

Effects of Work Load, Role Ambiguity, and Type A Personality on Anxiety, Depression, and Heart Rate

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Type A personality (hard driving, persistent, involved in work) was studied as a conditioner of the effects of quantitative work load and role ambiguity (stresses) on anxiety, depression, resentment, and heart rate (strains) among 73 male users of a university computer system that was approaching an imminent 23-day shutdown. Each respondent was his own control. Stress, personality, and psychological strain were assessed by questionnaire, and heart rate was measured. Change scores were then analyzed. Role ambiguity was positively associated with anxiety, depression, and resentment; subjective work load was positively associated only with anxiety. Anxiety was positively related to heart rate. The relationship between work load and anxiety was greatest for Type A persons, and a similar, but nonsignificant trend appeared for the effects of anxiety on heart rate. Response and respondent specificity are discussed.

Given a particular set of job demands and a particular person(ality), how do the two combine to determine the human ability to cope with job stress? This question is often stated programmatically as $B = f(P, E)$, where B is behavior, P is the person, and E the environment. Although B can represent productivity or the behavior of the employee in relating to others, it can also represent the emotional and physiological reactions of the person as in the present research. This study examined the role of Type A personality in the relationship between work stresses and psychological and physiological strains. The study, longitudinal in design, capitalized on the impending shutdown of a large computer facility at a university.

Expected Effects of the Computer Shutdown on Work Stress

The main computer at a large university was being shut down for a move to a new facility. Normally, the computer operates 24

hours a day, 7 days a week with brief, periodic interruptions for normal servicing and unanticipated disruptions of the system. Such interruptions usually last no more than a few hours, but in this case according to the computing center newsletter, the shutdown was planned to last 23 days.

For many users the shutdown occurred at an unfortunate time. The shutdown took place at the end of an academic term and at the beginning of the 2-week final examination period. Usually, the 2 weeks of the final examination period provide an opportunity for many computer users to work long stretches at a time on the computer without the interruption of scheduled seminars and classes. Very often, term projects requiring the use of the computer are completed during this final examination period. Consequently, the shutdown seemed to provide an ideal situation for studying the effects of high work load. Because the situation was unique we expected that many users might experience a great deal of ambiguity in deciding how to complete their work most efficiently in the short time that remained.

Distinctions Among Forms of Stress

In studying stress we differentiated between its objective and subjective forms. Objective stress is measured independently of a person's environmental perceptions, whereas subjective stress relies on self-reports. This distinction is

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necessary unless one is willing to assume that objective and subjective stress have the same effects on human strain. We know from previous research, however, that such an assumption may be unwarranted. For example, subjectively measured role conflict, compared to objectively measured conflict, was a better predictor of job-related tension (Kraut, 1965). Similarly, in a study of the relationship between quantitative work load and cardiovascular response, it was shown that subjective ratings of work load, compared to objective tallies by observers of each person's phone calls, office visits, and meetings, were better predictors of heart rate (French & Caplan, 1972). Although the objective and subjective measures were positively correlated ($r = .64$), and although both measures were positively correlated with heart rate, all of the variance in the relationship between the objective measure of work load and heart rate could be explained by the effect of the subjective measure. It was how the person viewed the work, rather than its objective amount, that counted. The study indicated that both objective and subjective measures of work load independently accounted for variance in serum cholesterol levels.

Two stresses, quantitative work load and role ambiguity, were chosen for study because both appeared to be salient features of the computer shutdown. Quantitative work load refers to the amount of work a person is asked to complete in a given amount of time. Role ambiguity exists when a person does not know what is expected of him or her for adequate performance of a role or task demand. Both of these forms of stress are quite prevalent in the American work force: A survey of the work force of the United States found that 44% of the respondents reported high quantitative work load (overload) and that 35% of the respondents reported role ambiguity (Kahn, Wolfe, Quinn, Snoek, & Rosenthal, 1964).

Personality

Theoretical formulations of human behavior (Lewin, 1935; Murray, 1938) and previous laboratory (Sales, 1969, 1970) and cross-sectional research (Caplan, 1971; Kahn

et al., 1964) suggest that personality interacts with job stresses to determine the well-being of employees. Our research has focused on the set of personality characteristics known as Type A because of their predictive association with coronary heart disease as found by Rosenman, Friedman, Straus, Jenkins, Zyzanski, and Wurm (1970). Their studies depicted the Type A coronary personality as hard driving, persistent, involved in work, oriented toward leadership and achievement, and having a sense of time urgency; Type B personality characteristics were considered to be the opposite. Most people's personalities, however, are believed to lie on a continuum between the two.

