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A reflection of cognitive styles in the heart rate of paranoid and nonparanoid schizophrenics.

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A REFLECTION OF COGNITIVE STYLES IN THE HEART RATE OF PARANOID AND NONPARANOID SCHIZOPHRENICS

A Thesis Presented

By

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OF PARANOID AND NONPARANOID SCHIZOPHRENICS

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In 1894 Freud differentiated paranoid from nonparanoid schizophrenics by comparing their major defenses. From clinical data he identified the major defense of the nonparanoid schizophrenic as repression and that of the paranoid as projection. In the 80 years which have followed, numerous and sometimes conflicting differences between paranoid and nonparanoid schizophrenics have also been observed on a variety of laboratory measures. Magaro (1974) has proposed a theory to account for these multiple differences. He states that it is the failure to understand the impact of multiple variables, such as drive, perception, cognition, and attention, which is responsible for the consistent finding of a schizophrenic deficit and the persistent, conflicting results in research. He concludes that multiple, complex psychological processes are required even in completing a simple task, and that it is the inability to integrate these processes, rather than the effect of any single variable, that is responsible for the deficit.

Integration Theory

The work to be reported will test the integration theory of schizophrenia proposed by Magaro (1974; Magaro, Miller, & McDowell, 1975; McDowell, Reynolds, & Magaro, 1975). The theory contends that the schizophrenic performance deficit is the result of an inability to integrate a variety of cognitive and perceptual functions in problem solving situations. According to integration theory, cognition and perception cannot function independently since a combination of these two processes is required for satisfactory performance on most tasks. Their reciprocal, corrective influence on one another is crucial to successful task performance. In normals cognition and perception function as integrated processes with their specific equilibrium being both situationally and developmentally determined. Schizophrenics emphasizing only one of these two basic processes will be deficient in both everyday living situations and most laboratory tasks where the integration of cognitive and perceptual processes is necessary. Magaro further suggests that the impaired capacity for integration results in separate resolutions which differentiate paranoid and nonparanoid schizophrenic subgroups. The paranoid resolves the integration deficit by relying on cognitive processes which, because they are poorly integrated with perceptual processes, are not modified or refined by data from the environment. The paranoid processes data by forcing or distorting percepts into existing cognitive structures. Nonparanoids resolve the problem by relying on perceptual data which are not related to former patterns, events, or logical schemes of organization.

Other theorists have also emphasized the importance of the reciprocal influence of cognition and perception. Piaget (1952) and Werner (1948) have been clear in their contentions that an integration between the individual's perceptions of the world and his internal cognitive structures, by which perceptions are organized, is important for adequate adaptation. To generate a developmental model of schizophrenia, Magaro draws a rough parallel between Piaget's dialectic processes of assimilation and accomodation and the integration of conceptual and perceptual systems:

> We propose that Piaget's theory of adaptation, in which the dialectic processes of assimilation and accomodation produce equilibrium at successively higher levels of schema-complexity, is translatable to a theory of integration of conceptual and perceptual systems.
>
> Flavell (1963) sees assimilation rising from "the fact that every cognitive encounter with an environmental object necessarily involves some kind of cognitive structuring (or restructuring) of that object in accord with the nature of the organism's existing intellectual organization" (p. 48). That is, assimilation involves the fitting of perceptions into existing schemas (cognitive structures). This may do some violence to what we call objective reality, e.g., the thumb and breast are different objects, but when both are assimilated in the sucking schema the perceptions of each are assigned to a single cognitive structure. Thus, in our terms, assimilation is a largely perceptual process, a process permitting the assignment of data to an existing cognitive structure. Accomodation, on the other hand, is "the process of adapting oneself to the variegated requirements or demands which the world of objects imposes upon one. In even the most elementary cognition, there has to be some coming to grips with the special properties of the thing apprehended" (Flavell, p. 48). Accomodation thus refers to a cognitive process in which cognitive structures are modified to better fit the data of perception. Piaget's equilibrium of these two "processes which regulate themselves by a progressive compensation of systems" is in our model the integration of perceptual

> and cognitive processes" (Magaro, 1975, p. 109-110).

Magaro suggests that the failure to achieve equilibrium of conceptual and perceptual systems at progressively higher stages of development as being responsible in turn for autism, two types of childhood schizophrenia, and adult paranoid and nonparanoid schizophrenia.

In childhood autism psychic development is arrested at stage four of Piaget's sensori-motor period (8-12 months) which is operationally defined as the "coordination of secondary schema and their application to new situations" (Flavell, 1963). At this stage of development the normal infant begins to differentiate between assimilation (perception) and accomodation (cognition) by combining the common elements of separate sensori-motor action patterns to form new, accomodative object schemas. An object present in several motor schemas emerges as distinct from specific patterns of action. In the autistic child this transition does not occur; objects do not become separate from his/her action with them. The autistic child does not separate assimilation from accomodation, perceptual from cognitive processes, self from object.

While the autistic child never achieves the first step toward integration, the schizophrenic child achieves this differentiation in a relatively normal fashion, attaining object constancy and self-object differentiation. S/he then enters what Piaget calls the "pre-operational" period of ages (2-4 years of age), which is identified by the child's capacity for representational thought. This period involves its own form of disequilibrium and requires a new integration of perceptual (assimilation) and cognitive (accomodation) processes. The resolution of this second period of disequilibrium may be achieved in one of three ways. First, the child may achieve the normal integrative resolution between perception and cognition, assimilation and accomodation in Piagetian terms. In this case cognition and perception continually operate in an integrated fashion with perception modifying cognitive structures and cognitive structures organizing perceptual processes.

The second mode of resolution during this period takes the form of emphasizing accomodation (cognition) over assimilation (perception), that is the uniqueness of perceptions rather than their similarity. In this "perceptual" resolution, the

> . . .child continually alters his concepts to fit immediate perceptions. The influx of perception is not ordered by cognition; rather, cognitive structures vary with each perception. In Piaget's terms the child has a dominance of accomodation. This resolution corresponds well with descriptions of the majority of childhood schizophrenics. The child has symbols, language, and a primitive notion of the other, but has not developed the stable 'secondary schemas' necessary to integrate these percepts with a stable representation of the world. Integration is fleeting at best, and perception dominates cognition, constructing them dissolving schemas as new elements are apprehended. Thus both

> perceptions and cognitions appear distorted, fantasized. We call this perceptual resolution 'childhood schizophrenia, perceptual type' Magaro, 1975, p. 129-130).

The third type of resolution during this period emphasizes assimilation (perception) over accomodation (cognition). This is referred to by Magaro as a "conceptual resolution" (p. 130).

> The child with a conceptual resolution develops a few connections between concepts. But these connections are tenuous and unstable and therefore threatened by discrepant percepts. The child maintains these emergent cognitive structures by disregarding or distorting perceptual influence. He continues to differentiate and develop his concepts, but their relation to perceptual reality is less than normal. He disregards perceptual data in order to retain the validity and stability of his concepts. In Piaget's terms, assimilation is dominant. . . . We call this type of resolution 'childhood schizophrenia, cognitive type' (Magaro, 1975, p. 131).

There is also a third period of disequilibrium described by Piaget. It is this period of disequilibrium, occuring in early adolescence (about 11-12 years of age), which exacerbates previously inadequate integration, and results in the syndromes of paranoid and nonparanoid schizophrenia. For the child who adopted a perceptual resolution (accomodation over assimilation) during the second period of disequilibrium the transition to formal operations will be marked by his falling progressively further behind, and more isolated from his peers. He will appear more and more unusual until he is finally labelled "schizophrenic." The child whose preoperational resolution was cognitive (assimilation over accomodation), however, will meet the transition to formal operations with some eagerness. For a period of time he may even attract peers seeking to emulate his capacity for abstraction. Without an adequate perceptual base, however, these concepts will become progressively more and more isolated from reality until they are so discrepant that he is diagnosed a "paranoid schizophrenic."

In conclusion, integration theory has been applied to autism, childhood schizophrenia and adult paranoid and non-paranoid schizophrenia. In each of these cases the inability to integrate perceptual and cognitive processes is seen as the etiological agent. Failure to achieve an integrative resolution at one of the three periods of normal disequilibrium disrupts further psychological development. The various clinical syndromes are distinguished by both the period of disequilibrium and the type of nonintegrative resolution adopted. Autism is seen as a failure to make the first step in differentiating perception and cognition normally occuring between eight and twelve months. Childhood schizophrenia is the result of a failure to make an integrative resolution during the second period of disequilibrium which usually occurs between ages two and four. The two types of nonintegrative resolutions--perceptual and cognitive--result in one of two hypothetical subgroups of childhood schizophrenia. Failure during the third period of disequilibrium, which occurs during early adolescence, is seen as exacerbating the inadequate integration made during the second period and resulting in either paranoid or nonparanoid schizophrenia.

