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The Effects of Stress on Judgment and Decision Making: An Annotated Bibliography

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for

Contracting Officer's Representative
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This bibliography contains annotations for 48 articles. The articles fall into two main categories: empirical studies and theoretical and review articles. Although the former outnumber the latter 35 to 13, the ratio of review articles to empirical articles is surprisingly large.

The bibliography will help researchers to locate scientific articles on the effects of stress on judgment and decision making: (25) *Judgement (Psychology), *Decision making, *Stress (Psychology), *Stress (Physiology).

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THE EFFECTS OF STRESS ON JUDGMENT AND DECISION MAKING: AN ANNOTATED BIBLIOGRAPHY

PART I: INTRODUCTION

This bibliography is the result of two literature searches. One was performed on the Psychological Abstracts database from 1980 to November 1988 with the key words "stress," "judgment," and "decision making." The other was performed on the database at the Center for Research on Judgment and Policy with "stress" as a key word. In addition, the reference lists of key articles were scanned for relevant citations from 1970 to the present. A letter of inquiry was sent to each of the 60 authors cited in an effort to discover more recent work. This resulted in producing 40 more articles for consideration, bringing the total number of those considered to 165.

Description of Contents

The bibliography contains annotations for 48 articles. The articles fall into two main categories: empirical studies and theoretical and review articles. Although the former outnumber the latter 35 to 13, the ratio of review articles to empirical articles is surprisingly large.

The bibliography is intended to assist researchers to locate scientific articles concerning the effects of stress on judgment and decision making in which they might have an interest. We undertook this task because our own efforts to review the literature found that whereas generalizations abound, support for them was virtually non-existent. In order to assist the reader to find as quickly as possible those articles germane to his/her interests, each entry (with few exceptions) includes:

1. A bibliographic citation in APA style, each of which has been checked and found to be accurate, to the best of our knowledge,

2. A description of the domain to which the work applies (e.g., "word identification"),

3. The type of stressor employed (e.g., "fatigue" (sleep loss)),

4. A brief description of the method employed: for example, (a) Lab Experiment: "Within-Ss", (b) Static vs. dynamic task, (c) Task Structure: for example, "lexical decision task in right or left visual field in the context of a sleep-deprivation environment," (d) Task Content: for example, "decide whether or not a letter string constitutes a word," (e) Subjects: for example, "Young adults,"

5. Results/Conclusions: usually exact quotations from authors, and

6. Comments: usually a brief, very broad description of the article, and/or references to other articles annotated in the bibliography.

Reasons for Inclusion

Any empirical, theoretical, or review article pertaining to the relation between stress and decision making or information processing was considered for inclusion.

Reasons for Exclusion

Articles were excluded if:

1. The article was not directly concerned with decision making of a resasonably complex variety. That is, if an article merely mentioned "decision making" or "cognition" but did not make specific reference to or use of cognitive principles in the theory under examination or in the design of an experiment, the article was excluded. This criterion accounted for the largest number of articles examined but excluded.

2. The article was focused primarily on psychomotor or narrowly perceptual functions.

3. The article included mainly broad clinical observations about the effects of stress, or decisions about interpersonal relations and the like.

4. The article appeared in the literature before 1970. For example, Broadbent's (1971) book, Decision and Stress, is not included in the bibliography because (a) much of the book greatly predates its 1971 publishing date, and (b) it is seldom cited in the recent decision making and stress literature.

Empirical Work

The empirically based articles describe a wide variety of stressors; time pressure and electric shock were those most often manipulated experimentally. Stressors that appeared in observational studies are heat and emergency operations of various kinds; for example, controlling air traffic or directing a helicopter simulator through difficult maneuvers. Experimental studies far outnumber observational or field studies. Very few persistent, systematic efforts to pursue specific topics over a period of several years were found.

Theoretical/Review Work

The theoretical work fails to yield a consensus regarding the causes or effects of stress on judgment and decision making behavior. Theories are largely informal; hypotheses are rarely rigorously formulated, empirical work tends to be loosely related to hypotheses.

The review articles do not aid in establishing coherence among the articles included. Review articles cover work ranging from performance in dangerous environments such as deep-sea diving to critiques of the noise-as-a-stressor literature. They do not organize empirical studies in relation to theories.

Conclusions

No generalization regarding the effects of stress on judgment and decision making can be readily justified on the basis of the articles annotated here. No general principle explaining the effect of stress on judgment and decision making is supported by a conclusive set of empirical studies. It has not been clearly demonstrated that stress impairs, enhances, or has no effect on cognitive activity. Predictions about the effects of stress on judgment and decision making in specific circumstances cannot be defended by reference to this literature.

Organization of the Bibliography

The annotations appear in three parts. Part II lists the annotated citations alphabetically and by number. Part III lists the stressors that have been used in studies of judgment and decision making and refers the reader to the relevant study by its number in the alphabetical listing. Part IV lists the behavioral consequences (dependent variables) that have been examined and also refers the reader to the relevant study by its number.

-1-

ALLNUTT, M. F.
(1987).
Human factors in accidents. British Journal of Anaesthesia, 59, 856-864.

Domain: Review article

Stressor: N/A

Method: N/A

Results/Conclusions:

This article discusses human factors in the context of military aviation accidents. The cause and investigation of accidents are discussed as they relate to human factors in aviation accidents. Several kinds of errors contributing to accidents are distinguished, including stress, which the author terms "environment-aided errors." Generalizations about stress and human error are discussed and include (a) the simplistic nature of research on the effects of stress despite the complexity of the phenomenon in the real world; (b) the fact that "objective and subjective reactions to stress are often not well correlated" (p. 861); (c) various ways performance may break down under stress, such as narrowing of attention or "reversion" to well-learned behavior patterns.

Comments:

This article covers approximately 50 articles related to human factors and accidents, with particular attention paid to military aviation accidents. The emphasis is on errors (human or otherwise) rather than stress, although the author makes some observations about stress and human error.

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-2-

BABKOFF, H., GENSER, S. G., SING, H. C., THORNE, D. R., & HEGGE, F. W.
(1985).
The effects of progressive sleep loss on a lexical decision task: Response lapses and response accuracy. Behavior Research Methods, Instruments, and Computers, 17, 614-622.

Domain: Word identification

Stressor: Fatigue (sleep loss)

Method:

Lab Experiment: Within-Ss

Static Task

Task Structure: Lexical decision task in right or left visual field in the context of a sleep-deprivation environment

Task Content: Decide whether or not a letter string constitutes a word

Subjects: Young adults

Results/Conclusions:

"Response lapses increased as a function of sleep loss and were fitted best by a composite equation with a major linear component and a minor rhythmic component. Response accuracy decreased as a function of sleep loss, with the rate of decrease being greater for nonwords than for words. Although d' was higher for right visual field (RVF), it decreased for both fields almost linearly as a function of sleep deprivation. The rate of decrease for RVF stimulation was greater than for left visual field (LVF) stimulation. β did not change monotonically as a function of sleep loss, but showed strong circadian rhythmicity, indicating that it was not differentially affected by sleep loss per se" (p. 614).

Comments:

This article is one of four (see also Babkoff, Thorne, Sing, Genser, Taube, & Hegge, 1985; Babkoff, Mikulincer, Caspy & Kempinsky, 1988; Babkoff, Mikulincer, Caspy, Carasso & Sing, 1989) that examines the effects of sleep loss as a stressor on the performance of a specific cognitive task.

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-3-

BABKOFF, H., MIKULINCER, M., CASPY, T., CARASSO, R. L., & SING, H. (1989).
The implications of sleep loss for circadian performance accuracy. Work and Stress, 3, 3-14.

Domain: Sleep loss

Stressor: Fatigue (sleep loss)

Method:

Lab Experiment: Within-Ss

Static Tasks

Task Structure: Performance assessment battery consisting of various cognitive and perceptual tasks

Task Content: Memory and search task and psychomotor task

Subjects: Young adults

Results/Conclusions:

"The effect of sleep loss on circadian performance rhythm is discussed. Data are presented which indicate that the maxima and minima of the circadian component of performance curves are delayed by 2 to 4 h[ours] as a result of sleep deprivation. The consequences of such a change are discussed" (p. 3).

Comments:

This article evaluates the effects of sleep loss on circadian rhythmicity and cognitive performance.

