PREDICTION OF INSOMNIA FROM AROUSABILITY PREDISPOSITION SCORES: SCALE DEVELOPMENT AND CROSS-VALIDATION

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Summary—In light of evidence which suggests that some forms of insomnia may result from cognitive hyperarousal, an attempt was made to develop an instrument composed of items which measure arousability as a predisposition or a trait, in the hope that this might predict tendencies toward disrupted sleep patterns. Starting with an original pool of 314 items a 70 item preliminary inventory was selected. Next a sample of 196 subjects was used to develop and validate a 12-item self-report inventory called the Arousal Predisposition Scale. Item selection was based on the ability to predict a global measure of insomnia. The resultant scale was then cross-validated on a sample of 693 subjects and shown to be both a valid and reliable predictor of several indexes of sleep disturbance.

Epidemiologic data suggest that sleep disturbance is very prevalent in the general population. In 1980, the U.S. Department of Health Services estimated that about 14% of the adult population suffers from insomnia on a fairly regular basis (Wallace and Fisher, 1987). However, other estimates have suggested that the actual prevalence may be as high as 32% in some urban centers (Bixler, Kales, Soldatos, Kales and Healey, 1979). Similar figures are found for adolescents (e.g. Price, Coates, Thoresen and Grinstead, 1978). The effects of insomnia are physical as well as psychological, with some research suggesting that insomnia may be associated with an increased risk of mortality (e.g. Kripke, Simons, Garfinkel and Hammond, 1979). Insomnia may also serve as a condition which predisposes individuals toward the use and possible abuse of hypnotic medications and alcohol (Institute of Medicine, 1979).

The study of mechanisms of arousal has been viewed as relevant to the problem of insomnia since Monroe (1967) first reported that poor sleepers have higher levels of autonomic activity. Arousal, as it is used in this context, is not a simple, unidimensional process, but rather should be viewed as a set of subdimensions or channels (Borkovec, 1976, 1979; Davidson and Schwartz, 1976; Lacey, Bateman and Van Lehn, 1953; Schwartz, 1975; Suefeld, 1980). One useful way of describing the situation is to use a global dichotomy between somatic and cognitive arousal. An example of the potential usefulness of such a distinction comes from a study by Schwartz, Davidson and Goleman (1978) who measured anxiety responsiveness in subjects who engaged in regular exercise in comparison with those who practiced meditation. Based upon data from a self-report measure called the Cognitive-Somatic Anxiety Questionnaire, the authors report that meditators showed less cognitive and more somatic anxiety while exercisers had more cognitive and less somatic anxiety. This study demonstrates that the cognitive and somatic components of anxiety may be isolated psychometrically. A similar distinction between cognitive and somatic dimensions seems useful when considering the relationship between arousal and insomnia.

If we study cognitive and somatic arousal separately we find that the two factors have different degrees of impact on sleep disturbances. Following the original positive report of Monroe (1967) a number of studies have measured the relationship between somatic indexes of arousal and various indexes of sleep disruption; however, the results have been rather mixed to negative (cf. Van Oot, Lane and Borkovec, 1984, for a review). Similar, generally negative, conclusions may be drawn from investigations which have used physiological indicators to measure the effects of relaxation treatment upon insomnia. Most have found no significant relationships between these measures of somatic arousal and changes in sleep patterns (e.g. Coursey, Frankel, Gaarder and Mott, 1980; Hauri, 1981; Nicassio, Bolyan and McCabe, 1982).
If we isolate cognitive hyperarousal from somatic hyperarousal the results are more promising. Clinical observations and direct experimental data suggest that insomniacs are more cognitively aroused and suffer from more sleep-retarding intrusive thoughts, despite the fact that they may not differ from good sleepers in terms of somatic arousal (Lichstein and Rosenthal, 1980). Direct experimental manipulations of cognitive arousal, by inducing a mild threat (Lichstein, Fanning and Cernosek, 1979) or triggering a chain of cognitive activity and planning (Gross and Borkovec, 1982) have resulted in increased sleep-onset latency and more frequent night wakenings. On the other hand, treatment interventions which attempt to reduce cognitive arousal by relaxation and meditation procedures and those which attempt to block the sleep-incompatible cognitive activity (e.g. by focusing on relatively pleasant, monotonous, internal stimuli) do seem to lead to significant improvement in sleep patterns (Borkovec and Hennings, 1978; Borkovec, Grayson, O'Brien and Weerts, 1979; Mitchell, 1979; Thoresen, Coates, Kirmil-Gray and Rosekind, 1981; Woolfolk and McNulty, 1983).