Related Theory and Research

The integration of cognition and perception has also been considered by other theorists as a basic requirement for adaption. Carni (1969, 1973) in his theory of symbolic transformations states that the ratio of cognitive and perceptual processes gradually increases with development and that this shift is slowed or attenuated in schizophrenia. Carni, however, does not distinguish between schizophrenic subgroups. The same general point has more recently been made by Liebowitz (1974) in demonstrating that the influence of retinal image declines with age as the result of the increased strength of the central, cognitive processing mechanisms. Feffer (1967), using Piaget's (1950) concept of mature reasoning, which involves the subordination of perceptual sensory impressions into cognitive categories, contends that if these two processes are not integrated there is "a lack of reciprocal influence between different aspects of experience or, at a more formal level, lack of contact between systems of functioning" (Feffer, 1967, p. 18). The characteristic schizophrenic symptoms which appear are either manifestations of associations not tied to perceptions, or perceptions not grouped into conceptual categories. This is similar to the perceptual and cognitive resolutions earlier described in relation to childhood schizophrenia.

There is also a body of evidence supporting the integration theory interpretation of perceptual and cognitive processes differentiating different types of schizophrenia. Ornitz (1969) in reviewing neurophysiologic studies suggests that "the breakdown in perceptual modulation proceeds in the direction of excessive inhibition in one type of schizophrenia and deficient inhibition in another" (p. 662). In terms of integration theory, the "excessive inhibition" refers to the paranoid's emphasis on cognitive processes to the relative exclusion of perception; "deficient inhibition" refers to the nonparanoid emphasis on perception to the relative exclusion of conceptual processes.

Clinically, Bowers (1974) contrasts the phenomenology of paranoid and nonparanoid schizophrenia, suggesting that paranoids are characterized by "irrefutable cognitive experience" and nonparanoids by the destructuring of perception and affect (p. 179-181). Regarding the nonparanoid, Sarbin, Juhasz, and Todd (1971) instructed schizophrenics and normal subjects to identify an odor where there was none. Schizophrenics were more accurate than normals in judging no odor present; they did not form a strong expectation or or set. While no subgroup information is presented, these results are consistent with those integration theory would predict for the nonparanoid who is hypothesized to be more perceptual and less affected by cognitive expectations than the paranoid would be. Snyder, Rosenthal, and Taylor (1961) found that schizophrenics were more accurate than normals in reproducing unclosed circles, whereas normals made the usual closure response.

From the Russian literature, Polyakov (1969) reported on a series of studies which showed superior schizophrenic performance when tasks required the use of low probability images or associations. When required to use high probability, more common associations, the schizophrenic does worse than the normal. Here again, the schizophrenic is superior when the task requires a lack of conceptual framework; that is when strong expectations, which are the product of a rigid conceptual framework, hinder performance.

Regarding paranoid behavior, McReynolds, Collins, and Acker (1964), using the McGill Closure Test, found that delusional schizophrenics attempted to identify more pictures, and identified more pictures correctly, than nondelusional schizophrenics, thus supporting their hypothesis that the former "have a stronger tendency to organize ambiguous stimuli in a meaningful way" (p. 211-212). This seems to be an example of what Bowers (1974) calls the "press for meaning" and Cameron (1947) describes as the "sudden clarification" of the paranoid. Abrams, Taintor and Lhamon (1966) build on

McReynolds' theory and offer a cogent explanation of paranoid cognitive strategy:

> In the face of new experiences, a perceiver has the option of formulating new hypotheses to assimilate them or leaving them unexplained pending the collection of more data, i.e., suspending judgment. The tendency to take the latter option, when circumstances permit, is commonly called open-mindedness or tolerance of ambiguity. It is a thesis of this study, following McReynolds, that paranoid individuals find it difficult to be open-minded or tolerant of ambiguity. Confronted with a large quantity of anxiety-provoking percepts, the products of his hypervigilence, the paranoid has developed a strategy of urgently forming assimilatory hypotheses (pp. 419-420).

Operationalizing assimilation much the same as McReynolds did, Abroms et al. found that in a task in which judgment must be based on incomplete data (Street Gestalt Completion Figures), paranoids tended to form atypical and incorrect judgments rather than none at all. The hypothesis that the "assimilation tendency" increases with severity of paranoid symptoms was not supported although the results were in the predicted direction. The authors interpret their results as suggesting that:

> . . .the paranoid operates with the metahypothesis that, to process his experience, it is preferable to form an incorrect hypothesis than none at all. Furthermore, the greater the degree of paranoid severity, the stronger the metahypothesis (p. 495).

This "metahypothesis," in integration theory terms, is the cognitive compensation for difficulty in integration.

Young and Jerome (1972), in a task which required the solution of a series of conceptual problems in which relevant cues were varied, found that paranoids consistently performed less efficiently than nonparanoids following cue changes. They concluded that paranoids conceptualized the task too rigidly to permit efficient adjustment to contextual variation. It appears that this task was sensitive to the paranoid cognitive emphasis. Their task was constructed so that relatively inflexible expectations impaired performance.

A direct investigation of integration theory has shown mixed results. McDowell, Reynolds, and Magaro (1975), using single-word, high- and low-probability sentence endings at five signal-to-noise ratios, reported that paranoids identified high-probability sentence endings more accurately than nonparanoids; while nonparanoids tended to be more accurate in identifying low probability sentence endings at higher signal-to-noise ratios. The results of this investigation support the contention that paranoids are more successful where cognitive processes facilitate task performance and offered some support for the contention that nonparanoids are more successful where perceptual processes result in improved performance.

In conclusion, integration theory has been conceptually related to Piaget's (1952) developmental concepts of assimilation and accomodation through which theoretical conceptualizations of autism, cognitive and perceptual forms of childhood schizophrenia, and finally paranoid and nonparanoid schizophrenia were developed. The views of other theorists who have considered perceptual and cognitive processes to be of central importance to schizophrenic performance (Carni, 1969, 1972; Feffer, 1967; Ornitz, 1969; Bowers, 1974) were also considered. Related research suggests an integration type deficit (Magaro, 1974), but lacks direct specificity to the integration concept (McReynolds, Collins, & Acker, 1964; Young & Jerome, 1972) and at times is nonspecific with regard to the schizophrenic subgroup being examined (Polyakov, 1969; Snyder, Rosenthal, & Taylor, 1961). Direct investigations of the integration concept have offered only partial support (McDowell, Reynolds, & Magaro, 1975; Reynolds & Magaro, 1976, in preparation). In both of these studies, difficulty was experienced operationalizing tasks with both the specificity and the tested validity required to directly assess the hypothesized cognitive and perceptual elements of the two schizophrenic subgroups. The present investigation seeks to overcome that difficulty by utilizing a heart rate measure which has been shown to directly reflect cognitive and perceptual processes both as organismic component and task variable.

Heart Rate

Lacey and Lacey (1958, 1963, 1967) have proposed and tested a theory which states that attentive observation of the environment, i.e., environmental intake or perceptual activity, is accompanied by a deceleration in heart rate. Situations which require mental or cognitive work, rejection of the environment, produce heart rate acceleration. In their original work the Laceys used eight tasks: 1) making up meaningful "sentences" in which each of the words had to begin with the same letter; 2) solving "arithmetic" problems; 3) performing a reverse "spelling" task; 4) noting and detecting varying colors and patterns of lights ("flash"); 5) listening to, and empathizing with, the affect presented in a tape recorded recitation of the thoughts and feelings of a dying man ("drama"); 6) playing white "noise" at 100db with instructions to note and detect environmental input; 7) listening to tape recorded "rules" for a fictitious game in which subjects expected to be questioned as a test of their intelligence ("rules of the game"); 8) taking part in a "cold" pressure test. While each of the first three tasks differed in its formal task requirements, all required the internal manipulation of symbols and the retrieval of stored information. Each of the first three tasks resulted in cardiac accelerations. In conditions four, five and six, where task requirements were simply to note and detect environmental inputs without demands for cognitive elaboration or the manipulation and retrieval of information, heart rate tended to be driven below resting levels. Task seven was created to require both intake and cognitive elaboration. The demand characteristic of the task required subjects to pay close attention to incoming stimuli and to resort to activities involving cognitive elaboration, such as the storage, retrieval and recombination of information. The hypothesis that heart rate would assume a function intermediate between the more purely cognitive and perceptual conditions was supported for both groups tested in this condition. In one group heart rate did not change at all from alert to stress periods and in a second group there was a slight deceleration but this was not nearly as great as in the straight environmental intake situations. This seventh condition indicates that heart rate reflects, not only direct cognitive and perceptual activity, but intermediate functions as well where some integrated use of conceptual and perceptual activity is required. The final task, "cold" pressor, resulted in increases in heart rate. The Laceys speculate that the reason for this increase is to facilitate "rejection" of painful stimuli.

Clearly, there are similarities and differences in each of these task conditions. The conditions that resulted in cardiac deceleration all required the subject to behave perceptually--to simply note and detect incoming stimuli. These tasks do differ among themselves however, in terms of the modality of sensory input ("noise" and "flash"), in their appeal to emotional and empathetic participation ("rules" and "drama"), and in their symbolic and semantic complexity ("noise" and "flash" vs. "drama" and "rules"). In comparison to the perceptual tasks, those conditions which produced cardiac accelerations all have in common the element of mental or cognitive work requiring the manipulation of two symbolic modes--words and numbers.