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-4-

BABKOFF, H., MIKULINCER, M., CASPY, T., & KEMPINSKY, D. (1988).
The topology of performance curves during 72 hours of sleep loss: A memory and search task. Quarterly Journal of Experimental Psychology, 4, 737-756.

Domain: Sleep loss

Stressor: Fatigue (sleep loss)

Method:

Lab Experiments: Within-Ss

Static Tasks

Task Structure: Performance assessment battery consisting of physiological, psychological and performance testing

Task Content: Various cognitive tasks as well as physiological measures

Subjects: Young adults

Results/Conclusions:

"General performance and accuracy decrease over time with monitoring and rhythmic components. The signal detection discriminability index, d', decreases monotoxically with rhythmic variations. The index of response bias, [beta], shows no monotoxic trend, but significant circadian rhythmicity. The extent of the monotoxic and rhythmic changes in accuracy and in d' is directly related to the level of working memory load. The amplitude of the circadian component of accuracy and d' is enhanced for the higher levels of working memory load. The implication of potential circadian rhythmicity as a function of cumulative sleep loss is discussed" (p. 737).

Comments:

This is one of few articles to discuss how sleep loss affects performance under different working memory loads.

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-5-

BABKOFF, H., THORNE, D. R., SING, H. C., GENSER, S. G., TAUBE, S. L., & HEGGE, F. W.
(1985).
Dynamic changes in work/rest duty cycles in a study of sleep deprivation.
Behavior Research Methods, Instruments, & Computers, 17, 604-613.

Domain: Sleep-deprivation

Stressor: Fatigue (sleep loss)

Method:

Lab Experiment: Within-Ss

Static Tasks

Task Structure: Performance assessment battery consisting of visual search, mental arithmetic, logical reasoning, and memory tasks, as well as questionnaire-type tasks. Physiological variables were also recorded.

Task Content: Various cognitive tasks as well as mood questionnaire and physiological measures

Subjects: Young adults

Results/Conclusions:

"As sleep deprivation continued, the average time on task increased at an accelerating rate. The rate of increase differed among tasks, with longer tasks showing greater absolute and relative increases than shorter ones. Such increases confound sleep deprivation and workload effects. In this article, we compare the advantages and disadvantages of several experimental paradigms; describe details of the present design; and discuss methodological problems associated with separating interactions of sleep deprivation, workload, and circadian variation with performance" (p. 604).

Comments:

The participants in this study were assessed with a substantial test battery. In this article, however, the authors chose to report only the overall time it took to perform tasks of various kinds, and did not report more specific measures of performance.

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-6-

BACON, S. J.
(1974).
Arousal and the range of cue utilization. Journal of Experimental Psychology, 102, 81-87.

Domain: Dual-task performance

Stressor: Shock

Method:

Lab Experiment: Within-Ss

Static Task

Task Structure: Dual task. Central task: pursuit-rotor tracking; peripheral task: auditory signal detection

Task Content: Visual tracking task performed simultaneously with an auditory detection task signal

Subjects: University undergraduates

Results/Conclusions:

"Results indicate that arousal narrows the range of cues processed by systematically reducing responsiveness to those aspects of the situation which initially attract a lesser degree of attentional focus. This stimulus loss under arousal represents, independently of any response

criterion changes, an actual diminution in the Ss' sensitivity. In addition, it seems that arousal mediates its effect not so much by impeding the initial sensory impression as by affecting the capacity limitations and attentional control processes operating within short-term memory" (p. 81).

Comments:

This study is one of a few that use signal detection theory (cf. Babkoff et al., 1985) to distinguish sensitivity from response bias in performance of a task under stress. It may even be unique in briefly discussing the possibility that stress affects short-term memory processes rather than perceptual encoding processes.

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-7-

BADDELEY, A. D.
(1972).
Selective attention and performance in dangerous environments. British Journal of Psychology, 63, 537-546.

Domain: Review article

Stressor: N/A

Method: N/A

Results/Conclusions:

"Evidence on human performance in dangerous environments is reviewed and suggests that danger reduces efficiency, except in the case of experienced subjects. Perceptual narrowing is shown to be one source of decrement. It is suggested that danger increases the subject's arousal level which influences performance by producing a narrowing of attention. The nature of the performance decrement and of adaptation to danger are discussed in this context" (p. 537).

Comments:

This review of over 25 experimental and theoretical articles concentrates mostly on studies of dangerous environments such as deep-sea diving but also draws parallels from research on performance in other dangerous environments.

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-8-

BEN ZUR, H., & BREZNITZ, S. J.
(1981).
The effect of time pressure on risky choice behavior. Acta Psychologica, 47, 89-104.

Domain: Risky choice

Stressor: Time pressure

Method:

Lab Experiment: Within-Ss

Static Task

Task Structure: Pairs of gambles with different variances, amounts, and probabilities of winning and losing

Task Content: Use probabilities and payoffs to choose a gamble to play

Subjects: University undergraduates

Results/Conclusions:

"The results show that subjects are less risky under High as compared to Medium and Low time pressure, risk taking being measured by choices of gambles with lower variance or lower amounts to lose and win. Subjects tended to spend more time observing the negative dimensions (amount to lose and probability of losing), whereas under low time pressure they preferred observing their positive counterparts. Information preference was found to be related to choices. Filtration of information and acceleration of its processing appear to be the strategies of coping with time pressure" (p. 89).

Comments:

Ben Zur and Breznitz's results are comparable to those of Wright (1974), who employed a multi-attribute decision making paradigm. Based on their results, Ben Zur and Breznitz conclude with an implicit recommendation about the manipulation of time pressure. "Thus, the method of obtaining information about dimensions according to preferences is of greater significance in analyzing information processing prior to decision when the extreme values of the time pressure continuum are investigated" (p. 103).

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-9-

BRECKE, F. H.
(1982).
Instructional design for aircrew judgment training. Aviation, Space, and Environmental Medicine, 53, 951-957.

Domain: Aviation

Stressor: Danger

Method: N/A (theoretical article)

Results/Conclusions:

A theoretical model is presented that "unites the variables of cognitive complexity, time availability, uncertainty, and stress into one coherent model. The model is used to examine current aircrew training and to develop new training strategies for improving judgment performance" (p. 951). The model assumes that (a) "Judgment task difficulty can be seen as the resultant vector of cognitive complexity, uncertainty, and the inverse of time availability" and (b) "Stress will affect judgment performance in a non-linear fashion: positively up to an individual maximum and negatively beyond that. The stress in a situation requiring judgment can be thought of as consisting of three components: the null-level stress, stress resulting from the difficulty of the judgment task itself, and stress resulting from the interaction of the flight problem and background problem" (p. 954). Brecke describes the lack of training aircrews are given in making judgments in stressful situations. The need is particularly acute in the armed forces because of the extreme combination of variables such as cognitive complexity, uncertainty, time pressure, and stress. Brecke also describes a way to train individuals for difficult judgment situations.

Comments:

Brecke presents a model of judgment task difficulty, particularly as it relates to decision making under stress. By his own admission, however, his suggestions for training people to make decisions under stress have "not [been] tested by either experiment or experience" (p. 957).

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-10-

CHRISTENSEN-SZALANSKI, J. J. J.
(1978).
Problem solving strategies: A selection mechanism, some implications, and some data. Organizational Behavior and Human Performance, 22, 307-323.

Domain: Cost-benefit analysis

Stressor: Fatigue

Method:

Lab Experiment: Within-Ss

Static Task

Task Structure: Calculate or estimate expected profits a hypothetical person might realize (written scenario)

Task Content: Use 1 of 8 potential strategies to derive answer

Subjects: University undergraduates

Results/Conclusions:

"A manipulation check revealed failure of the task to produce fatigue. . . .[although] all participants reported that they felt more mentally fatigued after each 3-hr session than when they began. Thus, an alternative approach to fatigue is afforded by comparing the data from the first half of each of the two sessions session with those of the second half. . . . the results were significant in the predicted direction" (p. 316). That is, participants were significantly less confident in the accuracy of their responses when they reported being more fatigued.

Comments:

Although the main concern of this article was not the effect of stress (or fatigue, as manipulated here), participants were less confident in their answers when fatigued.

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-11-

COX, T.
(1987).
Stress, coping and problem solving. Work and Stress, 1, 5-14.