These studies added Type A personality to the list of unique risk factors in coronary heart disease, but they did not deal with the reasons for the association of the traits and the disease. Is it a matter of heredity? Do those with Type A personality tend to enter high-stress work and social environments or do they react to stress differently? It is our belief that Type A persons should be the most strongly strained by the effects of a job stress such as an impending computer shutdown because they are more involved in their work and more persistent than persons without Type A traits. On these bases, it was predicted that Type A persons would show stronger relationships between changes in stress and changes in strain than Type B persons, their opposites.

METHOD

Subjects

One hundred twenty-two males, (mean age = 23, $SD = 4.7$), representing a 94% response rate, completed the first questionnaire. Of this sample, 91% were graduate and undergraduate students, and the remainder were faculty or postgraduate fellows.

Procedure

April 14-16, 1971, marked the last 3 days preceding the announced shutdown of the central computing facility of the university. During this time (Time 1), systems users were approached by the first author at the output window and asked if they would sit down in a nearby area and fill out a 10-minute questionnaire dealing with their work.

The respondents were told that if they volunteered, a second questionnaire would be sent to them several months later in order to obtain additional informa-

tion. In September, 1971 (Time 2), a period chosen for its relatively low level of stress, all respondents were mailed a practically identical questionnaire. Sixty percent ($n = 73$) of the original sample returned this questionnaire, and they formed the sample upon which analyses were performed.

Measures

Subjective quantitative work load and role ambiguity. Three-item indexes of these stresses were used. They had previously been used in a longer form in other research and development settings (Caplan, 1971). The quantitative work load index required ratings of items such as "the amount of work you have to do," and the role ambiguity index had items such as "the extent to which you know what you are supposed to do." The items were rated on a 5-point scale ranging from "very little" (1) to "very great" (5). The indexes of quantitative work load and role ambiguity had estimated reliabilities (formula from Nunnally, 1967) of .77 and .82, respectively, and repeat reliabilities of .06 and .34, respectively. These coefficients indicate that the measures had acceptably high cross-sectional reliabilities, yet had repeat reliabilities low enough to suggest they were measures varying with changes in the objective environment (Time 1 was assumed to be objectively more stressful than Time 2).

Type A personality. A set of four items described by Vickers (Note 1) was used. Validation information is presented in Caplan (1971). This four-item index has a cross-sectional reliability of .73 and a repeat reliability that is also acceptably high for a measure of a trait rather than a state ($r = .69$). Items for the index, such as "In comparison to most people I know I'm very involved in my work" and "I thrive on challenging situations; the more challenges I have the better," were rated on a 7-point scale ranging from "not at all true of me" (1) to "very true of me" (7).

State rather than trait anxiety, depression, and resentment. These indicators of psychological strain were developed by Cobb (Note 2) in a study of men losing their jobs. Respondents were asked to rate "how much of the time do you feel this way?" on a four point scale ranging from "a little of the time" (1) to "most of the time" (4). The measure of anxiety included items such as "I feel nervous" and "I am worried." The measure of depression included items such as "I feel unhappy" and "I feel depressed." The measure of resentment included items such as "I feel I get a raw deal out of life" and "Other people always seem to get the breaks." Despite the relatively high cross-sectional reliabilities of the anxiety, depression, and resentment measures ($r_{kk} = .88, .70, \text{ and } .87$, respectively), their repeat reliabilities were low with the exception of the index of resentment ($r_{kk} = .34, .40, \text{ and } .63$, respectively).

Heart rate. The computer shutdown was brought to the first author's attention 6 days before the shutdown took place. The urgency of the situation (data collection commenced 3 days later) ruled out mea-

asures of physiological strain other than heart rate. Heart rate, however, has been suggested as a risk factor in coronary heart disease by Stamler et al. (Note 3), although the level of psychological stress of persons with high heart rate in the Stamler et al. study has not been examined. Following the completion of the questionnaire at Time 1, a 30-sec reading of heart rate was taken while each respondent remained seated. At Time 2 respondents took their own heart rates at the start and at the end of the questionnaire according to pretested instructions. Heart rate was asked for at the start of the questionnaire to give the respondent practice and also to obtain an estimate of the reliability of the self-administered pulse rate readings. The correlation between the two pulse rates at Time 2 was .89 ($p < .001$).