On the basis of these data, it is hypothesized that cognitive behavior is accompanied by cardiac acceleration while perceptual behavior is accompanied by cardiac deceleration.

Further support for the Lacey hypothesis has come from a number of experimental laboratories and a variety of tasks. Obrist (1963) reported a replication and extension of the major results reported by the Laceys, finding depression in cardiovascular activity for tasks which involved attention to the environment and acceleration in cardiovascular activity for both conceptual task and noxious stimuli. Baylock (1972) similarly found that simply observing flashing lights produced decreases in heart rate while a subtraction task resulted in heart rate acceleration.

In a task designed to investigate response requirements and directional fractionation of autonomic response, Hare (1972) had a group of male subjects rate slides of homicide victims by pressing one of seven buttons; another group simply viewed the slides; and a third group viewed the slides and pressed a button but without the requirement to rate the slides. Results showed cardiovascular deceleration for the nonraters and cardiovascular acceleration for the raters. The heart rate responses of the button-pressing nonraters were almost identical with those of the nonraters who simply viewed the slides. These results are consistent with the hypothesis that the requirement to rate the stimuli is associated with "cognitive" elaboration while the requirement to passively observe, or to observe and simply respond in a fashion that does not require cognitive activity, is associated with cardiac deceleration.

In two other investigations from the same laboratory, Hare and his associates (Hare, Wood, Britain, & Frazelle, 1971; Hare, Wood, Britain, & Shadman, 1971) found that both males and females showed significant cardiac deceleration while viewing affective visual stimuli including homicide scenes, nude females and slides of ordinary objects. There were no overall differences in the magnitude of cardiac deceleration between sexes, although there were several differences in the type of slides eliciting the largest response. For males the largest cardiac response was elicited by the homicide slides while the largest vasomotor and electrodermal responses were elicited by the nude slides. For women this was reversed.

Other investigators (Porges & Raskin, 1969), studying heart rate and respiratory components of attentive observation to internal stimuli (subject was required to estimate his own heart rate), as well as external stimuli, found that heart rate accelerated for internal observation and decelerated for external observation.

In a direct investigation of cardiac acceleration during mental activity, Blatt (1961) divided subjects into efficient vs. inefficient problem solvers. His results indicate a highly significant increase in heart rate for efficient subjects during attempts to solve problems. Further, these increases were significantly greater than their own resting baseline and at the same time significantly greater than the changes in cardiac patterns of inefficient subjects.

In a pair of experiments, Obrist, Webb, Sutterer and Howard (1970) and Webb and Obrist (1970) investigated cardiac response to a two second preparatory interval presented regularly (Webb & Obrist, 1970) and irregularly (Obrist _et al._, 1970). They conclude that:

> . . .both the direction and magnitude of the cardiac change is a function of what the organism is doing somatically to prepare for the behavioral response. . .cardiac and somatic effects have been observed to be concomitant in that a 2 second PI presented in a predictable manner, i.e., regular series, results in greater decreases in cardiac and somatic effects (Webb and Obrist, 1970) than a two second PI presented irregularly as in the present experiment (p.

Here the regular presentation of a simple fixed interval reaction time task produces cardiac deceleration as in other tasks reported which required simple perceptual functioning;

whereas heart rate to the same length PI presented in an irregular series was higher indicating increased cognitive requirements of the task. These investigators further report that in all preparatory intervals in excess of 2 seconds (4, 8 and 16 seconds) 16 out of 21 subjects show decreases in heart rate. At the two second interval both regular groups (ascending and decending fixed interval series) show significant declines; whereas for the irregular group only 8 of 21 subjects show significant deceleration in heart rate. They also note that beyond the 2 second interval the group receiving the fixed interval, ascending series, showed roughly two times the deceleration of the variable interval group.

Another investigation (Andressi, Rapisardi, & Whalen, 1969) also found heart rate significantly higher with a variable interval series (11-22 second intervals) than with a fixed interval series (30 second interval). These investigators conclude:

> Lacey et al. (1963) present evidence that tasks involving cognitive functioning are accompanied by increases in HR while those emphasizing perceptual functioning are accompanied by HR decreases. In the present investigation all Ss expressed an effort to "figure out" the uncertain VI signal pattern and HR increases occurred, as would be predicted by Lacey and his colleagues for cognitive type tasks, and, even though the present study could come under the heading of a human operant conditioning paradigm, it is apparent that the cognitive aspects under VI cannot be dismissed. The performance of SS under FI demanded constant attention to external stimuli, but did not involve

> cognitive activity in the same sense as was reuired under VI since the signal pattern was regular and known. Thus, HR was lower under FI since perceptual functioning was primarily involved, a result it seems fair to say, which would be predicted by Lacey and associates (p.

These three investigations (Obrist _et_ _al_., 1970; Webb & Obrist, 1970; Andressi _et_ _al_., 1969) all report relative increases in heart rate with variable interval reaction time tasks. These data together with investigations presented earlier which more clearly defined cognitive and perceptual task requirements, and the statements of Andressi _et_ _al_.'s subjects who tried to "figure out" the uncertain variable interval, argues for the presence of a cognitive element in variable interval tasks which is absent in simple fixed interval tasks.

Evidence for the ability of heart rate to differentiate individual differences in cognitive and perceptual response styles is provided by the work of Israel (1969). In her investigations with normal, white, male undergraduates, subjects were classified as either levelers or sharpeners on the basis of a laboratory perceptual test (Schematizing Test). Sharpeners are defined as individuals whose characteristic style of behavior is to be attentive to all types of external detail. They tend to pay attention to everything--to focus on differences rather than on similarities between stimuli. Levelers, on the other hand, make global judgments and are inattentive to environmental details. As predicted by Israel the heart rate deceleration of sharpeners was greater than that of levelers. Both groups decelerated, but sharpeners--the individuals acutely aware of and attentive to external environmental details--evidenced about the same magnitude of deceleration no matter what the stimuli. The sharpener was equally attentive to everything, and this was mirrored by cardiac deceleration of approximately the same degree to all stimuli--low-preferred, high-preferred or anxiety producing. Levelers, in contrast, did not decelerate as much, and the actual magnitude of the cardiac deceleration in anticipation of the visual stimuli <u>did</u> depend upon whether it was low-preferred, high-preferred, or anxiety producing stimuli.

Concluding Remarks and Hypotheses

In summary, it appears that both task conditions and organismic variables influence the direction and magnitude of cardiac acceleration and deceleration and in the process reflect the predominance of cognitive or perceptual behavior. This conclusion is important to the present investigation which will study the characteristic styles of paranoid and nonparanoid schizophrenics on a variety of fixed and variable interval reaction time tasks. Integration theory would predict that the heart rate of paranoids would reflect a more cognitive orientation while that of nonparanoids would be more perceptual. The tasks in the present experiment were chosen for their ability to vary in cognitive and perceptual requirements. The simple, short, fixed interval trials draw more on perceptual processes; the more complex, variable interval trials draw more on cognitive processes (Andressi _et al_., 1969; Obrist _et al_., 1970; Webb & Obrist, 1970). These same hypothesized perceptual and cognitive processes are seen as organismic or characteristic dispositional styles of nonparanoid and paranoid schizophrenics respectively. Task requirements can be expected to augment these processes.

On the tasks in the present investigation it is hypothesized:

1) Paranoid schizophrenics will behave more like control subjects on variable interval tasks (3 and 5). Nonparanoid schizophrenics will behave more like controls on fixed interval conditions (1, 2, and 4). In condition 6, a 5 second fixed period interval condition, a 25 watt green light was added to increase the intensity, observability and thereby perceptual element of the task. This dimension was added to determine if this would facilitate perceptual functioning, primarily that of the nonparanoid schizophrenic. Perceptual functioning should be greater for nonparanoids in this over other fixed interval conditions.

2) Overall conditions paranoid schizophrenics will re-

flect a more accelerative heart rate function relative to nonparanoid schizophrenics and control subjects, while nonparanoid schizophrenics will reflect a greater decelerative function relative to paranoid schizophrenics and control subjects.

3) Controls' heart rate should show greater deceleration on fixed than on variable interval conditions.

METHOD

Subjects

Subjects, all male, were seven acute paranoid, seven acute nonparanoid, and seven hospitalized, nonpsychotic controls. Criteria for inclusion in the subject groups were eight months or less current hospitalization; two years or less total hospitalization; age between 18 and 60; no evidence of organicity or retardation and a hospital diagnosis of either paranoid schizophrenia, nonparanoid schizophrenia, or nonpsychotic personality disorder.

Subjects were identified by searching the state hospital inpatient records and through cooperation of the hospital admission staff. Groups were comprised of the first seven subjects who agreed to participate in the study and whose subdiagnosis was confirmed by Vojtisek's (1975) modification of a scale developed by Venables and O'Connor (1959). No subjects were eliminated because of conflicting diagnosis.

One subject refused to participate.