Domain: Review article

Stressor: N/A

Method: N/A

Results/Conclusions:

"This article outlines the developing consensus on the nature of stress. It offers a definition of stress as a psychological state derived from the person's appraisal of their [sic] ability to cope with the demands

which are made of them. The article then examines the concept of coping and explores its role in stress theory. . . . The article focuses on . . . [coping as problem solving] and in so doing it describes the nature of rational models of problem solving, considering their utility and application to stress management" (p. 5).

Comments:

This review covers more than 40 primarily theoretical articles about stress in the workplace. The small number of empirical articles reviewed rely primarily on observational data.

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-12-

COYNE, J. C., & LAZARUS, R. S.
(1980).
Cognitive style, stress perception, and coping. In I. L. Kutash, L. B. Schlesinger, & Associates (Eds.), Handbook on stress and anxiety (pp. 144-158). San Francisco: Jossey-Bass.

Domain: Review article

Stressor: N/A

Method: N/A

Results/Conclusions:

Lazarus and Coyne describe a "transactional" model of stress. This model "is explicitly cognitive-phenomenological, emphasizing how the person appraises what is being experienced and uses this information in coping to shape the course of events. . . . The effects of the coping are in turn appraised and reacted to as part of the continuous flow of psychological, social, and physiological processes and events. Stressful commerce with the environment thus involves extensive psychological mediation and reciprocal feedback loops, [which] . . . therefore requires that any comprehensive model of it be developed within a transactional, process-oriented perspective" (p. 145). In addition to describing their model in some detail, Lazarus and Coyne advocate naturalistic studies of stress, at the same time warning researchers to remain aware of laboratory studies.

Comments:

This review covers over 40 articles, many of them theoretical and not cognitively oriented. Coyne and Lazarus claim that the transactional model is a "radical redirection" from most of the current conceptions of stress.

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-13-

FRIEDLAND, N., & KEINAN, G.
(1982).
Patterns of fidelity between training and criterion situations as determinants of performance in stressful situations. Journal of Stress, 8, 41-46.

Domain: Visual search task

Stressor: Electric shock

Method:

Lab Experiment: Between-Ss

Static Task

Task Structure: Varied degrees of shock vs. control

Task Content: Visual search task

Subjects: Male Israeli candidates for officers' training course

Results/Conclusions:

The empirical evaluation of "'graduated fidelity training' whereby the trainee is exposed to gradually increasing stressor intensities . . . suggested that it is potentially more effective than high fidelity training. However, two conditions are necessary for the realization of this potential effectiveness. First, the trainee must be informed about the upper limit of the stressor intensity which he might encounter in the course of training. In the absence of such information, graduated fidelity training might become highly ineffective. Second, the trainee has to perceive high quality performance as being instrumental for the removal or attenuation of stressors" (p. 41).

Comments:

This article is grounded in theory and is one of a small number of studies that compare ways of training people to perform a task under stress. It is uncertain whether the methods explored and the results obtained may be generalized to other tasks and stressors.

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-14-

HAMILTON, V.
(1982).
Cognition and stress: An information processing model. In L. Goldberger & S. Breznitz (Eds.), Handbook of stress: Theoretical and clinical aspects (pp. 105-120). New York: Free Press.

Domain: Review article

Stressor: N/A

Method: N/A

Results/Conclusions:

Hamilton favors making a "distinction among types of stress, particularly between stress as an effect and stress as an agent" (p. 105). He argues "in support of an information processing concept of stress as an agent, where stress as an effect is seen as the consequence of the type and amount of information processing mediated by stressors, which contain and generate stressful information" (p. 105). Hamilton also distinguishes among physiological, cognitive, and psychogenic stressors. His main point about cognitive stressors concerns their effect on overloading short-term or working memory. Because all information used to guide behavior resides in working memory, it follows that stress information can overload working memory's limited capacity. "By definition, cognitive stressors are those cognitive events, processes, or operations that exceed a subjective and individualized level of average processing capacity" (p. 109). This overload can result from a person's experience or inexperience with particular stimuli. Thus, "an event does not become a stressor until a cognitive processing system has identified it as such on the basis of existing long-term memory data" (p. 117).

Comments:

This article covers more than 40 articles related to information processing and stress. Hamilton's idea is that stress can overload the limited capacity of working memory and thus degrade cognition and behavior. Hamilton does not cover the facilitation of processing under stress, however, but concentrates on its negative effects.

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-15-

HOCKEY, G. R. J.
(1970).
Effect of loud noise on attentional selectivity. Quarterly Journal of Experimental Psychology, 22, 28-36.

Domain: Visual tracking

Stressor: Loud noise

Method:

Lab Experiment: Within-Ss

Static Task

Task Structure: Dual Task. Central task: Visual tracking task; Peripheral task: detection of lights at varied positions around subjects

Task Content: Maintain alignment of pointer with moving target while also trying to detect appearance of lights

Subjects: Navy personnel

Results/Conclusions:

The results showed that "tracking (the primary task) improves in noise, as does the detection of centrally located signals in the monitoring task. Peripheral signals are detected less often in noise. The data are interpreted in terms of increased selectivity of attention with arousal" (p. 28).

Comments:

This article briefly reviews the literature up to 1970 on the effects of noise on behavior in vigilance tasks.

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-16-

HOCKEY, R.
(1979).
Stress and the cognitive components of skilled performance. In V. Hamilton & D. M. Warburton (Eds.), Human stress and cognition (pp. 141-177). New York: Wiley.

Domain: Review article

Stressor: N/A

Method: N/A

Results/Conclusions:

"The aims of this chapter are twofold; firstly, to attempt an integrated survey of research findings in the area of stress and performance and, secondly, to propose alternative methodological and theoretical approaches to the experimental study of stress effects in cognition. In reviewing the literature I have concentrated on two main areas of skilled performance, sustained attention and memory. This is primarily because most work has been done in these two fields and the findings are therefore more reliable. In addition, however, and this may be no accident, these two components may be considered as, in some ways, primary in the organization of skilled behaviour" (pp. 141-142).

In addition to pointing out the problems caused by referring to stress as both cause and effect, Hockey emphasizes the "widespread and largely uncritical acceptance of the Yerkes-Dodson law in human stress research. I do not want to object to its failure to describe the effects of stress adequately, but it blinds us to the recognition of more fundamental changes in functioning" (p. 144). More important questions are "'What changes underly the observations embodied in the Yerkes-Dodson law?' 'Why are high levels of arousal bad for performance?' 'What makes a task difficult?' In general these questions have been side-stepped in favour of circular reasoning and naive operational definitions" (p. 144).

Hockey makes two recommendations: "adopt an approach of examining the detailed effects of a single stress across a range of tasks" (p. 170), develop "a realistic functional model of cognitive behaviour. . . [with a] closer link with the mainstream theory" (p. 170).

Comments:

This article reviews over 100 articles related to the effects of stress on cognition and behavior. Much of the material reviewed is now dated and restricted to stimulus response studies, but Hockey makes important arguments concerning the Yerkes-Dodson law and suggestions for future research.

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-17-

HURST, M. W., & ROSE, R. M.
(1978a).
Objective job difficulty, behavioural response, and sector characteristics in air route traffic control centres. Ergonomics, 21, 697-708.

Domain: Aviation

Stressor: Work load

Method:

Field Study

Dynamic Task

Task Structure: Air traffic control

Task Content: Air traffic control

Subjects: Air traffic controllers

Results/Conclusions:

"Two thousand observations on 47 radar sectors in Boston and New York were used to determine the principal behavioural stressors in the air traffic control environment. Predictor variables included peak traffic, mean airspeed, sector area, sector type, radio-communication time, and theoretically derived control load factors. Expert observers rated the degree of activity and behavioural arousal of ATCs working the 47 radar sectors at the same time the objective measures were made. These 'pace' ratings were significantly related to peak traffic count and duration of radio-communications. The control load factors were not related to behavioural responses. These results suggested that estimations of workload may be made by a relatively few objective measures, and that at least one estimate of individual's behavioural responses, i.e., pace ratings, can be predicted by peak traffic counts" (p. 697).

Comments:

This article, along with Hurst and Rose (1978b), is one of a few recording observations of human behavior in a stressful, noncontrived, dynamic decision making environment. The authors do not directly study or measure cognitive variables, however.