A recent study by Nicassio, Medlowitz, Fussell and Petras (1985) further demonstrates the usefulness of the concept of cognitive hyperarousal as a predictor of insomnia. These investigators developed a self-report, pre-sleep arousal scale, containing both cognitive and somatic subscales. While scores on both scales tended to be associated with sleep disruption, the cognitive subscale was more strongly related to general indexes of insomnia and to sleep-onset latency, than was the somatic scale.

One important aspect of insomnia is its tenacity. There is evidence which suggests that insomnia may be an outcropping of some persistent and stable behavioral or physiological predisposition. It is thus not unusual for complaints about disrupted sleep to extend over many years. Perhaps the most dramatic example of this comes from Coren and Searleman (1985) who sampled 1,272 college-aged individuals and also obtained maternal reports about their sleep behaviors as infants. Of those individuals whose mothers reported that they had disrupted infant sleep patterns, 18 years later 77.3% of these subjects still report that they presently have delayed sleep-onset latencies and 73.9% report that they are currently bothered by frequent night wakenings. Other findings are consonant with the idea that insomnia may be associated with relatively permanent predispositions. For example, there are reports that some long term personality traits, such as neuroticism, tendencies toward depression or obsessive worrying, also seem to be related to patterns of sleep disruption (e.g. Coursey, Buchsbaum and Frankely, 1975; Monroe and Marks, 1977).

In order to integrate the conception that arousal is related to insomnia with the suggestion that there is a long term predisposition toward disturbed sleep patterns, we must first abandon the notion that the only important aspect of arousal is that associated with the immediate pre-dormital time period. One promising synthesis of the available data begins with the possibility that insomnia may be associated with cognitive arousability, conceptualized as a long term trait or behavioral predisposition. If such a speculation is valid, then it ought to be possible to develop an instrument, based upon self-reports of general cognitive arousability, which could predict disturbed sleep patterns. The data reported below comprise the development, validation and cross-validation of an instrument to measure the tendency toward insomnia in individuals, based upon the concept of an arousability predisposition.

**STUDY 1: DEVELOPMENT OF THE AROUSAL PREDISPOSITION SCALE**

**METHOD**

*Measures.* The first step involved in the development of this instrument required the assembly of an item bank. Items were selected from a variety of personality scales, observational protocols, and clinical and research reports which provide face-valid descriptions of arousal related behaviors. This procedure generated an initial pool of 314 items. These items were then culled to remove redundancies, any mention of sleep related behavior, and any items which could not be reformulated into the response format which had been chosen for the final inventory. A screening of the initial item bank was effected to isolate items which seemed to emphasize common cognitive states which might best indicate arousability as a predisposition. This resulted in a set of 70 candidate items which was to be used in the initial developmental inventory. Each item was cast...
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in the format of a self description (i.e. "I get excited easily.") and subjects could select one of five responses: "never", "seldom", "occasionally", "frequently" or "always". A sleep pattern inventory, which was an expanded version of that used in previous studies (Coren and Searleman, 1985, 1987) was prepared to measure self-reported sleep behaviors. Six specific indexes frequently associated with insomnia were assessed: (1) delayed sleep-onset latency, (2) frequent night wakenings, (3) frequent nightmares, (4) dormital restlessness, (5) early morning wakenings and (6) subjective feelings of tiredness upon arising. Each of these items was assessed using the same five point scale, ranging from "never" to "always". These items were embedded in a larger inventory which assessed some demographic and medical information.

Subjects. The population tested for the development phase consisted of 196 undergraduate student volunteers. There were 108 females and 88 males, with a mean age of 18 yr 6 months.

Procedure. Administration of the inventory to assess sleep quality was accomplished approx 1 wk before the inventory containing the arousal items was given. Testing was effected in groups, and subjects were naive as to the purpose of the experiment.