The scale used (Appendix I) contains ten bipolar symptom ratings. The five paranoid items are from Venables and O'Connor's (1959) paranoid subscale, and four of the nonparanoid items are from the nonparanoid subscale of Overall and Gorham (1962). A time disorientation item was added to the nonparanoid scale (Vojtisek, 1975). Each item may be scored from 1 (no symptom) to 5 (spontaneous, strong expression). Paranoid symptoms rated were suspicion of control or influence; suspicion of persecution or conspiracy; exaggerated opinion of ability, status, power, wealth, or knowledge; ideas of reference; and hostility. Nonparanoid symptoms rated were auditory and visual hallucinations; verbal incoherence; emotional incongruity; time disorientation (season, month, year, day of week, and time in hospital); and bizarre motor behavior. Summing scores for each set of items yields paranoid and nonparanoid symptom scores. All subjects were rated for symptoms by the author in a 10-15 minute, semidirective interview. Since no cases were eliminated because of conflicting diagnosis, all cases were "pure" as suggested by Shakow (1969).

Both scales from which items were drawn report adequate reliability. Scale diagnosis agreed with hospital diagnosis for all of the subjects tested. Validity of the current scale has been investigated by Vohtisek (1975) and Gripp (1975). Vojtisek found that scale-diagnosed nonparanoids were significantly more confused on the expanded similarities test (Hamlin & Lorr, 1971) than either paranoids or controls, who did not differ. Gripp found a correlation of -.66 (n = 21; p < .01) between nonparanoid symptom scores and scores on the expanded similarities for a group of hospitalized psychotics. Paranoid scores correlated only -.12, as expected. Likewise, nonparanoid scores correlated .39 (n = .21; p < .05) with Embedded Figures Test scores, but paranoid scores correlated only .08. Also, nonparanoid scores correlated .44 (n = 21; p < .05) with reaction time, but paranoid scores correlated only .06. A significant correlation between paranoid scale scores and type of admission was found (r = .47; n = 21; p < .05), whereas no correlation existed for nonparanoid score and type of admission. Those with higher paranoid scores tended to be involuntarily committed and those with lower paranoid scores tended to be voluntary patients.

Symptom rating scale data on the subjects used in this investigation are presented in Table 1. In each case Anovas indicate significant differences (p < .05) between groups. When the nonparanoid scores are considered Duncan's Multiple Range Test indicates that this is due to differences between nonparanoid schizophrenics and controls and

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Insert Table 1 about here

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between nonparanoid schizophrenics and paranoid schizophrenics; there were no significant differences between paranoid schizophrenics and control subjects. When the paranoid scores are considered Duncan's Test indicates significant differences between paranoid schizophrenics and controls and between paranoid schizophrenics and nonparanoid schizophrenics; there were no differences observed between controls and nonparanoid schizophrenics.

Table 2 summarizes other descriptive subject characteristics.

Insert Table 2 about here

There were no significant differences between the groups in age, number of admissions, weeks in hospital, or marital status. There were significant differences in the amount of medication received in mg/day chloropromazine equivalent (Hollister, 1973), $F(2,18) = 3.75$, $p < .05$. Duncan's Multiple Range Test indicates that nonparanoid schizophrenics were receiving significantly more medication than controls ($p < .05$). There were no differences between paranoid and nonparanoid schizophrenics or between paranoid schizophrenics and control subjects.

Stimuli

A yellow and a green jewel light both 1/2 inch in diameter, served as warning signal and reaction time signal, respectively. The lights were placed 13 inches apart (warning signal on the left and reaction time light on the right) in the middle of a 21 x 23 inch stimulus box located three feet in front of the subject's chair. A series of four red lights of the same size and type as the warning and reaction time lights were placed 7-1/2 inches above and at 2-1/2 inch intervals between the warning and reaction time lights. A 7 x 6-1/4 inch wide frosted glass window with a 25 watt green bulb behind it was located between the warning and reaction time signals. The unlit bulb could not be seen by the subject.

Procedure and Apparatus

Upon entering the experimental room subjects were seated in a large comfortable arm chair and administered the symptom rating scale. Arm and leg leads were then attached in the standard fashion while their function was explained. One cup-type electrode was taped on the ventral side of the upper right forearm and another was similarly located on the left forearm. The third electrode, a grounding plate, was attached to the inside of the right ankle. Heart rate was recorded continuously on a Narco-Biosystems Physiograph (Model DMP-4A) and Biotachometer (Model BT-1200) including associated accessory and preamplifier units. After the leads were attached and functioning, a board was placed across the arms of the chair with a standard telegraph key placed to the right or left depending on which hand the subject preferred. The instructions were then read to the subject explaining the stimulus board and telling him that his job was to press the telegraph key as quickly as possible when the green light came on. Subjects were told that the yellow light (warning signal) would precede the green light (reaction time signal) and that this was a signal that the green light would be coming on soon. Concerning the red lights, subjects were only told that they would be going on and off through various conditions during the trials and that when this happened their job was still to press down the key as quickly as possible when the green lights came on. No instructions beyond this were given regarding the red lights (see Appendix II). After the directions were read, isolation headphones were placed on the subject and low level white noise was produced from a Bruel and Kjoer Noise Generator (Type 1024), recorded on a Tandberg tape recorder (Model 823-F), and presented through Pioneer headphones (Model SE-50). Subjects were next asked to relax for approximately three minutes while the equipment was being readied. All subjects were continually monitored via closed circuit television. Subjects were told via the headphones, by the experimenter in an adjacent room, when the trials would begin, and prior to the final condition that the green light behind the frosted glass would serve as a reaction time signal for the final condition.

Conditions

The first 70 trials, in blocks of 14 each, were presented to the subject in the following order:

1) 5-second, fixed preparatory interval between the warning signal and reaction time signal;
2) 3-second, fixed preparatory interval trials;
3) 4-, 5-, and 6-second variable preparatory interval between one warning signal and reaction time signal with interval lengths first randomized and then presented to every subject in the following order: 6, 5, 6, 4, 5, 5, 4, 6, 5, 4, 5, 4, 4, 5, 4;
4) 5-second, fixed preparatory interval trials with red sequencing lights following the warning signal at 1, 2, 3, and 4 second intervals. The reaction time signal followed the fourth sequencing light by 1 second; these lights were added to further reduce uncertainty;
5) 4-, 5-, and 6-second variable preparatory interval trials (interval length presentations same as condition 3) with red lights following the warning signal at 1, 2, 3, and 4 seconds. The reaction time signal came on concurrently with the fourth light in the 4-second interval; following the fourth sequencing light by 1 second in the 5-second interval and by 2 seconds in the 6-second interval. These red lights were maintained during this inter-

val to maximize uncertainty;

6) For the final 15 trials the white noise was temporarily discontinued while the subjects were given instructions via the headphones. Subjects were told that a green light would now also come on behind the window between the warning and reaction time lights. They were again told that the yellow light would warn them, just as before, that the green lights would be coming on soon. Following this the white noise was again turned on and 14 trials of 5-second fixed preparatory interval trials were run with both the high-intensity 25 watt bulb and jewel light acting as reaction time signals. This additional light was added, as stated earlier, to increase intensity, observability, and facilitate perceptual functioning.

All lights, in all conditions, remained on for 1 second except for the reaction time signal which remained on either until the telegraph key was pressed or for 2 seconds after which subjects were alerted to respond. A total of 84 trials were presented. The entire task lasted approximately 22 minutes, dependent on the length of the subject's reaction times. Reaction times were recorded from a Standard Timer.

RESULTS

Heart rate was recorded continuously in beats per minute from the onset of condition one until the end of the final condition. From these data a trial basal was obtained by averaging the final two seconds of the 10-second inter-trial-interval between the preceding reaction time signal and the forthcoming warning signal. Heart rate at warning signal and reation time signal was taken directly from the point of warning and reaction time signal within each subject's continuous record. These were both single readings rather than the averaged readings used to establish a trial basal level because the intent was to establish heart rate during particular events in a process. Each subject's heart rate at trial basal, warning signal and reaction time signal was evaluated using a four-way groups x conditions x blocks (i.e., trial basal, warning signal, reaction time signal) x trials repeated measures analysis of variance. (ANCOVA was not significant, $p < .46$, indicating medication differences were not influential.) For ease of exposition, and as major findings are not affected, only three-way ANOVA results are presented. Table 3 contains the results of this analysis.

Insert Table 3 about here

For the purpose of graphing these data, difference scores (difference in absolute heart rate from trial basal to warning signal and from warning signal to reaction time signal) were used to more clearly show the relationship between group heart rate functions. The absolute values are presented in the graphs.

As is indicated in Table 3 the main effect of Conditions and the interaction effect of Conditions x Blocks x Groups were both highly significant; the interaction effects of Conditions x Groups and Conditions x Bocks are both marginally significant; and the main effects for Groups, Blocks and the interaction effects of Blocks x Groups are not significant. From these results it is clear that Conditions figures predominantly in all of the highly significant and marginally significant results whereas it is not present in the nonsignificant results. The findings bearing on the Integration Theory hypotheses are as follows: 1) Paranoid schizophrenics will behave more like control subjects on variable interval tasks (3 and 5). Nonparanoid schizophrenics will behave more like controls on fixed interval conditions (1, 2 and 4).