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-18-

HURST, M. W., & ROSE, R. M.
(1978b).
Objective workload and behavioural response in airport radar control rooms.
Ergonomics, 21, 559-655.

Domain: Aviation

Stressor: Work load

Method:

Field Study

Dynamic Task

Task Structure: Air traffic control

Task Content: Air traffic control

Subjects: Air traffic controllers

Results/Conclusions:

"The results replicated previous findings that peak traffic and the duration of radio-communications functioned as behavioural stressors. Time monitoring and stand-by time also were found to predict behavioural responses. Careful consideration of these and other results led to the conclusion that peak traffic is the most generalisable environmental stressor for ATC's behaviour whereas the other workload measures are more correctly viewed as concomitants of the demand characteristics of ATC work" (p. 559).

Comments:

This article, along with Hurst and Rose (1978a), is one of a few examinations of behavior in a stressful situation fully representative of the subjects' work environment. The authors do not take cognitive variables into account, however.

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JANIS, I. L.

In a series of book chapters and articles, some of which are cited below, Janis has put forward a series of propositions about the effects of stress on decision making. We do not annotate these in detail, however, because Janis's theoretical propositions are more abstract than those generally considered here. For example, he lists seven symptoms of defective decision making as follows:

1. Gross omissions in the survey of goals or values implicated by the choice.
2. Gross omissions in the survey of alternatives.
3. Poor information search.
4. Selective bias in processing information at hand.
5. Failure to reconsider originally rejected alternatives.
6. Failure to examine some major costs and risks of the preferred choice.
7. Failure to work out detailed implementation, monitoring, and contingency plans.

For good examples of Janis's recent work the reader should consult the following:

JANIS, I. L.
(1983).
Groupthink. In H. H. Blumberg, A. P. Hare, V. Kent & M. Davies (Eds.), Small groups and social interaction (Vol. 2, pp. 39-46). London: Wiley.

JANIS, I. L.
(1983).
Stress inoculation in health care: Theory and research. In D. Meichenbaum & M. E. Jaremko (Eds.), Stress reduction and prevention (pp. 67-99). New York: Plenum Press.

JANIS, I. L.
(1983).
The role of social support in adherence to stressful decisions. American Psychologist, 38(2), 143-160.

JANIS, I. L.
(1984).
Improving adherence to medical recommendations: Prescriptive hypotheses derived from recent research in social psychology. In A. Baum, S. E. Taylor, & J. E. Singer (Eds.), Handbook of psychology and health (Vol. 4, pp. 113-148). Hillsdale, NJ: Erlbaum.

JANIS, I. L.
(1985).
Coping patterns among patients with life-threatening diseases. In C. D. Spielberger, I. G. Sarason & P. B. Defares (Eds.), Stress and anxiety (Vol. 9, pp. 461-476). Washington, DC: Hemisphere.

JANIS, I. L.
(1986).
Problems of international crisis management in the nuclear age. Journal of Social Issues, 42(2), 201-220.

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-19-

JANIS, I., DEFARES, P., & GROSSMAN, P.
(1983).
Hypervigilant reactions to threat. In H. Selye (Ed.), Selye's guide to stress research (Vol. 3, pp. 1-42). New York: Van Nostrand Reinhold.

Domain: Review article

Stressor: N/A

Method: N/A

Results/Conclusions:

Janis et al. discuss the concept of "hypervigilance," which, "in its most extreme forms, consists of an extremely agitated state of panic or near-panic. It is characterized by indiscriminate attention to all sorts of minor and major threat cues as the person frantically searches for a means of escaping from the anticipated danger." They assert that "salient characteristics of hypervigilance are temporary impairment of cognitive functioning and defective decision making in which excessive vacillation is followed by impulsive choice" (p. 2). Physiological responses and their relationship to stress are also discussed. For example, "substantial impairments of memory, concentration, discriminative abilities, and perceptual-motoric functioning have all been reported as sequelae of severe hyperventilation" (p. 7). In addition, various forms of prevention of stress are discussed.

Comments:

This article reviews over 100 articles related to stress. Most of these articles are theoretical, but many empirical findings are also discussed. Much space is devoted to physiological reactions to stress, as well as to preventive measures that might reduce stress. A related article (Mann & Janis,1982; see below) discusses Janis and Mann's "conflict theory" and describes additional hypothetical coping patterns.

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-20-

JOHANNSON, G.
(1989).
Stress, autonomy, and the maintenance of skill in supervisory control of automated systems. Applied psychology: An international review, 38(1), 45-56.

Domain: Control of automated systems

Stressor: Psychosocial

Method:

Field Studies/Lab Study

Dynamic Task

Task Structure: Various

Task Content: Control room problems

Subjects: Control room operators

Results/Conclusions:

"Results of field studies involving control room operators in process industries and a laboratory study are presented to illustrate these conditions and their consequences. It is concluded that one important way to cope with this particular application of computer technology should be to safeguard an active rather than a passive operator role. Modifications at the technical and the organizational levels. . .are discussed" (p. 45).

The authors also found that "the shift from passive monitoring to the active information processing and problem solving required during a process failure is extremely difficult to analyse in a field setting. Therefore," they "attempted to study this phenomenon in the laboratory" (p. 51) and found that "performance errors were more frequent and performance was more variable and unpredictable after passive monitoring" (p. 53).

Comments:

Although stress was not directly manipulated in this study we cite this article because we are given to understand that control room failures are stressful. The authors note that their results are in agreement with several other studies regarding passive and active control.

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-21-

KEINAN, G.
(1987).
Decision making under stress: Scanning of alternatives under controllable and uncontrollable threats. Journal of Personality and Social Psychology, 52, 639-644.

Domain: Word analogies

Stressor: Threat (electric shock)

Method:

Lab Experiment: Between-Ss

Static Task

Task Structure: Varied conditions of shock vs. control

Task Content: Solving word analogies

Subjects: University undergraduates

Results/Conclusions:

"There was no time constraint for the performance of the task. The controllability of the stressor was found to have no effect on the participants' performance. However, those who were exposed to either controllable or uncontrollable stress showed a significantly stronger tendency to offer solutions before all available alternatives had been considered and to scan their alternatives in a nonsystematic fashion than did participants who were not exposed to stress. In addition, patterns of alternative scanning were found to be correlated with the correctness of solutions to decision problems" (p. 639).

Comments:

This article (see also Keinan et al., 1987) discusses three ways in which decision making, seen as the scanning of relevant alternatives, could be considered faulty. One way, "premature closure," occurs when "a decision is reached before all alternatives have been considered" (p. 639). Another way, "nonsystematic scanning," occurs when "alternatives are considered and scanned in a nonsystematic, disorganized fashion" (p. 639). A third way, "temporal narrowing," occurs when "insufficient time is devoted to the consideration of each alternative" (p. 640).

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-22-

KEINAN G., & FRIEDLAND, N.
(1984).
Dilemmas concerning the training of individuals for task performance under stress. Journal of Human Stress, 10, 185-190.

Domain: Visual search task

Stressor: Electric shock

Method:

Lab Experiment: Between-Ss

Static Task

Task Structure: Varied degrees of shock vs. control

Task Content: Visual search task

Subjects: Male Israeli candidates for officers' training course

Results/Conclusions:

"The results pointed to three conditions for the enhancement of training effectiveness: (a) minimal interference of exposure to stressors with task acquisition, (b) familiarity with stressors characteristic of the criterion situation, and (c) absence of unrealistic expectations about future stressors. However, none of the five training procedures meets all three conditions. Implications for the design of procedures whereby persons can be trained to perform proficiently under stress are discussed" (p. 185).

Comments:

This article (see also Friedland & Keinan, 1982) is one of a small number of studies that compare methods of training people to perform a task under stress. The comparison of five different procedures, which yielded ambiguous results, demonstrates the complexity of studying decision making and training in decision making under stress.

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-23-

KEINAN, G., FRIEDLAND, N., & BEN-PORATH, Y.
(1987).
Decision making under stress: Scanning of alternatives under physical threat. Acta Psychologica, 64, 219-228.

Domain: Word analogies

Stressor: Threat (electric shock)

Method:

Lab Experiment: Between-Ss

Static Task

Task Structure: Controllable vs. no shock

Task Content: Solving word analogies

Subjects: University undergraduates

Results/Conclusions:

"Stress was found to induce a tendency to offer solutions before all decision alternatives had been considered and to scan such alternatives in a nonsystematic fashion. In addition, patterns of alternatives-scanning were found to be correlated with the quality of solutions to decision problems" (p. 219).