Average number of cigarettes smoked was obtained as a potential dependent variable. Only 13% (9) of the 73 respondents smoked, however, thus yielding too little variance for analyses.

Analyses

The relationships between changes in stress and changes in strain from Time 1 to Time 2 were examined. Respondents served as their own controls. To deal with regression toward the mean in change scores, adjustments were made for the law of initial values (Wilder, 1957). Since initial values may determine ceilings on the amount of change possible, scores were residualized for their relationship with the Time 1 scores by the use of linear regression equations. Inspection of the scatter plots of Time 1 scores against their respective change scores indicated that this procedure was statistically justified. OSIRIS (Institute for Social Research, 1973) and MIDAS (Fox & Guire, 1972) computer programs were used for the statistical analyses.

RESULTS

Time 1 Versus Time 2

The levels of stress and, particularly, of strain at the time of the shutdown were compared with the respective levels during the follow-up period, 5 months later. There were changes over time, and these changes supported our contention that the period of the impending shutdown was indeed a trying one. These findings are presented in Table 1.

Mean anxiety dropped from 2.29 at Time 1 to 1.83 at Time 2 ($p < .001$). Depression and resentment were also significantly lower at Time 2 ($p < .004$ and $p < .002$, respectively), although the change in their levels was not as marked. Heart rate dropped from 73.9 to 69.7 beats per minute ($p < .005$). Thus, there were clear changes in strain.

TABLE 1
 MEANS AND STANDARD DEVIATIONS OF STRESS, PERSONALITY, AND STRAIN AT TIMES 1 AND 2

Measure	Time 1		Time 2		<i>t</i>	<i>p</i> <	Residualized ^a	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			<i>t</i>	<i>p</i> <
Subjective stress								
Quantitative work load	3.55	.79	3.39	.66	1.36	.10	—	—
Role ambiguity	2.20	.66	2.26	.54	-.78	<i>ns</i>	—	—
Type A personality	4.71	1.21	4.68	1.06	.22	<i>ns</i>	—	—
Strain								
Anxiety	2.29	.75	1.83	.58	5.02	.001	-1.26	<i>ns</i>
Depression	1.81	.63	1.59	.57	2.78	.004	-.58	<i>ns</i>
Resentment	1.45	.54	1.29	.47	2.91	.002	.21	<i>ns</i>
Heart rate	73.90	13.26	69.74	11.59	2.83	.003	-1.53	.07

Note. *N* = 70.

^a Strain residualized for the effects of subjective quantitative work load and, where appropriate, for role ambiguity.

Subjective quantitative work load tended to be highest at the time of the shutdown ($p < .10$), but role ambiguity remained unchanged. It appears that the ambiguities of the shutdown matched the ambiguities marked by the start of the new academic year at Time 2. Type A personality scores remained unchanged over time, as would be expected of a measure of a trait rather than a state.

Personal observations by the first author also support the conclusion that the period of the impending shutdown was quite stressful. During the 3 days preceding the shutdown, unusually long queues of people stood before the computer input window. Turn-around time for data processing had tripled. When users were asked to fill out the questionnaire, their first reaction often seemed to be a discharge of strain. They often broke into grins, some even burst out laughing, and many made comments such as "Hook me up; I'm your man," or "I've been stuck here since eight o'clock last night." Bloodshot eyes, a usually clean work and study area that was cluttered with crumpled, frayed, and often spilled throwaway coffee and cola cups, a normally airy keypunch room jammed with people standing in lines and waiting their turn at the punches, and groups of bedraggled users crowded around television monitors that displayed the processing status of their jobs, all suggested a high-stress situation as people worked against the approaching deadline for the shutdown.

Main Effects of Stress

Longitudinal relationships between stress, personality, and strain support our theoretical model of behavior as a function of person and environment. The major findings are summarized in Figure 1.