The effect of major interest to this hypothesis, Groups x Conditions x Blocks, was highly significant, $p < .007$. In terms of the major hypotheses, however, the results were "mixed." As predicted, the heart rate of paranoid schizophrenics reflected an accelerative function on variable interval conditions (Figure 1) with controls intermediate and

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Insert Figure 1 about here

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nonparanoid schizophrenics reflecting a decelerative function. However, when conditions 3 and 5 are looked at individually the hypothesis holds only for condition 3 (Figure 2). In condition 5 (Figure 3) in which lights were se-

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Insert Figures 2 and 3 about here

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quenced at one second intervals and the time between the warning and reaction time signals varied (4, 5 or 6 seconds), there were virtually no differences between either of the experimental groups and the control group. All three groups reflected a slightly decelerative, intermediate function.

The parallel prediction that nonparanoid schizophrenics would show a greater decelerative function on fixed interval conditions was not supported. Overall fixed interval conditions (Figure 4) nonparanoid schizophrenics heart rate <u>in-</u>

Insert Figure 4 about here

<u>creases</u> from warning to reaction time signal reflecting a biased accelerative function while paranoids and control subjects showed a decelerative function during that same period. In condition 1 (Figure 5) and 4 (Figure 6) paranoid schizophrenics decelerate from warning to reaction time sig-

nal to a point between controls and nonparanoids. In condition 2 (Figure 7), a short three-second fixed interval se-

Insert Figures 5, 6, and 7 about here

ries, clear increases in nonparanoid and controls heart rate are apparent while paranoids assume an intermediate function.

In condition 6 (Figure 8), where an additional 25 watt

Insert Figure 8 about here

green light was added to increase signal intensity, observability and thereby the perceptual element of the task, nonparanoid schizophrenics continue to show an accelerative function, while paranoid schizophrenics decelerate very slightly from warning to reaction time signal and control subjects show a marked decelerative function. 2) Overall conditions paranoid schizophrenics will reflect a more accelerative heart rate function relative to nonparanoid schizophrenics and control subjects, while nonparanoid schizophrenics will reflect a greater decelerative function relative to paranoid schizophrenics and control subjects.

This hypothesis, Groups x Blocks, was not confirmed ($p < .24$). Overall conditions in which fixed interval outnumber variable interval conditions 4 to 2, nonparanoid heart rate accelerates slightly, paranoid schizophrenics heart rate decelerates slightly and controls show a marked decelerative function (Figure 9). Equating for number and type of conditions (conditions 1 & 4 vs. 3 & 5) tends to bring both of the experimental groups closer to a median function (i.e., no change from trial basal to warning signal to reaction time signal, Figure 10).

Insert Figures 9 and 10 about here

DISCUSSION

The major tenet of Integration Theory and the fundamental hypothesis of this investigation was that the resolution of the schizophrenic deficit is cognitive in paranoid schizophrenia and perceptual in nonparanoid schizophrenia. The findings failed to support this hypothesis. Although paranoid schizophrenics' heart rate generally reflected a cognitive function during variable interval conditions, during fixed interval conditions their heart rate just as clearly reflected a perceptual function--at times more so than controls. Likewise, while nonparanoid schizophrenics' heart rate reflected a perceptual function on variable interval conditions, as predicted, in contrast to predictions their heart rate reflected a cognitive function during fixed interval conditions. Finally, overall conditions nonparanoid schizophrenics' heart rate accelerated slightly from trial basal to warning signal to reaction time signal while paranoid schizophrenics showed no change and control subjects decelerated.

The results also establish that the operations had their predicted effects on control subjects by indicating controls' relatively increased function on variable interval over fixed interval tasks and lend support to Andressi et al. (1969) showing a more cognitive heart rate function on variable interval vs. fixed interval tasks. The actual increase in heart rate of controls during condition 3, the three-second fixed interval condition, was not expected but is understandable. Obrist and his colleagues (Obrist, Webb, Sutterer, & Howard, 1970; Webb & Obrist, 1970) have shown that heart rate deceleration is sharply attenuated at shorter preparatory intervals (usually two-second) in a fixed interval series with 20-25% showing no deceleration. This shorter interval had the effect of increasing the heart rate function of all groups over other fixed interval conditions.

By far the most interesting finding in this experiment was the crossover of paranoid and nonparanoid schizophrenics on variable interval and fixed interval conditions. Since these results are both interesting and contrary to the hypotheses, the heart rate behavior of each group will be looked at by conditions before any conclusions are drawn. Immediate "explanations" for group heart rate behavior will reflect that of the Lacey's; increases in heart reflects a "rejection" of the environment and cognitive activity; decreases in heart rate reflect "intake" or attention to the environment, a perceptual behavior; intermediate functions reflect the combined use of both processes.

Conditions Summary

Conditions 1, 4 and 6 were all predictable in terms of their being fixed interval conditions. Condition 4 was made more predictable than condition 1 by inserting red lights at one second intervals between the warning signal and reaction time signal. However, even with this added predictability nonparanoid and paranoid schizophrenics' heart rate functions are almost exactly the same between warning signal and reaction time signal; the most noticable change is that controls decelerate less in the same period. During condition 6 the direction of the functions is still the same for all groups although the divergence between paranoid and nonparanoid schizophrenics' heart rate is markedly reduced. In terms of the Lacey model, during a five-second fixed interval condition nonparanoid schizophrenics tend to be more cognitive and reject the environment whereas paranoid schizophrenics and control subjects are more perceptual and attentive to the environment.

In the three-second fixed interval condition the heart rate function of paranoid and nonparanoid schizophrenics is directionally the same as for the five-second fixed interval conditions, only controls change direction. Again, generalizing from the Lacey hypothesis, during this fixed interval condition nonparanoid schizophrenics go in the direction of being more cognitive and rejecting the environment, while paranoid schizophrenics are more perceptual and attentive to the environment. During this shorter interval controls are more like nonparanoid than paranoid schizophrenics.

In variable interval condition 3 the results for paranoid and nonparanoid schizophrenics are reversed from the fixed interval conditions--paranoid schizophrenics become cognitive and reject the environment while nonparanoid schizophrenics become perceptual and attentive to the environment. During condition 5 where confusion was added to uncertainty by flashing lights at a regular sequence while the intervals between the warning signal and reaction time signal varied, all groups reflected a slight perceptual function between the warning and reaction time signal. It would appear that the uncertainty of the variable interval together with the confusion by an element which had just signaled increased predictability can act as a powerful force in bringing some otherwise divergent groups together.

Summary, Integration with Selected Theory and Conclusions

There are points in time in their relationship to the environment that the heart rate of either paranoid and/or nonparanoid schizophrenics are directionally synchronous with control subjects and times one or the other is desynchronous with controls. This can be seen as a disruption of a psychophysiological rhythm (trial basal to warning signal to reaction time signal) which depends upon the interaction with, and relationship of the individual to a particular state of affairs in the environment (e.g., fixed interval, variable interval and variations of these tasks). It is clear from this research that the situation within which paranoid and nonparanoid schizophrenics are interacting is an important factor in determining psychophysiological behavior and directional concordance or discordance with control subjects. Paranoid and nonparanoid schizophrenics while they may have certain behavioral dispositions are not exclusively cognitive or perceptual, or probably anything else. How they behave depends in large part on the interaction between them and the situation within which they are responding.

This experiment reproduced six different situations--variations of fixed and variable interval reaction time tasks--within which some aspects of the relationships between task conditions, paranoid and nonparanoid schizophrenics, behavior, and control subjects' behavior could be observed. Generally, paranoid schizophrenics' performance was most like controls during fixed interval reaction time situations. Here their heart rate, like that of control subjects, reflected more perceptual, attentive behavior. During a variable interval situation their heart rate reflected cognitive behavior and a rejection of the environment. Even during fixed interval situations, however, the magnitude of the heart rate deceleration is not as great for paranoid schizophrenics as it is for control subjects. Variations of this general situation also have effects on the concordance or the likeness between the two groups, i.e., they react more or less alike depending on the variations of the situation.

Nonparanoid schizophrenics, on the other hand, reflect psychophysiological behavior which is most like controls at times when they are within a variable interval situation. Here, their heart rate reflects more perceptual, attentive behavior, while during fixed interval conditions their heart rate reflects cognitive behavior and a rejection of the environment. Here also, while they are directionally the same as controls during variable interval situations, nonparanoids and controls reflect different degrees of change.

Variations of simple fixed or variable interval situations, where time or additional elements are added to tasks, have effects on all groups including control subjects. While condition 2 (Figure 7) alters the psychophysiological behavior of control subjects it does not change the behavior of paranoid or nonparanoid schizophrenics from other fixed interval situations. In the confusion of condition 5 (Figure 3) where there is both the uncertainty of a variable interval situation and lights which are desynchronous with the length of the interval the psychophysiological rhythm which reflects groups' interactions with the environment hardly differ. Nobody looks deviant when everybody is confused.