Comments:

This article, along with Keinan (1987), explores the hypothesis that previous studies of decision making under stress using time pressure as the stressor have proven inconclusive due to a potential confound, namely "that a complete, systematic scanning of all available alternatives, and the investment of sufficient time in the evaluation of each, might be physically impossible when time is severely limited" (pp. 221-222). Thus previous investigators have interpreted their results as being due to stress when in fact the results may be attributable purely to time limitations.

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-24-

KRUEGER, G. P., ARMSTRONG, R. N., & CISCO, R. R. (1985).
Aviator performance in week-long extended flight operations in a helicopter simulator. Behavior Research Methods, Instruments, & Computer, 17, 68-74.

Domain: Aviation

Stressor: Emergency operations and fatigue

Method:

Lab Experiment: Within-Ss

Dynamic Task

Task Structure: Extended flight operations in helicopter simulator

Task Content: Simulated helicopter flight and battery of psychological, physiological, and biochemical tests

Subjects: Army aviators

Results/Conclusions:

"Pilots maintained simulator flight parameters within acceptable tolerances of assigned headings, airspeeds, and altitudes, even into the morning of the 4th day of the schedule. However, cognitive and judgmental errors were made. Even though flight surgeons deemed them unsafe to fly by the 3rd night, pilots continued to fly well to the 5th day" (p. 68).

Comments:

The number of dependent measures in this study was quite large, although the measures related to cognition were not explored in detail.

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-25-

LAUX, L.
(1976)
The multitrait-multimethod rationale in stress research. In I. G. Sarason & C. D. Spielberger (Eds.), Stress and anxiety (Vol. 3, pp. 171-181). Washington, DC: Hemisphere

Domain: Methodology

Stressor: N/A

Method: N/A

Results/Conclusions:

"This contribution dealt with the application of multitrait-multimethod analysis to the stress area. . . .the Campbell and Fiske (1959) logic was applied to the crucial issue as to whether behavior is consistent across different stress situations or whether it is situation specific. . . .Reviewing some former studies. . .[indicated] the need for a multitrait-multimethod analysis" (p. 180).

Comments:

Readers should also consult Runkel, P., & McGrath, J. (1972). Research on Human Behavior: A Systematic Guide to Method. New York: Holt, Rinehart and Winston for suggestions regarding the use of this method for individual cases.

See also Hammond, K., Hamm, R., & Grassia, J. (1986), Generalizing over conditions by combining the multitrait-multimethod matrix and the representative design of experiments. Psychological Bulletin, 100(2), 257-269.

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-26-

LEVI, A., & TETLOCK, P. E.
(1980).
A cognitive analysis of Japan's 1941 decision for war. Journal of Conflict Resolution, 24, 195-211.

Domain: Politics

Stressor: Political confrontation

Method:

Observational study

Dynamic task

Task Structure: N/A

Task Content: N/A

Subjects: Japanese policymakers during WWII

Results/Conclusion:

"Previous studies have found that the cognitive performance of government decision-makers declines in crises that result in war. This decline has been attributed to crisis-produced stress which leads to simplification of information processing. The present study tested the disruptive stress hypothesis in the context of Japan's decision for war in 1941. Two content analysis techniques . . . were used to analyze the translated records of statements by key Japanese policy-makers. Comparisons between statements made in the early and late periods of the 1941 crisis yielded only weak evidence of cognitive simplification. Interestingly, however, the social context in which statements were made significantly affected the complexity of cognitive performance: Statements made in Liaison conferences (in which policies were formulated) were significantly less complex than statements made in Imperial conferences (in which policies were presented to the Emperor for approval). Theoretical and methodological implications of the results were discussed" (p. 195).

Comments:

This study, although conducted after events took place, is unique in that it explores the effects of stress on national policy makers.

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-27-

MALATERRE, G., FERRANDEZ, F., FLEURY, D., & LECHNER, D. (1988).
Decision making in emergency situations. Ergonomics, 31, 643-655.

Domain: Automobile accident avoidance

Stressor: Danger (accident avoidance)

Method:

Lab Experiment: Within-Ss

Dynamic Task

Task Structure: Varied speed of approach to obstacle

Task Content: Indicate minimum distance at which it was feasible to either brake or turn to avoid an obstacle.

Subjects: Experienced drivers

Results/Conclusions:

Subjects' estimates of the minimum distance at which they could turn to avoid an obstacle were significantly smaller than their estimates of the distance at which they could brake to avoid an obstacle. This suggests that a lateral movement might be the best accident-avoidance procedure, yet the available literature on the subject shows that people rarely do anything other than brake, and in many cases are not even aware of an alternative course of action.

Comments:

Stress was not directly manipulated in these experiments, although it presumably was a part of the experimental situation. The effects of stress per se on the behavior under study are not explored in detail.

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-28-

MANDLER, G.
(1982).
Stress and thought processes. In L. Goldberger and S. Breznitz (Eds.), Handbook of stress: Theoretical and clinical aspects (pp. 88-104). New York: Free Press.

Domain: Review article

Stressor: N/A

Method: N/A

Results/Conclusions:

A theory of stress is described that Mandler calls "interruption theory." "The basic premise of interruption theory is that automatic activity results whenever some organized action or thought process is interrupted. . . . That is, any event, external or internal to the individual, that prevents completion of some action, thought sequences, plan, or processing structure is considered to be interrupting. . . . It is important to note that interruption should not be imbued with negative characteristics; this process simply and neutrally involves the disconfirmation of an expectancy or the non-completion of some initiated action. Interruption is not synonymous with frustration or other related terms. Interruption may be interpreted emotionally in any number of ways,

ranging from most joyful to most noxious" (p. 92). Interruption theory is related to other theoretical conceptions of stress as well as to various aspects of cognition, such as memory and problem solving.

Comments:

This article reviews over 40 theoretical and empirical articles on stress and thought processes. Mandler discusses the interrelationships of stress and memory, consciousness, and problem solving. He also discusses the problems that extensive previous use of the term "arousal" has caused and suggests a more precisely defined alternative.

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-29-

MANN, L., & JANIS, I.
(1982).
Conflict theory of decision making and the expectancy-value approach. In N. T. Feather (Ed.), Expectations and actions: Expectancy-value models in psychology (pp. 341-364). Erlbaum: Hillsdale, NJ.

Domain: Review article

Stressor: N/A

Method: N/A

Results/Conclusions:

In this article, Mann and Janis present the "conflict theory" of decision making. Their model "is primarily concerned with identifying factors that determine the major modes of resolving conflicts. It describes how the psychological stress of decisional conflict affects the ways in which people go about making their choices" (p. 341). Mann and Janis "postulate that there are five basic patterns of coping with challenges that are capable of generating stress by posing agonizingly difficult choices" (p. 344).

The first coping pattern is "unconflicted adherence [in which] the decision maker complacently decides to continue whatever he or she has been doing, which may involve discounting information about risk of losses" (p. 344). The second pattern is "unconflicted change [in which] the decision maker uncritically adopts whichever new course of action is most salient or most strongly recommended" (p. 344). The third coping pattern is "defensive avoidance [whereby] the decision maker escapes the conflict by procrastinating, shifting responsibility to someone else, or constructing wishful rationalizations to bolster the least objectionable alternative, remaining selectively inattentive to corrective information" (p. 344). The fourth pattern is "hypervigilance [in which] the decision maker searches frantically for a way out of the dilemma and impulsively seizes upon a

hastily contrived solution that seems to promise immediate relief. . . . In its most extreme form, hypervigilance is known as 'panic'" (p. 344). The fifth coping pattern is "vigilance [whereby] the decision maker searches painstakingly for relevant information, assimilates information in an unbiased manner, and appraises alternatives carefully before making a choice" (p. 345). Mann and Janis hypothesize that, in general, the first four coping patterns tend to be maladaptive, whereas the fifth pattern usually meets "the main criteria for high-quality decision making" (p. 345). Mann and Janis also describe various related aspects of conflict theory.

Comments:

This article covers more than 40 articles related to stress and decision making, a few of which are cognitive in nature. Janis and Mann's "conflict theory" is not cast in a formal theoretical framework, however, as it "offers a general theory of decision making, not a theory of choice behavior. It is concerned with how human beings arrive at the key consequential choices of living and working, but not with predicting the actual choices they make" (p. 342). A related article is Janis, Defares, and Grossman (1983), which discusses the hypervigilance coping pattern in more detail.

