The effects of internal versus external information processing on symptom perception in an exercise setting.

By: Roger B. Fillingim and Mark A. Fine

Fillingim, R. A., & Fine, M. A. (1986). The effects of internal versus external information processing on symptom perception in an exercise setting. *Health Psychology*, *5(2)*, 115-123.

Abstract:

Determined the effects of internal vs external attentional focus on symptom perception and performance in an exercise setting. 15 undergraduates ran 1 mi under each of 3 experimental conditions: "word-cue," in which Ss were required to focus externally by listening for a target word heard repeatedly over headphones; "breathing," in which Ss were directed to attend to their own breathing and heart rate; and a control. Ss reported significantly less symptomatology, particularly exercise-relevant symptoms (as measured by a symptom/emotion checklist), in the word-cue condition than in the breathing or control conditions. Findings are discussed with reference to previous theory, and methodological differences between this and earlier research by J. W. Pennebaker and J. M. Lightner (see record 1981-22664-001) are delineated.

Keywords: psychophysiology | health psychology | psychology | symptom perception | exercise | attention

Article:

Many athletes can attest that pain and fatigure are more noticeable after than during a sporting event. Because they process primarily environmental information while participating, athletes may be less aware of internal sensations. Our study addresses this issue by assessing the effect of differential information processing in an exercise setting. It is hypothesized that directing attention to environmental stimuli will reduce perception of internal sensations of fatigue.

Internal sources of information (sensations) emanate from the body (e.g., pain or fatigue), whereas external sources are perceived by the senses (e.g., sights or sounds). Because the amount of information an individual can process at one time is limited (Navon & Gopher, 1979), processing external data should restrict the processing of internal sensations of fatigue. Thus, according to this model, individuals required to process external information will likely be less able to process internal sensations. And, in fact, auditory stimulation has been demonstrated to reduce pain perception (Licklider, 1951).

Research suggests that individuals process external and internal sensations to varying degrees. For instance, personality dimensions such as Type A and Type B characteristics (Carver, Coleman, & Glass, 1976) and degree of self-consciousness (Fenigstein, Scheier, & Buss, 1975) may be related to differential processing of internal and external stimuli. Further, experimental manipulation may alter the extent to which individuals process internal data. For example, instructing subjects to attend to pain (Kanfer & Goldfoot, 1966), muscle soreness (Pennebaker, Skelton, Wogalter, & Rodgers, 1978), and nasal congestion (Pennebaker & Skelton, 1978) can intensify these perceptions.

The above studies focus primarily on internal or external stimuli, whereas more recent work deals with competition between the two. One study (Pennebaker, 1980) demonstrated that subjects coughed more during boring than interesting parts of a movie. The researchers suggested that subjects were less likely to attend externally during boring segments; therefore, they were more aware of the internal sensation of an itchy throat, which leads to coughing (Beecher, 1959).

Other studies have assessed information processing in an exercise setting. Pennebaker and Lightner (1980) found that subjects ran faster on a wooded cross-country trail than when running the same distance on a track. The authors proposed that the cross-country runners attended more to their surroundings than did track runners. Thus, the former were less aware of their internal sensations of fatigue, resulting in faster times. In another study (Pennebaker & Lightner, 1980), subjects who heard street sounds (e.g., passing cars and parts of a conversation) over headphones while walking on a treadmill reported less fatigue than did subjects who heard their own breathing, suggesting that bodily information increased perceived fatigue.

The present study derives from Pennebaker and Lightner’s (1980) studies. Subjects jogged under three conditions: “word-cue,” “breathing,” and control. The word-cue and breathing conditions focused on external and internal stimuli, respectively. In expanding on previous work in this area, several methodological improvements were implemented. First, the success of the manipulation in Pennebaker and Lightner’s studies was questionable. In their jogging study, it was inferred that cross-country joggers attended externally and lap runners internally, but this is an assumption that requires empirical confirmation. By contrast, our study experimentally manipulated the attentional focus. Also, in the “treadmill” study, subjects in the “breathing” condition, who were allegedly processing internal cues, heard their own breathing over headphones, which was actually an external (auditory) and not an internal source of information. Second, Pennebaker and Lightner (1980) used beginning joggers, who may be more heterogeneous with respect to physical conditioning than the experienced joggers in the present study.