Nonparanoid and paranoid schizophrenics also reflect nearly identical psychophysiological rhythms in different kinds of situations that are mirror opposites of those usually shown by control subjects. For example, see Figures 5 and 8 where nonparanoid and paranoid schizophrenics decelerate before accelerating. This is also apparent in the composite variable interval and fixed interval graphs (Figure 1 and 4) where the usual pattern of increasing from trial basal to warning signal then decelerating from warning signal to reaction time signal is shown by control subjects.

So far the heart rate of paranoid and nonparanoid schizophrenics and control subjects have been discussed in terms of the relationship and interaction of the individual groups within, and to, a situation, with changes in heart rate seen as reflecting a particular mode of psychological behavior. It has been noted that the psychophysiological rhythms for different groups are sometimes dichotomous, i.e., paranoids decelerating while nonparanoids accelerate. Other theorists have also noted bipolarities (Shakow, 1977) in paranoid and nonparanoid behavior and opposites (Steffy & Cromwell, 1975) in relation to control subjects. These observations were also made in regard to behavior which occurred within a reaction time situation. A selected review and integration with these views should provide some breadth and add insight into the relationship between, and behavior of these groups. The view will proceed from the most general to the more specific. Steffy and Cromwell deal with the larger group of "process schizophrenics"; whereas Shakow, with hindsight and a command of analytic theory makes a finer distinction in describing paranoid and nonparanoid schizophrenia. The information which both provide can be augmented and extended by the present results and observations. From this position future directions can be suggested.

Steffy and Cromwell (1975) in reviewing their own research and Shakow's research and theory before 1975, conclude that task features which one would intuitively expect to improve performance--e.g., regularity, intensity of signals, etc.--sometimes have the opposite effect on schizophrenic performance. They state that:

> . . .the various features of the task which constitute signals to the subject have a generally impairing influence on schizophrenic performance . . .the mechanism is not clear (p. 33-34).

In suggesting a "low order" theoretical inference they conclude:

> . . . the demands of an exacting vigilance demand-

> ing task provokes a level of stress which exceeds the coping capacity of schizophrenics--particularly the process schizophrenics. . .if the subject can predict the moment of performance demand--or even believe he can--the task may become more stress inducing. Hence, the regular trials have greater excitatory potential, which in turn may require greater coping responses. Similarly the presence of other signals--although presenting more information--may present greater task demands, and consequently increase stress to the schizophrenic (p. 34).

Shakow (1977) following upon 30+ years of research, and with a strong background in analytic theory, has concluded that paranoid and nonparanoid schizophrenics, particularly the hebephrenic, exemplify the extremes of bipolar behavior which characterizes inappropriate coping efforts in schizophrenia. The nonparanoid, "hebephrenic views things in a superficial, simplified overcontentual, confused, and loose way, the paranoid views things in an overly specified, complex, over-organized, and rigid way (p. 130). Normal behavior, according to Shakow, reflects a generalized or major set which disposes people to perceive and response to a situation objectively and autonomously; there is an integration of the cognitive, affective and conative aspect of behavior. Segmental sets, on the other hand, reflect the behavior of schizophrenics and involve a preparatory adjustment which is directed to portions of the stimulus situation. Schizophrenics, according to Shakow, attempt to change the environment to establish safe conditions for gratification.

Looking back over these observations from the perspective of this experiment it might be expected that the excitatory potential of a situation, which Steffy and Cromwell discuss, differs for paranoid and nonparanoid schizophrenics. Regularity and the resultant stress is a problem which sometimes causes nonparanoid schizophrenics to withdraw from the environment and become more "cognitive"; whereas for paranoid schizophrenics irregularity produces this effect. From the present results it also seems safe to say that the bipolarity which Shakow points out exists in relationship to some situations rather than being purely "dispositional" (my quotes). In other words, whether the nonparanoid "views things in a superficial, simplified overcontentual, confused, and loose way" or more like a "normal" subject with a more general set; and whether "the paranoid views things in an overly specific, complex, over-organized, and rigid way" or more like a "normal" subject with a more general set depends at least in part upon the situation they are behaving, or interacting, within. The effects of their relationship to the situation determine to some extent whether the paranoid or nonparanoid will be "perceptual" and "attentive" to the environment or "withdrawn" and "cognitive."

"Schizophrenic" behavior, or any other kind of behavior can take place within a situation which can be controlled and defined in limited ways, and at the same time within another situation in relationship to the experimenter, and within another situation in relationship to the hospital, etc. Most importantly, the individual or the group, with a particular disposition or dispositions, is acting in relationship and their behavior differs depending on the situation(s) they are within. A schizophrenic behaves more or less in a paranoid or nonparanoid way depending on what they are faced with.

Future research using the present model or some variation could take a number of directions. It is capable in a limited way of determining whether the individual is "in-sync" or "out-of-sync" with what is going on around him/her by utilizing psychophysiological measures in parallel with video tape, for example. Larger groups and more varied tasks and situations, both "controlled" and in vivo, using standard lab equipment or telemetry devices and video tape will offer a more "objective" picture of the state of relationship in schizophrenia. The work of the Laceys, Obrist, their colleagues and others carrying out psychophysiological research has provided some information regarding the relationship of psychological and physiological behavior. This work, together with skilled, self-aware observations of individuals within situations and relationships etc., would offer a more holistic perspective on schizophrenia.

TABLE 1

Symptom Rating Scale Data

	Min	Max	Range	Mean	SD
Nonparanoid Items					
Controls	5.0	7.0	2.0	5.28	0.75
Nonparanoids	12.0	16.0	4.0	13.85	1.77
Paranoid Schizo-phrenics	5.0	7.0	2.0	5.42	0.79
Paranoid Schizophrenic Items					
Controls	5.0	10.0	5.0	6.14	1.86
Nonparanoids	5.0	8.0	3.0	6.57	1.27
Paranoid Schizo-phrenics	12.0	20.0	8.0	14.57	3.15

TABLE 2

Subject Characteristics of Experimental and Control Groups

Variable	Group			F
	Control	Nonparanoid	Paranoid	
Age:				
M	25.71	21.57	30.14	N.S.
SD	7.95	3.20	10.70	
Number of Admissions:				
M	2.00	3.43	3.14	N.S.
SD	1.00	2.88	1.57	
Total Weeks in Hospital:				
M	4.85	32.00	23.14	N.S.
SD	2.41	46.59	28.49	
Ever Married:				
M	1.85	1.14	1.28	N.S.
SD	1.60	0.37	0.75	
Medication*:				
M	3.57	729.00	350.00	$p < .05$
SD	9.44	740.18	295.80	

Note: N = 7 for each group.

*In mg/day chloropronazine equivalent.

TABLE 3

Repeated Measures ANOVA for Heart Rate

SV	SS	DF	MS	F	Prob.
Groups	141060.80	2	70530.40	1.36	.28
error	931398.98	18	51744.38		
Conditions	4019.44	5	803.88	4.58	.001
Conditions x Groups	3223.83	10	322.38	1.83	.065
error	15777.03	90	175.30		
Blocks	113.19	2	56.59	1.19	.313
Blocks x Groups	267.30	4	66.82	1.41	.248
error	1698.13	36	47.17		
Conditions x Blocks	202.78	10	20.27	1.54	.128
Conditions x Blocks x Groups	539.89	20	26.99	2.05	.007
error	2366.07	180	13.14		