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-30-

MORRISON, M. S., NEUFELD, R. W. J., & LEFEBVRE, L. A. (1988).
The economy of probabilistic stress: Interplay of controlling activity and threat reduction. British Journal of Mathematical and Statistical Psychology, 41, 155-177.

Domain: Control in stressful situations

Stressor: Danger (threat)

Method:

Lab Experiment: Between-Ss

Static Task

Task Structure: Preference for situations varying in available control

Task Content: Various

Subjects: University undergraduates

Results/Conclusions:

"In this paper, we examine salient properties of control in stressing situations; the degree of control varies with the number of alternatives available to an individual within a situation. Simulated conditions of control indicate that as alternatives become more available, so does potential reduction of the probability that aversive events will occur. The simulations indicate, further, that realizing this potential rests on predictive judgements surrounding the alternatives; such judgements represent 'cognitive demands' which are regarded as stressing in their own right. After being demonstrated quantitatively, the inverse relation between aversive-event probability and requisite predictive judgements is examined empirically. Mathematical models of preference and choice are then used to identify implications of the inverse relation for the relative 'appeal' held by alternate conditions of control. Both strengths and limitations of the current formulation and its supporting evidence are noted. Finally, the present type of control regarding stressing events is compared to other types, followed by discussion of their respective roles" (p. 155).

Comments:

These authors provide a formal treatment that makes comprehension of the theory and results difficult. Nevertheless, because it is one of the few articles to take a formal approach it constitutes significant work.

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-31-

NEUFELD, R. W. J., & PATERSON, R. J.
(1989).
Issues concerning control and its implementation. In R. W. J. Neufeld (Ed.), Advances in the investigation of psychological stress (pp. 43-67). New York: Wiley.

Domain: Theoretical article

Stressor: N/A

Method: N/A

Results/Conclusions:

"A substantial body of literature has been concerned with the interaction of stress and control. At one level, control over a threatening situation can provide the individual with the opportunity to select a less threatening future than might otherwise come about. Given that the magnitude of the stress response appears related to the intensity of threatened events, it seems likely that the response to a controllable situation is proportional to the degree of threat present in the most attractive of the available options. . . .

In addition to their stress-reducing effects, different forms of control are of interest in the way that they influence behavior in stressful situations. When multiple forms of control are available, individuals may select certain courses of action not only for their direct effects on their respective targets (stimuli, the stress response, or stress appraisals), but also for the way in which they inhibit or potentiate the use of other forms of control. This perspective is supportive of a more inclusive form of investigation which considers resources in all spheres of control. A number of strategies that may be used in the selection of coping options have been identified. While yet at an early stage of development, these models of the decision-making process hold promise for a more precise delineation of the appraisal and coping process than has so far been possible using more basic descriptive methods. An essential part of this more analytic view of the coping process will be a thorough examination of the changes in cognitive function and capacity attendant upon increases in the level of arousal: For example, a narrowing of the range of cues attended to may aid in processing relatively simple information, but impair the ability to consider more complex or peripheral stimuli" (p. 64).

Comments:

The authors present a model of choice and control, discuss the effects of stress on control and coping in detail, comment on types of control and functional relations among them, and present careful comments on arousal and information processing, including attention to peripheral stimuli and memory. Attention is given to evolutionary effects.

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-32-

PATERSON, R. J., & NEUFELD, R. W. J.
(1987).
Clear danger: Situational determinants of the appraisal of threat.
Psychological Bulletin, 101, 404-416.

Domain: Review article

Stressor: N/A

Method: N/A

Results/Conclusions:

"In this article we describe the situational determinants of the primary appraisal of threat in a specific and systematic manner. Each potential determinant is broken down and the relevant empirical and theoretical literature is reviewed. Eight propositions about the workings of these factors are presented and discussed. Primary attention is given to the factors of event severity, imminence, and probability of occurrence" (p. 404).

Comments:

This review covers more than 90 empirical and theoretical articles. Most of them do not address higher order cognitive activity, however.

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-33-

PAYNE, J. W., BETTMAN, J. R., & JOHNSON, E. J. (1988). Adaptive strategy selection in decision making. Journal of Experimental Psychology: Learning, Memory, and Cognition, 14, 534-552.

Domain: Decision making

Stressor: Time pressure

Method:

Simulation and Lab Experiment: Within-Ss

Static Task

Task Structure: Multiple risky options with multiple possible outcomes

Task Content: Use probabilities and payoffs in dollars to choose gamble to play

Subjects: University undergraduates

Results/Conclusions:

"A computer simulation using the concept of elementary information processes identified heuristic choice strategies that approximate the accuracy of normative procedures while saving substantial effort. However, no single heuristic did well across all task and context conditions. Of particular interest was the finding that under time constraints, several heuristics were more accurate than a truncated normative procedure. Using a process- tracing technique that monitors information acquisition behaviors, two experiments tested how closely the efficient processing patterns for a given problem identified by the simulation correspond to the actual processing behavior exhibited by subjects. People appear highly adaptive in responding to changes in the structure of the available alternatives and to the presence of time pressure. In general, actual behavior corresponded to the general patterns of efficient processing identified by the simulation" (p. 534).

Comments:

This article is unique in its use of a computer simulation as an aid for studying strategy selection in decision making. The within-subjects design strengthens the credibility of the conclusions reached and their representativeness of processes occurring outside the laboratory. The conclusion that "people appear highly adaptive" in the "presence of time pressure" (p. 534) is therefore significant.

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-34-

PAYNE, J. W., JOHNSON, E. J., BETTMAN, J. R., & COUPEY, E. (1989).
Understanding contingent choice: A computer simulation approach.
Unpublished manuscript.

Domain: Uses simulation to evaluate efficacy of various decision heuristics/strategies.

Stressor: Time pressure

Method:

Simulation: Measure various attributes of simulated strategies in various task environments

Static Tasks

Task Structure: Various

Task Content: Formal task properties

Subjects: Computer simulation

Results/Conclusions:

"This paper illustrates one approach to increasing our understanding of [task] contingent decision behavior, using an effort/accuracy framework and production system modeling of decision strategies to explore the interactions of [properties of] tasks with decision heuristics. The results of the simulation suggest that the contingent use of heuristics often represents an intelligent, if not optimal, form of decision making" (p. 35).

Comments:

Stress was manipulated in this study by assigning different "time weights" to various task properties. The authors conclude that the lexicographic and elimination by aspects heuristics "perform well for all

four of the time pressure and problem size combinations, whereas the other heuristics show performance declines as either time pressure or problem size increases" (p. 30).

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-35-

POULTON, E. C.
(1976a).
Arousing environmental stresses can improve performance, whatever people say. Aviation, Space, and Environmental Medicine, 47, 1193-1204.

Domain: Review article

Stressor: N/A

Method: N/A

Results/Conclusions:

"There are well known rules that heat, noise, and vibration degrade performance. Yet a number of experiments show that all three stresses can reliably improve performance, especially in tasks requiring speed or vigilance. Many of the results are not widely known, and those that are known may not be believed, whereas fallacious conclusions, which are consistent with the well-know [sic] rules, are sometimes accepted without ever checking up on them. In making recommendations for working conditions, the experiments reporting improvements in performance need to be remembered as well as the experiments reporting degradations. The ideal working environment for particular tasks is not necessarily free from all forms of stress. The questions used to obtain subjective assessment of stress do not usually provide categories to indicate that a stress can be beneficial. Subjective assessments do not necessarily mean what the investigator takes them to mean. They may be based upon a well-known rule and thus be consistent across observers. Yet they may indicate that performance has deteriorated when it, in fact, improved. Thus, subjective assessments are not an adequate substitute for measures of performance. Both subjective and objective measures are required in order to give a reasonably complete picture of the effects of stress" (p. 1193).

Comments:

This article covers over 80 articles concerned with performance under stress. Studies involving three stressors—heat, noise, and vibration—are discussed. The author argues that generalizable conclusions are difficult to derive from studies of the effects of these stressors. Inconsistencies among studies are highlighted, although there is little discussion of potential theoretical explanations for these inconsistencies.