It was hypothesized that if subjects maintained comparable times across conditions, then the subjects would report a lesser degree of symptomatology in the word-cue than in the breathing condition. Alternatively, if subjects paced themselves via perceived fatigue, then symptom reports would not differ, but subjects would jog faster in the word-cue than in the breathing condition.

METHOD

Subjects

Eight males and seven females who were active joggers participated in the study to fulfill a requirement in their introductory psychology course at a private midwestern university. The subjects were all college freshmen between the ages of 18 and 20 years, with the exception of one 38-year-old woman.

Procedure

In this repeated-measures design, there were three conditions: word-cue, breathing, and control. The study took place on an indoor running track during periods when there were few, if any, people on the track. Participants jogged 1 mile at each of three sessions and received the following general instructions before each session, regardless of the treatment condition:

I want you to jog 10 laps. Stay in the outer lane at all times. Jog as fast as you can without experiencing any discomfort.

The specific instructions for the two experimental treatment conditions were:

Word-Cue: While you are jogging, you will hear a tape with some words on it. I want you to count the number of times you hear the word dog. When you are through jogging, I will ask you how many times you heard it. Breathing: While you are jogging, focus your attention only on what your body is doing. Especially concentrate on the pattern of your breathing, and try to hear and feel the beating of your heart.

Subjects in the word-cue condition heard a cassette tape of 15 monosyllabic words over headphones while jogging, one word appearing every 10 sec. The word dog occurred an average of once per minute, and all participants accurately reported its frequency after jogging. Subjects in the breathing and control conditions also wore the headphones for experimental consistency. To control for order effects, each subject was randomly assigned to one of six possible condition sequences.

Each experimental session proceeded as follows. Upon arrival, the subject was given the general instructions followed by the appropriate experimental treatment instructions. Then the subject put on the headphones, and the tape was started (word-cue only). The experimenter started timing with the subjects’ first step and stopped the watch after 10 laps (1 mile). Word-cue subjects were then asked to report the number of times they heard the word dog. Finally, they completed the symptom checklist.

Initially subjects scheduled sessions separated by equal time intervals (e.g., every other day). Twelve subjects completed their sessions as scheduled, but three subjects rescheduled at slightly unequal intervals. However, the rescheduled times were arranged at well-spaced intervals to prevent fatigue from confounding the results.

Dependent Measures

Jogging times, to hundredths of a second, and the Symptom/Emotion Checklist: A State Measure (Pennebaker, 1982) were the two dependent measures. Subjects rated each of 17 symptoms on a scale from 1 to 7, with higher ratings indicating greater degrees of symptomatology. After receding items 13 and 17, which were keyed in a direction opposite to the others, the total score was obtained by summing all items. The total possible score is 119.

The checklist derives from similar scales that have been widely used. Because it is a new instrument, psychometric data are limited. Test-retest reliability should not be high, because the checklist assesses an individual's current awareness, and as expected, test-retest correlation coefficients dropped from .21 at a 1-month interval to .07 at 4 months. The mean Cronbach alpha correlation coefficient was .75 (Pennebaker, 1982), suggesting adequate internal consistency. Although data concerning criterion-related validity are scarce, the instrument appears to have good face and content validity. The symptom dimensions included in the checklist appear in Table 2, where means on each item for each condition are also presented.

Table 2 has been omitted from this formatted document.

RESULTS

Summed Symptom/Emotion Checklist Scores

A one-factor-within-subjects (control, breathing, word-cue) and one-factor-between-subjects (Sex) analysis of variance (ANOVA) was computed. The dependent measure was the summed checklist score. The means and standard deviations are presented in Table 1..

Table 1 has been omitted from this formatted document.

A significant main effect for condition was found for the analysis computed on the symptom checklist, $F(1, 28) = 7.0$, $p < .01$. Planned comparisons further revealed that, as expected, the symptom reports under the word-cue condition were significantly lower than under the breathing, $F(1, 28) = 8.5$, $p < .01$, and control $F(1, 28) = 12.2$, $p < .01$, conditions. No significant effects for sex or for the Sex × Condition interaction were found.