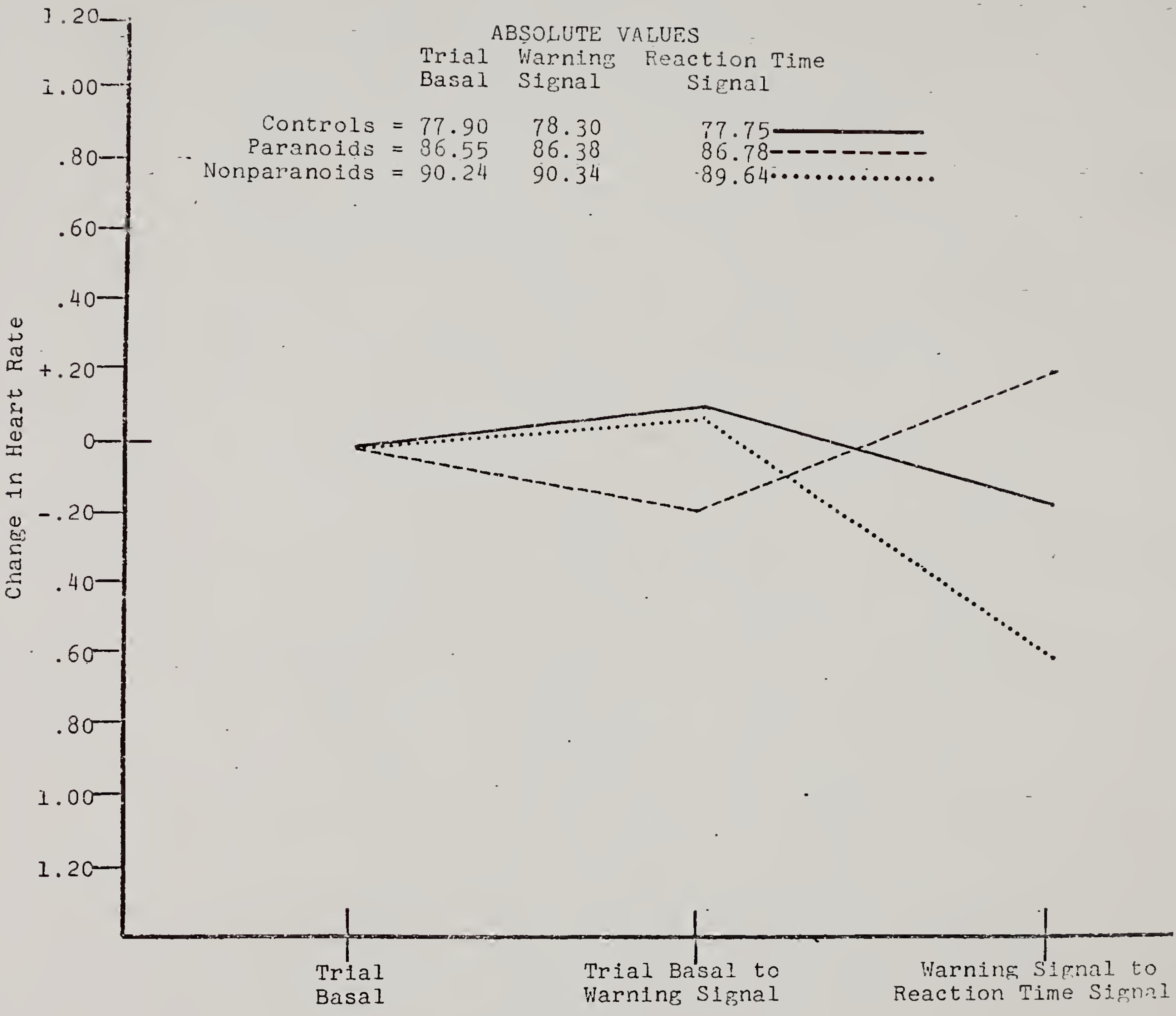

Figure 1. Variable interval overall: average of conditions 1 and 3.

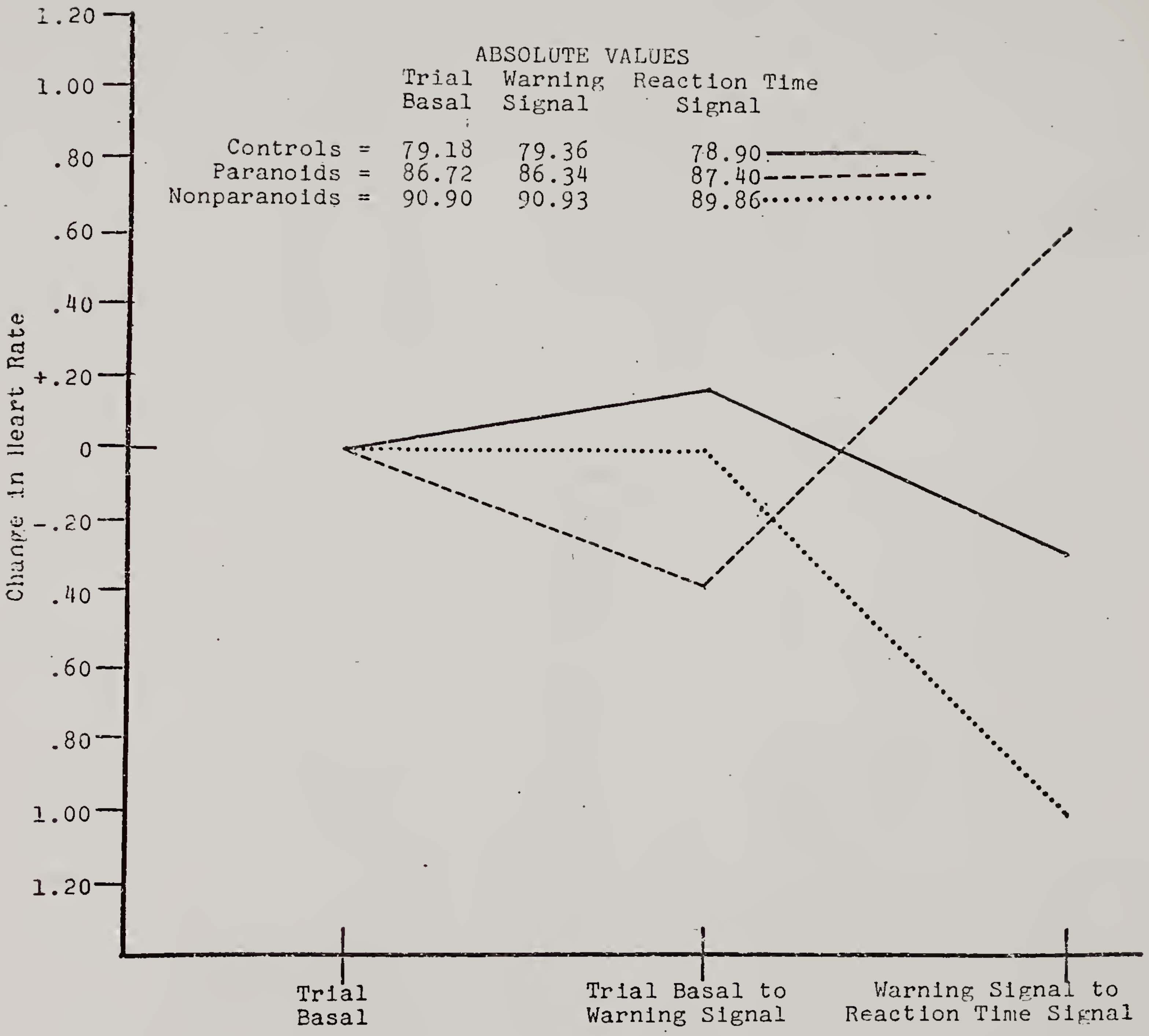

Figure 2. Condition 3: variable preparatory interval 4, 5, 6.

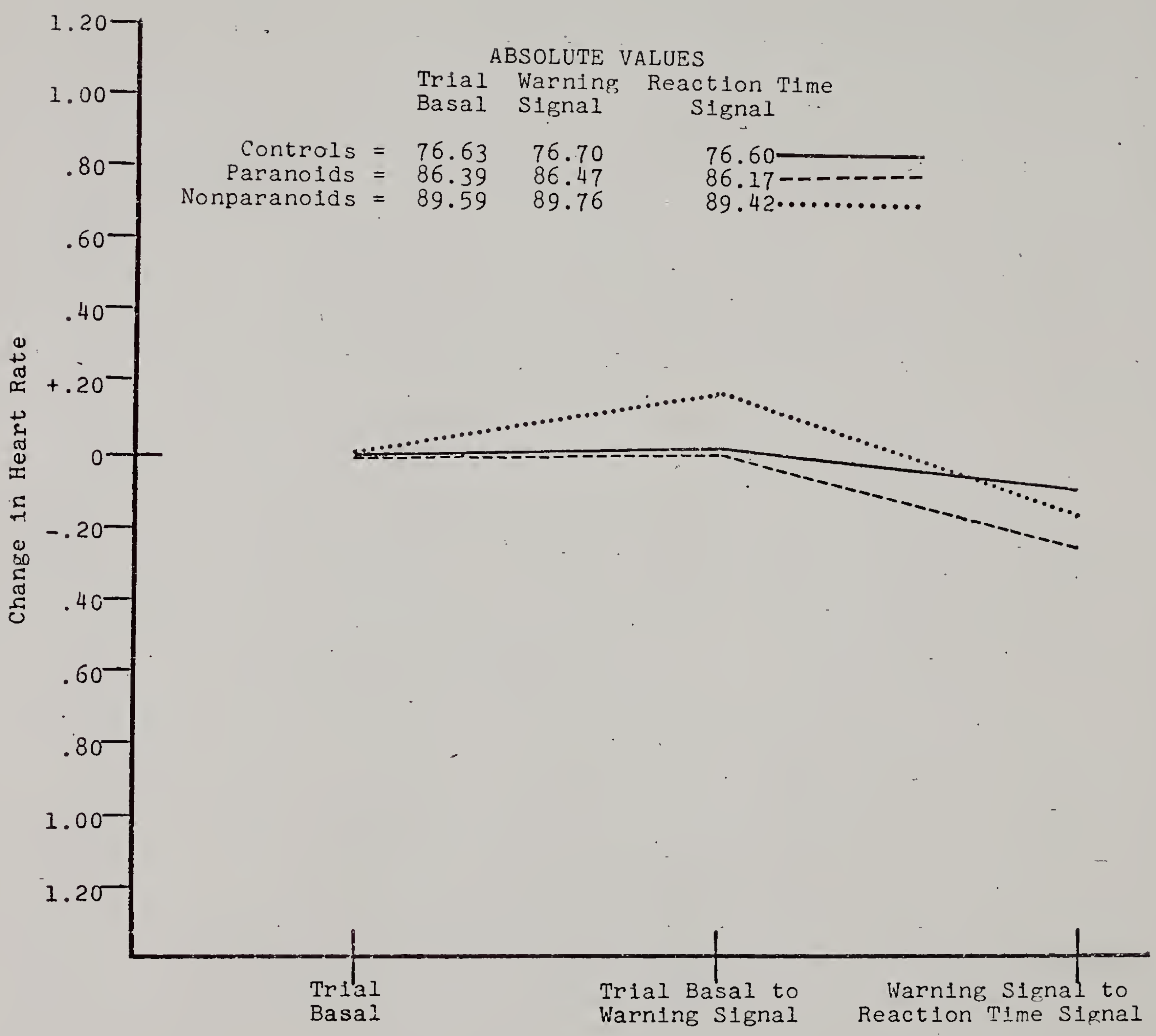

Figure 3. Condition 5: variable preparatory interval 4, 5, and 6 with four additional lights at one second intervals following the warning signal.