RESULTS AND DISCUSSION

For the preliminary analyses, a composite score was computed to provide a global indication of the degree of sleep disruption for each individual. This involved assigning weights from 1 to 5 to the responses to sleep pattern items, with higher scores indicating more disturbed sleep patterns. A similar scoring procedure was employed on the 70 arousability items, with higher scores indicating greater arousability. A step-wise regression was then conducted, using the composite sleep disruption score as the criterion variable and the individual inventory items as predictors. On the basis of this analysis a prototype inventory of 12 items was selected. This scale (now called the Arousal Predisposition Scale or APS) is shown as an Appendix to this paper.

Several steps were taken to ascertain the validity and reliability of this scale. To begin with, each subject was now given a total arousability score by simply summing the values given by their responses across the 12 APS items. Individual items are scored from a value of 1 (for "never") to a value of 5 (for "always"), except for item 1, which is reverse scored. The total APS score was then correlated with the composite sleep disruption index. Pearson Product–Moment correlations were also computed for the six individual indexes of sleep quality. Analyses were conducted for males and females separately as well as for the entire sample. However, since there were no significant differences as a function of gender, all subsequent analyses were collapsed across this variable and data are only presented for the total sample. The obtained correlations are presented in the first data column in Table 1.

As can be seen, the correlation between the composite sleep disruption index and the APS total is 0.51, which is highly significant ($P < 0.001$). In addition, the breakdown by individual sleep difficulties also reveals significant correlations, with the highest correlation for frequent night wakenings and the lowest for early morning awakening. Correlations for all but the latter are significant with $P < 0.001$, while the remaining correlation is significant with $P < 0.05$.

The above results suggest that the APS is a valid indicator of a predisposition toward sleep disruption. Reliability of the instrument was measured using Cronbach’s (1951) alpha coefficient as a measure of internal consistency or reliability. The obtained alpha was 0.84, showing a high internal consistency among the items.

While the above statistics suggest that we have developed an Arousability Predisposition Scale which reliably predicts self-reported sleep disruptions, we must be somewhat cautious. Before accepting the APS as a potentially useful means of assessing the predisposition toward sleep difficulties, one must recognize that the procedures employed here tend to capitalize on chance. Remember that we began by selecting the inventory items after we had ascertained the items which individually predicted the composite sleep disruption score, and then created a scale consisting of these items. Next we demonstrated the predictive validity of the resultant scale using components of the original criterion measure and the same sample that was used to select the individual items. It may be that this procedure has inflated the apparent validity of this scale. Good psychometric practice therefore requires that we cross-validate this scale—i.e. assess its validity when applied to an independent sample of subjects. In so doing we correct for the capitalization upon chance
relationships between individual items and the objective criterion which may have occurred in the development sample. To effect such a cross-validation, Study 2 was conducted.

STUDY 2: CROSS-VALIDATION OF THE AROUSAL PREDISPOSITION SCALE

METHOD

The procedures used in the cross-validation were very similar to those used in the original development study. Two testing sessions, separated by approx 1 wk, were employed. In the first, assessment of sleep difficulties was accomplished using the same inventory used in Study 1. The second session involved presentation of the 12-item Arousal Predisposition Scale, embedded in a 50-item questionnaire, containing general personality test items to mask the intent of the assessment somewhat.

The subject sample was of similar composition to that in the first study, however it was considerably larger, containing 693 individuals (396 females and 297 males) with a mean age of 18.6. The subjects were naive as to the purpose of the experiment, and none had participated in the initial development phase of the project.

RESULTS AND DISCUSSION

The statistical analyses followed a pattern similar to that used in the development of the APS, except that the item selection stage was not needed. The reliability of the scale was again assessed via Cronbach's alpha coefficient, and was found to be 0.83, which is almost identical to that obtained in the original development sample.

Predictive validity of the scale was assessed in a manner similar to that of the first study. The total APS score was correlated against the composite sleep difficulty index, and then against the individual indexes of sleep disruption. These results are presented in the right-most column of Table 1. The pattern of results is very similar to that obtained in the original sample. Although the actual value of the correlation coefficients obtained is a bit smaller in absolute magnitude (as one would expect in any cross-validation study for the reasons outlined earlier) all of the correlations are significant at P < 0.001, and all are of the same general order of magnitude obtained initially. In addition, the general pattern remains the same, with the highest association found between the APS score and self-reports of frequent night wakenings, and the lowest relationship with early morning awakenings.