Subscales of the Symptom/Emotion Checklist

To help clarify this general finding, the items on the checklist were subdivided into three subscales: (a) Exercise-Relevant, consisting of Items 3, 4, 5, 6, 7, 11, 12, 14, and 15; (b) Exercise-Irrelevant, consisting of Items 1, 2, 8, 9, and 10; and (c) Positive Mood, consisting of Items 13, 16, and 17. Because previous research has not empirically examined (through factor analysis) the underlying constructs of the checklist, the assignment to subscales was based on the collective judgment of the authors.

Separate one-factor-within-subjects (control, word-cue, breathing) ANOVAs were computed on each of the three subscales. Because there was no significant main effect for sex on the summed checklist scores, it was not included as a factor. A significant main effect for condition was found on the total scores from the Exercise-Relevant, $F(2, 18) = 4.3$, $p < .025$, and Positive Mood, $F(2, 28) = 5.0$, $p < .025$, subscales. Post-hoc comparisons revealed that exercise-relevant symptoms under the word-cue condition were significantly ($p < .05$) lower than under the breathing and control conditions, and that positive mood was significantly ($p < .025$) higher in the word-cue condition than either of the other two. No main effect for condition was found on the subscale containing exercise-irrelevant items.

Individual Items From the Symptom/Emotion Checklist

To assess which of the individual checklist items contributed to these main effects for condition, separate one-factor-within-subjects (Condition) ANOVAs were computed on each of the 17 items. Results revealed significant differences across conditions on four items: shortness of breath, $F(1, 28) = 4.3$, $p < .05$, side cramps, $F(1, 28) = 9.3$, $p < .01$, fatigued, $F(1, 28) = 9.7$, $p < .01$, and pleased, $F(1, 28) = 5.3$, $p < .05$. The means on each checklist item for each condition are presented in Table 2. Planned post-hoc comparisons revealed that symptom reports under the word-cue condition were significantly lower than under the breathing and control conditions on all four dimensions.

Jogging Times

A one-factor-within-subjects (Condition) and one-factor-between-subjects (Sex) ANOVA was computed with the total time required to jog 1 mile serving as the dependent variable. The analysis revealed no significant differences across the three conditions. Though males ($M = 405.63$ sec) jogged considerably faster than females ($M = 533.95$ sec), there was no significant Sex × Condition interaction.

DISCUSSION

As expected, subjects reported a lesser degree of symptomatology when they focused externally than when they focused internally while jogging. When focused externally (counting the number of times the word dog appears on audiotape), participants reported fewer exercise-relevant symptoms and described themselves as having a more positive mood (pleased, not anxious, and happy) than when in either of the other two conditions. The fact that there were no significant differences across conditions on items judged to be exercise-irrelevant demonstrates that the effect of the attention manipulation was task-specific. In other words, the external focus of attention was only effective in reducing symptoms relevant to the particular task performed. One might speculate that attention manipulations in other settings would also have task-specific impact.

Because participants in the internal focus of attention condition (monitoring breathing and heartbeat) obtained results which were not statistically significantly different from those in the control condition, it appears that instructing the subjects to focus externally was the key manipulation and was responsible for the significant differences across conditions. The results suggest that the internal focus of attention did not alter how subjects typically focus their attention while exercising, as those in the breathing group performed similarly to those in the control group. The potency of the word-cue instructions in reducing symptoms and improving mood indicates that athletes may improve their performance if they consciously focus their attention externally. This possibility needs to be explored in future research.