First, changes in subjective quantitative work load from Time 1 to Time 2 were positively correlated with changes in anxiety-tension ($r = .38$, $p < .001$). Changes in anxiety-tension were, in turn, positively associated with changes in heart rate ($r = .33$, $p < .005$). This positive association between anxiety and elevated heart rate was noted in a number of studies reviewed by Martin (1961). Changes in subjective work load were weakly associated with changes in heart rate ($p < .10$). This relationship dropped from .16 to .05 when the effects of anxiety-tension on heart rate were partialled out. Consequently, any effect of perceived work load on heart rate may have occurred via its impact on the computer user's state of anxiety.

Changes in role ambiguity were positively correlated with changes in anxiety ($r = .25$, $p < .05$), although they were unrelated to changes in heart rate ($r = -.03$). Changes in subjective role ambiguity and in subjective work load were relatively uncorrelated ($r = -.14$, *ns*). Together they accounted for 24% of the variance in the changes in anxiety ($R = .49$, $p < .001$). There were also some additional main effects, although weaker in

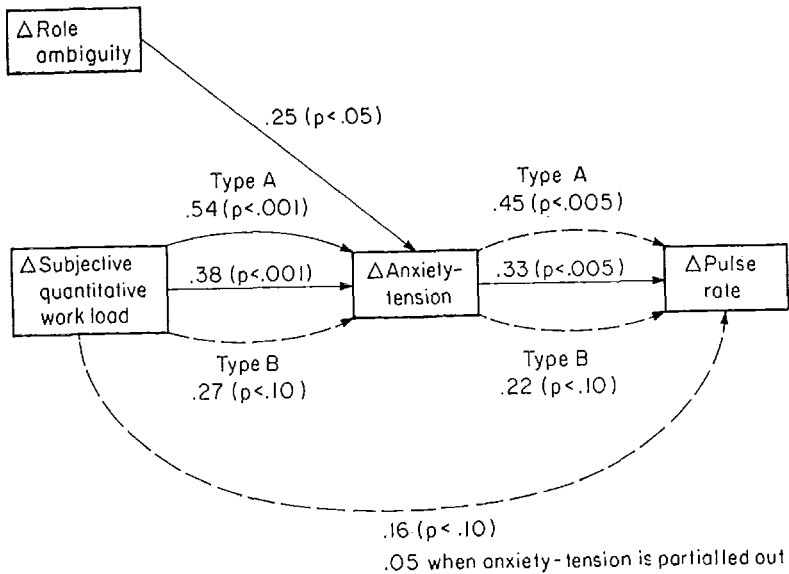


FIGURE 1. Theoretical interpretations of the relationships between perceived work load, anxiety, Type A/B personality, and pulse rate. (Solid arrows indicate the most probable pathways between the stresses and strains based on multiple regression analyses and tests of significance in the case of interactions with personality. Dotted arrows represent less probable pathways. First-order correlations are presented. Change scores are residualized for the effects of their initial values.)

magnitude, of stress on psychological strain and of psychological strain on physiological strains. Subjective work load was uncorrelated with depression and resentment ($r = .01$ and $.10$, respectively, *ns*). Role ambiguity correlated $.24 (p < .05)$ with resentment and $.20 (p < .10)$ with depression. Resentment and depression, in turn, had relatively low correlations with heart rate ($r = .23, p < .05$ and $r = .15, ns$, respectively). Consequently, it appears that the stresses of ambiguity and work load were more likely to be associated with feelings of anxiety than with feelings of resentment and depression.

Effects of Personality

To see whether or not the effect of stress on strain was greater for Type A than for Type B persons, the sample was split at the median of the Type A personality distribution. The correlation between changes in subjective work load and changes in anxiety was $.54$ for the Type A persons but only $.27$ for the Type B persons ($P_{r_1 > r_2} < .10$). The slope of the regression of changes in work load on changes in anxiety was higher ($p <$

$.05$) for the Type A persons ($\beta = .61$) than for the Type B persons ($\beta = .17$). There was a similar tendency for the relationship between changes in anxiety and heart rate to be higher for the Type A ($r = .45, p < .005$) than for the Type B persons ($r = .22, p < .10$), although there was no difference in the regression slopes of the two groups.