The size of the correlations are quite reasonable in magnitude, as well as being statistically significant. Thus, correlation between the APS score and the composite sleep difficulty index accounts for about 20% of the predictive variance, while the relationships for five of the six individual indexes of sleep disturbance and the APS score separately account for about 10% of the variance. The only sleep difficulty index for which the arousability score seems to have negligible predictive value is early morning awakening. Thus it seems fair to summarize the results of this cross-validation as indicating that the Arousal Predisposition Scale appears to be both a valid and reliable indicator of a pattern of sleep disruptions and insomnia.
GENERAL DISCUSSION

The two studies presented in this report trace the development of a brief, simple, and apparently behaviorally valid scale, which predicts self-reports of insomnia. The scale is interesting from both a pragmatic and a theoretical standpoint.

The theoretical importance of this scale is that it was originally constructed on the premise that insomnia might be predictable from a concept of cognitive arousal, viewed not simply as arousal manifest in the pre-dormital interval, but rather as a long term behavioral predisposition or trait. Items for inclusion in the original candidate item pool were all selected with this theoretical position in mind and the resultant 12 item APS seems to have a face valid relationship to this construct. The fact that reasonable prediction of sleep disturbance can be obtained by use of such a scale, suggests that the original premise may have merit. It may well be the case that insomniacs, as a group, are generally more cognitively arousable, and that this represents a relatively long standing behavioral tendency. If such is the case, it may well indicate why insomnia is often so tenacious and difficult to treat.

From a pragmatic standpoint, the level of association observed between arousability as measured via the APS and indexes of sleep disturbance is sufficiently high, that it seems to suggest that the APS may prove to be a potentially serviceable assessment tool. It may well be valuable, not only to individuals who are interested directly in the problem of insomnia but also to those who are interested in the general problem of arousal. It is quite brief, taking only moments to fill out and to score, and can easily be incorporated as a subscale in larger inventories.

Since contemporary research and theory suggest that insomnia may not be a unitary problem, rather it may problem which can be induced by a number of different causal mechanisms, acting separately or in concert (c.f. Van Oot et al., 1984) the Arousal Predisposition Scale may help to distinguish among groups of insomnia suffers. Thus, it may well be the case that some insomniacs suffer sleep disruption due to acute or local factors, while another subgroup suffers the problem due to a chronic and general pattern of hyperarousability. Clearly, it is the latter group which is most apt to be helped by relaxation procedures which directly address the issue of arousal. To the extent that this is true, the APS may turn out to be a useful diagnostic tool.

In summary, the two studies outlined above serve to present and validate a 12-item self-report inventory, called the Arousal Predisposition Scale which is capable of predicting tendencies toward disrupted sleep patterns in a general population.

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REFERENCES


**APPENDIX**

Instructions: This questionnaire deals with a number of common behaviors and self-perceptions. For each question you should select the response which best describes you and your behaviours. You can select from among the following response alternatives:

<table>
<thead>
<tr>
<th>Never (or almost never)</th>
<th>Frequently</th>
<th>Seldom</th>
<th>Occasionally</th>
<th>Always (or almost always)</th>
</tr>
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</table>

(1) I am a calm person. N S O F A

(2) I get flustered if I have several things to do at once. N S O F A

(3) Sudden changes of any kind produce an immediate emotional effect on me. N S O F A

(4) Strong emotions carry over for one or two hours after I leave the situation which caused them. N S O F A

(5) I am restless and fidgety. N S O F A

(6) My mood is quickly influenced by entering new places. N S O F A

(7) I get excited easily. N S O F A

(8) I find that my heart keeps beating fast for a while after I have been “stirred up”. N S O F A

(9) I can be emotionally moved by what other people consider to be simple things. N S O F A

(10) I startle easily. N S O F A

(11) I am easily frustrated. N S O F A

(12) I tend to remain excited or moved for a long period of time after seeing a good movie. N S O F A

Items are scored in ascending sequence, with “Never” equal to 1 up to “Always” equal to 5, except for item number 1, which is reverse scored. An individual’s score is simply the sum of the responses for the 12 items.