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-36-

POULTON, E. C.
(1976b).
Continuous noise interferes with work by masking auditory feedback and inner speech. Applied Ergonomics, 7, 79-84.

Domain: Review article

Stressor: N/A

Method: N/A

Results/Conclusions:

"Noise masks sounds, that is, it prevents people from being able to hear what they want to listen to. Noise arouses people and may make them feel annoyed. At night noise may arouse them from sleep, or keep them awake. Intermittent noise is distracting. It has been claimed that continuous broadband noise of 100 dB has a detrimental effect upon work which is distinct from the effects of noise in masking sound. Evidence is presented which indicates that the claim is not correct, and should never have been made" (p. 79).

Comments:

This article covers approximately 30 articles, all of them concerned only with the effects of noise on task performance. Poulton argues that virtually every study in this area ignores the feedback-masking effects of noise. Many examples are cited, (including Hockey, 1974, reviewed here). Previous investigators have instead attributed the deleterious effects of noise on task performance to other less mundane mechanisms. Thus Poulton urges caution be exercised when articles using noise as a stressor are examined.

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-37-

RAMSEY, J. D., BURFORD, C. L., BESHIN, M. Y., & JENSEN, R. C.
(1983).
Effects of workplace thermal conditions on safe work behavior. Journal of Safety Research, 14, 105-114.

Domain: Safety in the workplace

Stressor: Temperature (not directly manipulated)

Method:

Field Study

Static/Dynamic Tasks

Task Structure: N/A

Task Content: N/A

Subjects: Persons in two industrial plants

Results/Conclusions:

"The results indicate that temperatures below and above those typically preferred by most people have a significantly detrimental effect on the safety-related behavior of workers. This is demonstrated by an index based on the ratio of observed unsafe behaviors to the total number of observed behaviors. The relationship between this index of unsafe behavior and the ambient temperature formed a U-shaped curve. The minimum unsafe behavior index occurred within the zone of preferred temperature. . . . Other factors such as metabolic workload and time during the shift also had significant effects on worked safety-related behavior" (p. 105).

Comments:

This article describes an observational study that took place over a 14-month period and involved well over 10,000 observations. No attempt was made to discriminate among different kinds of cognitive behaviors or between the effects of ambient temperature in the workplace on cognitive versus noncognitive behaviors.

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-38-

ROTHSTEIN, H. G.
(1986).
The effects of time pressure on judgment in multiple cue probability learning. Organizational Behavior and Human Decision Processes, 37, 83-92.

Domain: Multiple cue probability learning

Stressor: Time pressure

Method:

Lab Experiment: Between-Ss

Static Task

Task Structure: Linear, mixed, and curvilinear cue function forms

Task Content: Use abstract, artificial cues to predict a criterion

Subjects: University undergraduates

Results/Conclusions:

"Lens model analyses indicated that cognitive control deteriorated under time pressure while cognitive matching remained unchanged. This effect was limited to complex cue-criterion environments containing curvilinear forms. The results suggest that the time pressured individual tends to be erratic even while implementing correct policy" (p. 83).

Comments:

This article explores the effects of time pressure on judgment in the context of the lens model (see also Schwartz & Howell, 1985).

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-39-

SCHWARTZ, D. R., & HOWELL, W. C.
(1985).
Optional stopping performance under graphic and numeric CRT formatting.
Human Factors, 27, 433-444.

Domain: Weather

Stressor: Time pressure

Method:

Lab Experiment: Between-Ss (mixed design)

Dynamic Task

Task structure: "Optional stopping" paradigm; artificial hurricane-tracking scenario

Task content: Decide if and when to evacuate hypothetical town

Subject: University undergraduates

Results/Conclusions:

"Display formation had a significant effect when time pressure was involved: subjects reached earlier and better terminal decision under the graphic than the numerical format. . . . The difference reduced to nonsignificance under self-pacing . . . although significant improvements were obtained by use of a simple aiding device (calculation of worst-case probabilities). Results are generally consistent with Hammond's cognitive consistency [sic] theory" (p. 433).

Comments:

This article is one of only a small number that examine decision making under more dynamic task conditions. In addition, this article studies the effects of display format (graphic vs. numeric) on decision making.

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-40-

SHANTEAU, J., & DINO, G. A.
(1983).
Stress effect on problem-solving and decision making behavior. Paper presented at the twenty-fourth annual meeting of the Psychonomics Society, San Diego. Bulletin of the Psychonomic Society, 21, 325-371 (Abstract No. 309, p. 362).

Domain: Problem solving/decision making

Stressor: Temperature (hot, crowded living quarters)

Method:

Lab Experiment: Between and Within-Ss

Static Tasks

Task Structure: Multiple test battery of various problem solving and decision making tasks

Task Content: Various kinds of tasks, including memory, problem solving, IQ, and creativity, administered before, during, and after a stay in a hot, crowded room

Subjects: Adult volunteers

Results/Conclusions:

"Under stress, subjects showed decreases in creativity, lower reliability in decision making, and shifts in serial-position effects. In contrast, stress had little impact on verbal problem solving, general intelligence, or decision complexity" (p. 362).

Comments:

This study examined the effects of stress on several problem-solving and decision making tasks. The finding of decreased creativity under stress is noteworthy.

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-41-

SMITH, R. C.
(1985)
Stress, anxiety and the air traffic control specialist: Some surprising conclusions from a decade of research. In C. D. Spielberger, I. G. Sarason & P. B. Defares (Eds.), Stress and anxiety (Vol. 9, pp. 95-109). New York: Hemisphere.

Domain: Air traffic control

Stressor: Time pressure

Method:

Self-report Mood and Personality Questionnaires

Physiological Measures

Dynamic Task

Task Structure: Tracking moving objects to avoid collision

Task Content: Alter course and speed of airplanes to achieve safe, orderly sequence

Subjects: Experienced air traffic controllers

Results/Conclusions:

"In conclusion, there is little evidence to support the notion that ATCSs are engaged in an unusually stressful occupation. This is not to say that ATCSs never encounter unusual stress on the job; however, it does appear that this is the exception rather than the rule. ATCSs appear both well qualified and well suited for air traffic work. The demands of air traffic work do not appear to place unusual stress on ATCSs; this professional group appears quite capable of handling requirements of the job without distress. The notion that this occupational group is being pressed to the psy[c]hological and physiological limit is clearly unjustified" (pp. 106-107).

Comments:

Although this study does not directly focus on judgment and decision making, we include it because the controller's task involves both, and because it is a highly stressful one. The long-term results, based on self-report questionnaires, strongly oppose this supposition.

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-42-

WELTMAN, G., SMITH, J. E., & EGSTROM, G. H.
(1971).
Perceptual narrowing during simulated pressure-chamber exposure. Human Factors, 13, 99-107.

Domain: Pressure-chamber exposure

Stressor: Danger (belief in being exposed to a depth of 60 feet)

Method:

Lab Experiment: Between-Ss

Static Task

Task Structure: Dual Task. Central task: the Landolt-ring task (visual acuity task); Peripheral task: detection of light to side of subjects. In addition, subjects completed a posttest anxiety checklist and their heart rate was monitored throughout the experiment

Task Content: Detect orientation of gap in ring and simultaneously detect appearance of peripheral light

Results/Conclusions:

"The chamber group showed significantly higher anxiety scores and also a significantly higher heart rate throughout the experiment. There was no difference between the groups with regard to correct Landolt detections, although the chamber group responded somewhat slower. Peripheral detection, however, was severely and significantly degraded in the chamber group. It was concluded that perceptual narrowing had been demonstrated as a result of psychological stress associated with exposure to the 'dangerous' pressure-chamber" (p. 99).

Comments:

This article demonstrates the effects of perceived threat on the performance of a task. None of the dependent measures involved higher-order cognitive functions.

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-43-

WICKENS, C. D.
(1989).
The integration of complex information from auditory and visual channels under stress. (Tech. Rep. No. ARL 89-9/AHEL 89-5). Urbana-Champaign: University of Illinois, Aviation Research Laboratory, Institute of Aviation.