Objective Versus Subjective Environment

To what extent were the differences in stress and strain at Times 1 and 2 due to the subjective perceptions of the computer users? In past studies that utilized quantifiable measurements of the objective environment by independent observers (French & Caplan, 1972; Kraut, 1965), it was relatively easy to partial out the effects of the objective environment and to see whether or not the subjective environment was still related to strain. In the present study, such procedures were not possible because no quantifiable measures of the objective environment were obtained. However, the following analysis is a partial approach to the preceding question.

In Table 1 we presented *t* tests of the mean differences in strain from Time 1 to Time 2. It may be assumed, for lack of better information, that any significant differences are due to a combination of effects of the objective and the subjective environments. We decided to residualize anxiety for the effects of subjective quantitative work load and role ambiguity and to residualize heart rate for the effects of subjective quantitative work load as a step toward removing the effects of subjective environment from the analyses. Multiple regression was used to compute the residuals. This procedure was appropriate since work load and role ambiguity correlated .29 ($p < .002$) and .42 ($p < .001$), respectively, with anxiety at Time 1 and correlated .36 ($p < .002$) and .21 ($p < .08$), respectively, with anxiety at Time 2. Work load was uncorrelated with heart rate at Time 1 ($r = .01$) but correlated .20 ($p < .05$) at Time 2. Student's *t* tests were once again performed using the residualized measures of strain. The recomputed *t* test values showed drops to nonsignificance (see Table 1). Obviously this is an oblique way to test hypotheses about the effects of an *objective* environment. The findings are suggestive, nevertheless, of the hypothesis that the effects of objective environment on strain operate via the subjective environment.

DISCUSSION

Response Specificity: Anxiety Versus Resentment and Depression

The analyses show that anxiety covaried with stress to a greater degree than did either resentment or depression. This pattern of results may be largely due to differences in the nature of a stimuli required to evoke each of these three emotions.

"Resentment," a term derived from Nietzsche's work, is, according to Max Scheler (1961, p. 46), "primarily concerned with revenge, hatred, malice, envy, the impulse to detract, and spite." Consequently, one finds resentment expressed in contexts where people are subject to one another's imagined or real machinations. This type of context is not very applicable, however, to the computer users; they were, foremost, victims of an impersonal technological change,

not the target of a specific person's malice. In spite of these conditions, persons did express higher levels of resentment during the anticipation of the shutdown than during the more tranquil follow-up period. Such resentment must have had its roots outside the domain of stresses surveyed by the questionnaire. There may have been feelings directed against people who required work of respondents by a certain deadline. The respondents may have made social comparisons with more fortunate persons who were able to fulfill their responsibilities without resorting to the dispassionate computer.

Depression appears to occur after a harmful or dangerous event rather than in anticipation of the event (Arieti, 1970). Whatever depresses a person is perceived as already having an impact on the present and the future. Anxiety, on the other hand, takes place during the anticipation of danger or harm. The anxious person sees the danger as a threat either in the near future (e.g., at each proceeding second) or in the more distant future. The anticipatory character of anxiety has been explained from various points of view (Brenner, 1953; Freud, 1926/1959; Lazarus & Averill, 1972) but always with its future orientation as an important facet of the emotion. The conditions for depression seem to be less well met than the conditions for anxiety in this study because we examined an impending shutdown, a threatening event in the future rather than in the past. This observation is supported by findings that showed greater reductions in anxiety than in depression from Time 1 to Time 2. Still, the mean level of depression in the sample was higher during the impending shutdown than in the follow-up period several months later. As Lazarus and Averill (1972) pointed out, anxiety accompanies states of ambiguity about the future. For those who were already depressed, the ambiguity may have been resolved. They may have already decided, a priori, that the die was cast, that the undesirable consequence of failing to complete their work before the shutdown was practically guaranteed, and that the future was, consequently, no longer ambiguous but patently all too clear.

Respondent Specificity: Type A Personality and Strain

The conditioning effects of Type A personality on the relationship between stress and anxiety are very consistent with the research previously cited. Stress had its greatest effects on strain in the hard driving, involved, Type A person. These findings are also consistent with data published by Gurin, Veroff, and Feld (1960) in the national survey study *Americans View Their Mental Health*. Gurin et al. point out that job involvement, characteristic of Type A personality, is both a blessing and a curse. They found that the higher the status of people's occupations, the more involved they were in their work. These highly involved persons obtained greater emotional rewards from their successes, but they also paid a greater psychological price when they faced prospects of failure in their work roles.

