal levels did not reach the extreme levels that are sometimes found in the situations of interest. More research is needed to test whether the effects of extremely high levels of arousal would lead to even greater effects in a linear fashion, or whether the pattern of relations differs at such high levels. Finally, future research

could explore whether the findings reported here apply to other aspects of visual attention, to memory search, and to the vigilance of information processing.

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