Domain: Aviation

Stressor: N/A

Method: N/A

Results/Conclusions:

"This report describes research that was carried out at the University of Illinois Aviation Research Laboratory to examine how the human operator's ability to integrate multiple channels of information is influenced by stress, and by display formatting which brings channels of information into closer proximity. In a series of experiments it is concluded that information integration is facilitated by combining information channels into a single object display and by the use of common color. These manipulations do not necessarily facilitate dual task performance or focused attention. Some important distinctions in the creation of object displays are also described. It is also concluded that the use of common perceptual modalities (all visual) or close spatial proximity does not enhance information integration ability, relative to dual task performance. The use of a single hand to perform two integrated response actions can facilitate performance, particularly if one action is continuous, and the other is discrete. The effects of mild stressors imposed in some of the studies in this research were to enhance benefits associated with multitask auditory displays and to enhance the benefits of object displays" (p. 1).

Comments:

This Technical Report also cites/annotates/lists 13 publications/reports that support the conclusions reached.

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-44-

WICKENS, C. D., BARNETT, B., STOKES, A., DAVIS, T., JR., & HYMAN, F. (in press).
Expertise, stress, and pilot judgment. In the 1988 NATO/AGARD Panel Meeting/Symposium of the Aerospace Medical Panel on Human Behavior in High Stress Situations in Aerospace Operations, 24-28 Oct 1988, Hague, Netherlands.

Domain: Aviation

Stressors: Time pressure, noise, financial risk, task loading

Method:

Lab Experiment: Between-Ss

Dynamic Task

Subjects: Novice/experienced pilots

Results/Conclusions:

"This paper describes two studies of pilot judgment examining the effects of stress and of expertise. Both studies were carried out on a computer-based aviation decision making simulation called MIDIS. In the first study the cognitive abilities of 40 instrument rated pilots, 20 novices and 20 experts were assessed. These pilots then flew the MIDIS simulator on a simulated cross-country flight during which their performance on a number of in-flight decisions was assessed. Experts were more confident than novices, but did not perform more optimally. The pattern of ability differences that predicted novice performance was different from that which predicted expert performance. In the second study, 10 instrument-rated pilots flew a different flight on MIDIS under conditions of stress (imposed by time pressure, noise, financial risk, and task loading), while 10 subjects flew in a nonstressed control condition. Stress had different effects on different kinds of decision problems. It degraded performance on those problems imposing high demand on working memory, but left unaffected those problems imposing high demand on the retrieval of facts from long term memory. The results are discussed in terms of the commonalities between the effects of expertise and stress, on the mechanisms of working memory and long term memory in pilot judgment" (p. 10-11).

Comments:

These studies provide perhaps the most readily generalizable results available. Moreover, the research is up-to-date theoretically and methodologically.

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-45-

WICKENS, C. D., STOKES, A., BARNETT, B., & HYMAN, F. (1988). The effects of stress on pilot judgment in a MIDIS simulator. (Tech. Rep. No. ARL-88-5/INEL-88-1). Urbana-Champaign: University of Illinois, Aviation Research Laboratory, Institute of Aviation.

Domain: Aviation

Stressors: Anxiety, time pressure, high risk

Method:

Lab Experiment: Between-Ss

Dynamic Task

Subjects: Novice/experienced pilots

Results/Conclusions:

"This report presents an information processing framework for predicting the effects of stress manipulations on pilot decision making. The framework predicts that stressors related to anxiety, time pressure, and high risk situations will restrict the range of cue sampling and reduce the capacity of working memory, but will not affect decisions that are based upon direct retrieval of knowledge from long term memory. These predictions were tested on MIDIS, a microcomputer-based pilot decision simulator. Performance on a series of 38 decision problems was compared between ten subjects in a control group and ten subjects who had performed under conditions of noise, concurrent task loading, time pressure, and financial risk. The results indicated that the stress manipulation significantly reduced the optimality and confidence of decisions. The manipulations imposed their greatest effect on problems that were coded high on spatial demand and on problems requiring integration of information from the dynamic instrument panel. The effects of stress were relatively independent of problem demands for working memory and knowledge" (p. ii).

Comments:

(See No. 44)

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-46-

WRIGHT, P.
(1974).
The harassed decision maker: Time pressures, distractions, and the use of evidence. Journal of Applied Psychology, 59, 555-561.

Domain: Multi attribute decision making (car buying)

Stressor: Time pressure, noise

Method:

Lab Experiment: Between-Ss

Static Task

Task Structure: Multi attribute decision making

Task Content: Choosing car based on five dimensions: selling price, ease of handling, cost of maintenance, styling, and riding comfort

Subjects: University undergraduates

Results/Conclusions:

"Data usage models assuming disproportionately heavy weighting of negative evidence provided best-fits to a significantly higher number of subjects in the high time pressure and moderate distraction [noise] conditions. Subjects also attended to fewer data dimensions in these conditions" (p. 555).

Comments:

The main finding of this study, that subjects under time pressure give more weight to negative information, is corroborated by Ben Zur and Breznitz's (1981) results from a risky choice task.

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-47-

ZAKAY, D.
(1985).
Post-decisional confidence and conflict experienced in a choice process.
Acta Psychologica, 58, 75-80.

Domain: Nursing

Stressor: Time pressure

Method:

Lab Experiment: Between/within-Ss

Static Task

Task Structure: Deciding between competing actions

Task Content: Nursing decisions about patient assistance

Subjects: Female (2nd year) nursing students

Results/Conclusions:

"The hypothesis regarding post-decisional confidence was supported: the level of confidence after non-compensatory decisions was higher than that after compensatory decisions. However, level of confidence was not influenced by time pressure. . . .

[Therefore] the hypothesis regarding the influence of time pressure was. . .supported; the utilization of compensatory strategy decreased under time pressure. This finding is consistent with Ben Zur and Breznitz's (1981) evidence for a filtration mechanism used under time pressure.

Post-experimental interviews held with nurses indicated clearly that under time pressure they relied mainly on that information which they felt to be most important.

Fluctuations between compensatory and non-compensatory decision processes were found within each subject, without any obvious systematic pattern. . . .

The findings that the level of confidence is higher after non-compensatory decisions than after compensatory ones has undesirable implications for real-life decisions since, as noted by Tversky (1972), from a rational point of view non-compensatory decisions might be inferior to compensatory decisions. The situation is, in a way, paradoxical: how can we expect decision makers to decide more optimally if they feel more confident when they decide less optimally"? (p. 79-80).

Comments:

Although the data base for this study is small (20 subjects, 6 cases) the distinction drawn between compensatory and non-compensatory decision processes is important, as is the discovery that time pressure led to a greater use of non-compensatory processes. Also significant is the author's discovery of alternation/fluctuation between these processes.

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-48-

ZAKAY, D., & WOLLER, S.
(1984).
Time pressure, training and decision effectiveness. Ergonomics, 27, 273-284.

Domain: Multi attribute decision making

Stressor: Time pressure

Method:

Lab Experiment: Between-Ss

Static Task

Task Structure: Multi attribute decision making, pre- and post-training

Task Content: Choosing household appliance based on five dimensions: cost, size, service quality, electricity consumption, and brand fame

Subjects: University undergraduates

Results/Conclusions:

"It was found that training resulted in more effective decision making only under the 'no time pressure' condition. Under time pressure the training did not improve the quality of decision making at all, and the effectiveness of the decisions was significantly lower than under no time pressure. It was concluded that specific training methods should be designed to help decision makers improve their decisions under time pressure" (p. 273).

Comments:

The topic of this article (training people to make decisions under stress) is related to work by Friedland and Keinan (1982) and Keinan and Friedland (1984).

Part III: CONDITIONS USED AS STRESSORS

Danger: 9, 27, 30, 42

Electric Shock: 6, 13, 21, 22, 23

Fatigue: 10, 24

Noise: 15, 46

Political confrontation: 26

Psychosocial: 20

Sleep loss: 2, 3, 4, 5

Temperature: 37, 40

Time pressure: 8, 33, 34, 38, 39, 41, 44, 45, 46, 47, 48

Work load: 17, 18

Part IV: BEHAVIORAL CONSEQUENCES EMPIRICALLY EXAMINED

Affect: 5, 14, 41

Attention: 15, 16, 24

Judgment/Decision Making (broadly defined): 5, 8, 10, 14, 19, 20, 22, 23, 24, 26, 27, 30, 33, 34, 38, 40, 43, 44, 45, 46, 47, 48

Memory: 4, 5, 6, 14, 16, 44, 45

Perception: 2, 5, 21, 22

Performance: 2, 4, 5, 6, 13, 24, 39