The results of this study support one version of the hypothesis, which posited that if jogging times did not differ, then subjects would report a greater degree of symptomatology under the breathing condition than under the word-cue condition. Previous work (Pennebaker & Lightner, 1980) supports the alternative version, revealing significant differences in jogging times for internally and externally focused joggers but no differences in symptom reports. There are several methodological factors that may account for the different outcomes of these two studies. First, because Pennebaker and Lightner’s subjects had no way of timing themselves, perceived fatigue was the only index available by which they could set a pace. Thus one would expect fatigue to remain constant while times varied across conditions. However, joggers in the present study were able to utilize a clock or watch to time themselves. Consequently, these participants could maintain a constant pace while perceived symptoms varied. Second, the earlier study employed beginning joggers, whereas the current work involved experienced runners. Thus subjects in this experiment may have maintained their “usual” pace without regard for the increase in perceived symptoms, whereas novice joggers would be unaccustomed to maintaining a set pace. Finally, subjects in this study were instructed to perform maximally without discomfort, as opposed to instructing them merely to jog comfortably (Pennebaker & Lightner, 1980). Therefore, participants in the current work may have prioritized jogging times over subjective discomfort in the breathing condition.

Other characteristics of this study may have permitted a more accurate assessment of the hypothesis than was true of previous work. Pennebaker and Lightner (1980) used auditory stimuli (street sounds), which subjects may have tuned out, to produce external focus; however, the present research implemented an effortful task requiring external focus to prevent subjects from ignoring the stimulus. Also, in the earlier work, subjects heard their own breathing over headphones while exercising, which is an external (auditory) rather than an internal source of information. However, participants in the present study were instructed to focus on actual internal stimuli, which seems to more directly assess internal versus external information processing.

Anecdotal reports from subjects following completion of the study suggested that the experimental manipulation of attentional focus was successful. Subjects stated that it was quite easy for them to attend to their breathing and to focus on internal sensations to the exclusion of environmental stimuli. In the word-cue condition, participants reported attending to the words they heard to the exclusion of any other stimuli. This is supported by the fact that all correctly identified exactly how often the word dog appeared. Subjects' reports indicate that they actively attended to their respective stimuli, suggesting no differences in intensity of attentional efforts. No consistent descriptions emerged concerning the attentional focus of the control condition. However, as discussed earlier, the similarity in symptom reports for the breathing and control conditions leads one to hypothesize that in the absence of specific directions, joggers focus their attention on internal sensations.

In conclusion, the present study, in agreement with earlier work, seems to indicate that attending to internal versus external stimuli influences the perception of physical symptoms. Future research should explore the utility of this theory in clinical settings (e.g., with chronic pain patients). This, and other avenues of future research, should extend the present theory and clarify its application boundaries.

REFERENCES

Beecher, H. K. (1959). Measurement of subjective responses: Quantitative effects of drugs. New York: Oxford University Press.

Carver, C., Coleman, A. E., & Glass, D. C. (1976). The coronary-prone behavior pattern and the suppression of fatigue on a treadmill test. Journal of Personality and Social Psychology, 33, 460–466.

Fenigstein, A., Scheier, M., & Buss, A. (1975). Public and private self-consciousness: Assessment and theory. Journal of Consulting and Clinical Psychology, 43, 522– 527.

Kanfer, F., & Goldfoot, D. (1966). Self-control and tolerance of noxious stimulation. Psychological Reports, 18, 79– 85.

Licklider, J. C. R. (1951). Basic correlates of the auditory stimulus. In S. S.Stevens (Ed.) , Handbook of experimental psychology. New York: Wiley.

Navon, D., & Gopher, D. (1979). On the economy of the human-processing system. Psychological Review, 86, 214– 255.

Pennebaker, J. W. (1980). Perceptual and environmental determinants of coughing. Basic and Applied Social Psychology, 1, 83– 91.

Pennebaker, J. W. (1982). The psychology of physical symptoms. New York: Springer-Verlag.

Pennebaker, J. W., & Lightner, J. M. (1980). Competition of internal and external information in an exercise setting. Journal of Personality and Social Psychology, 39, 165– 174.

Pennebaker, J. W., & Skelton, J. (1978). Psychological parameters of physical symptoms. Personality and Social Psychology Bulletin, 4, 524– 530.

Pennebaker, J. W., Skelton, J. A., Wogalter, M., & Rodgers, R. J. (1978, August). Effects of attention on the experience of physical symptoms. Paper presented at the meeting of the American Psychological Association, Toronto, Canada.