From a practical point of view, it appears that employees with Type A traits would be of great value to organizations devoted to productivity and achievement. The research presented here and in other cited studies, however, suggests that these same individuals may contribute to their organizations at some cost to their own mental and physical health. Whether or not these costs offset the value of the employee's productivity is a worthy scientific question even apart from any moral considerations.

REFERENCE NOTES

1. Vickers, R. *A short measure of the Type A personality*. Unpublished document, Ann Arbor: University of Michigan, Institute for Social Research, February 1973.
2. Cobb, S. *Class A variables from the card sort test* (A Study of People Changing Jobs, Project Analysis Memo 12). Ann Arbor: University of Michigan, Institute for Social Research, July 24, 1970.
3. Stamler, J. et al. *Heart rate: An important risk factor for coronary mortality, including sudden death—Ten year experience of the Peoples Gas Co. Epidemiologic Study (1958-1968)*. Paper presented at the Second International Symposium on Atherosclerosis, Chicago, November 1969.

REFERENCES

- Arieti, S. Cognition and feeling. In M. Arnold (Ed.), *Feelings and emotions*. New York: Academic Press, 1970.
- Brenner, C. An addendum to Freud's theory of anxiety. *International Journal of Psycho-Analysis*, 1953, 34, 18-24.
- Caplan, R. D. Organizational stress and individual strain: A social psychological study of risk factors in coronary heart disease among administrators, engineers, and scientists. Ann Arbor: University of Michigan, Institute for Social Research, 1971. (University Microfilms No. 72-14822)
- Fox, D., & Guire, K. *Michigan Interactive Data Analysis System (MIDAS)* (2nd ed.). Ann Arbor: University of Michigan, Statistical Research Laboratory, 1972.
- French, J. R. P., Jr., & Caplan, R. D. Organizational stress and individual strain. In A. J. Marrow (Ed.), *The failure of success*. New York: AMACOM, 1972.
- Freud, S. *Inhibitions, symptoms, and anxiety* (Vol. 20, Standard ed.). London: Hogarth Press, 1959. (Originally published, 1926.)
- Gurin, G., Veroff, J., & Feld, S. C. *Americans view their mental health*. New York: Basic Books, 1960. Institute for Social Research. *OSIRIS III. An integrated collection of computer programs for the management and analysis of social science data*. Ann Arbor: University of Michigan, 1973.
- Kahn, R. L., Wolfe, D. M., Quinn, R. P., Snoek, J. D., & Rosenthal, R. A. *Organizational stress: Studies in role conflict and ambiguity*. New York: Wiley, 1964.
- Kraut, A. The study of role conflicts and their relationships to job satisfaction, tension, and performance (Doctoral dissertation, University of Michigan, 1965). *Dissertation Abstracts*, 1965, 26, 7476. (University Microfilms, No. 66-6637)
- Lazarus, R. S., & Averill, J. R. Emotion and cognition: With special reference to anxiety. In C. D. Spielberger (Ed.), *Anxiety: Current trends in theory and research* (Vol. 2). New York: Academic Press, 1972.
- Lewin, K. *A dynamic theory of personality*. New York: McGraw-Hill, 1935.
- Martin, B. The assessment of anxiety by physiological behavioral measures. *Psychological Bulletin*, 1961, 58, 234-255.
- Murray, H. A. *Explorations in personality*. New York: Oxford University Press, 1938.
- Nunnally, J. C. *Psychometric theory*. New York: McGraw-Hill, 1967.
- Rosenman, R. H., Friedman, M., Straus, R., Jenkins, C. D., Zyzanski, S. J., & Wurm, M. Coronary heart disease in the Western Collaborative Group Study: A follow-up experience of 4½ years. *Journal of Chronic Diseases*, 1970, 23, 173-190.
- Sales, S. M. Organizational role as a risk factor in coronary disease. *Administrative Science Quarterly*, 1969, 14, 325-336.
- Sales, S. M. Some effects of role overload and role underload. *Organizational Behavior and Human Performance*, 1970, 5, 592-608.
- Scheler, M. *Ressentiment*. New York: Free Press, 1961.
- Wilder, J. The law of initial values in neurology and psychiatry. Facts and problems. *Journal of Nervous and Mental Diseases*, 1957, 125, 73-80.

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