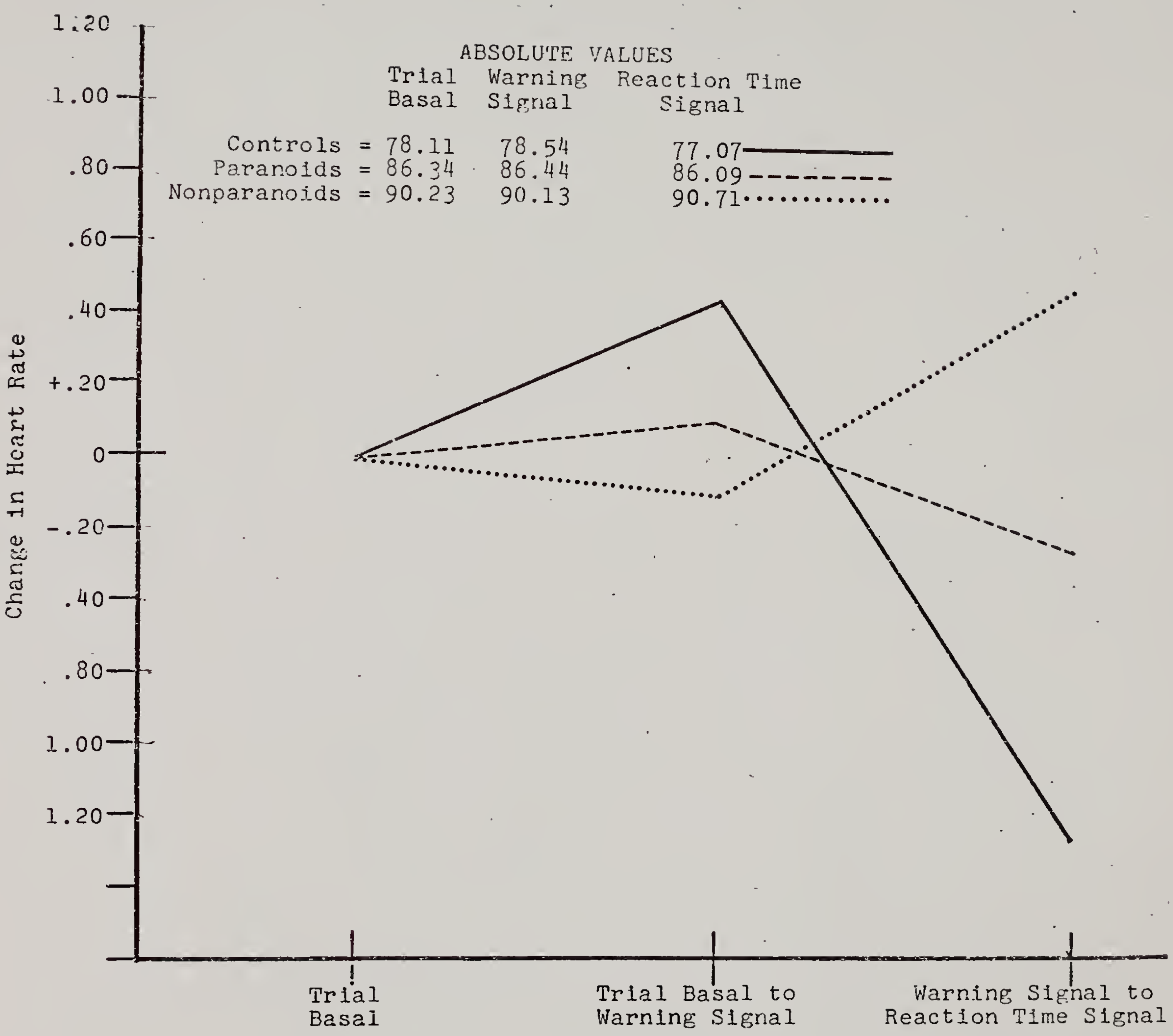

Figure 4. Fixed interval overall: conditions 1, 2, 4, and 6.

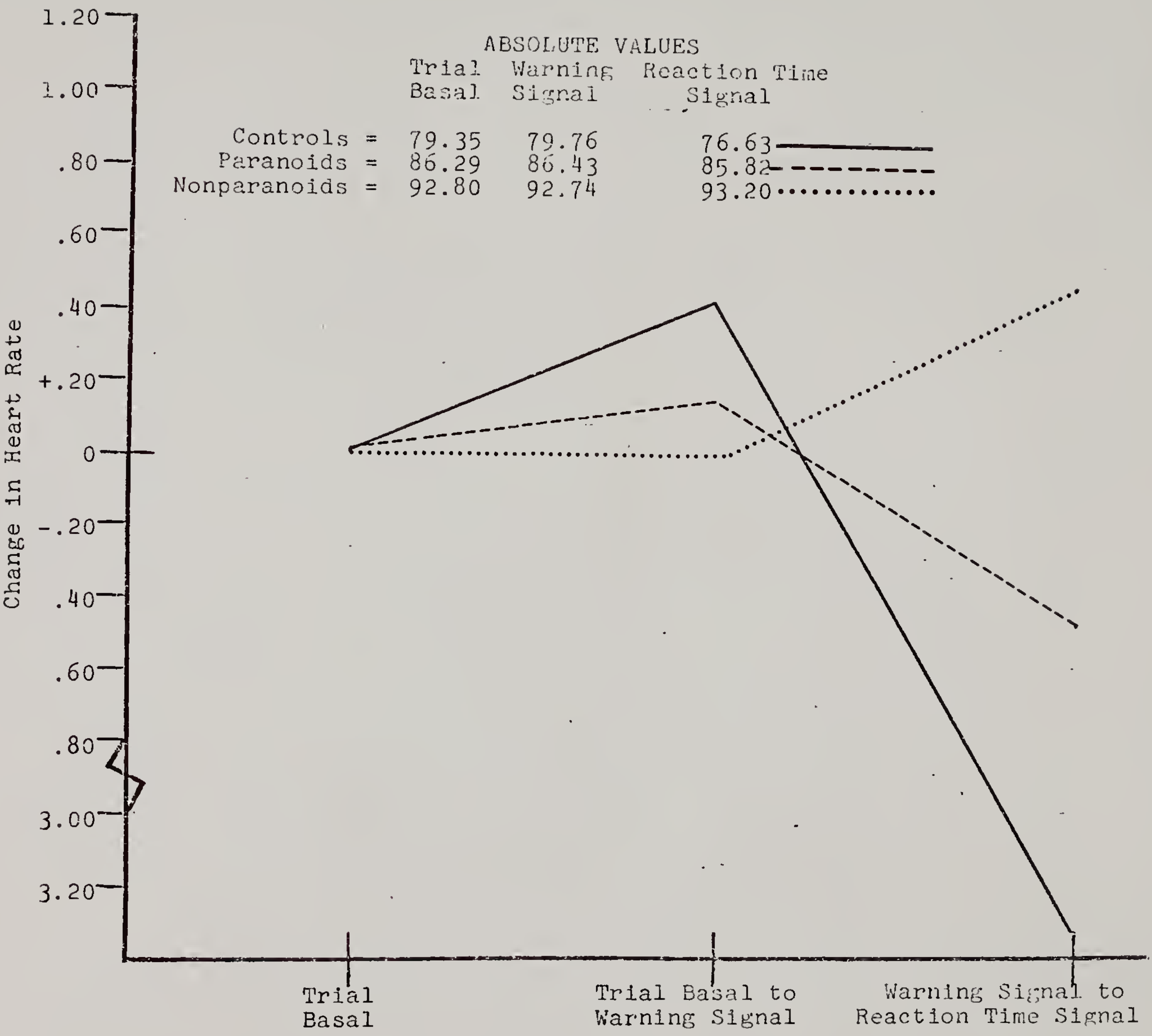

Figure 5. Condition 1: fixed preparatory interval 5.

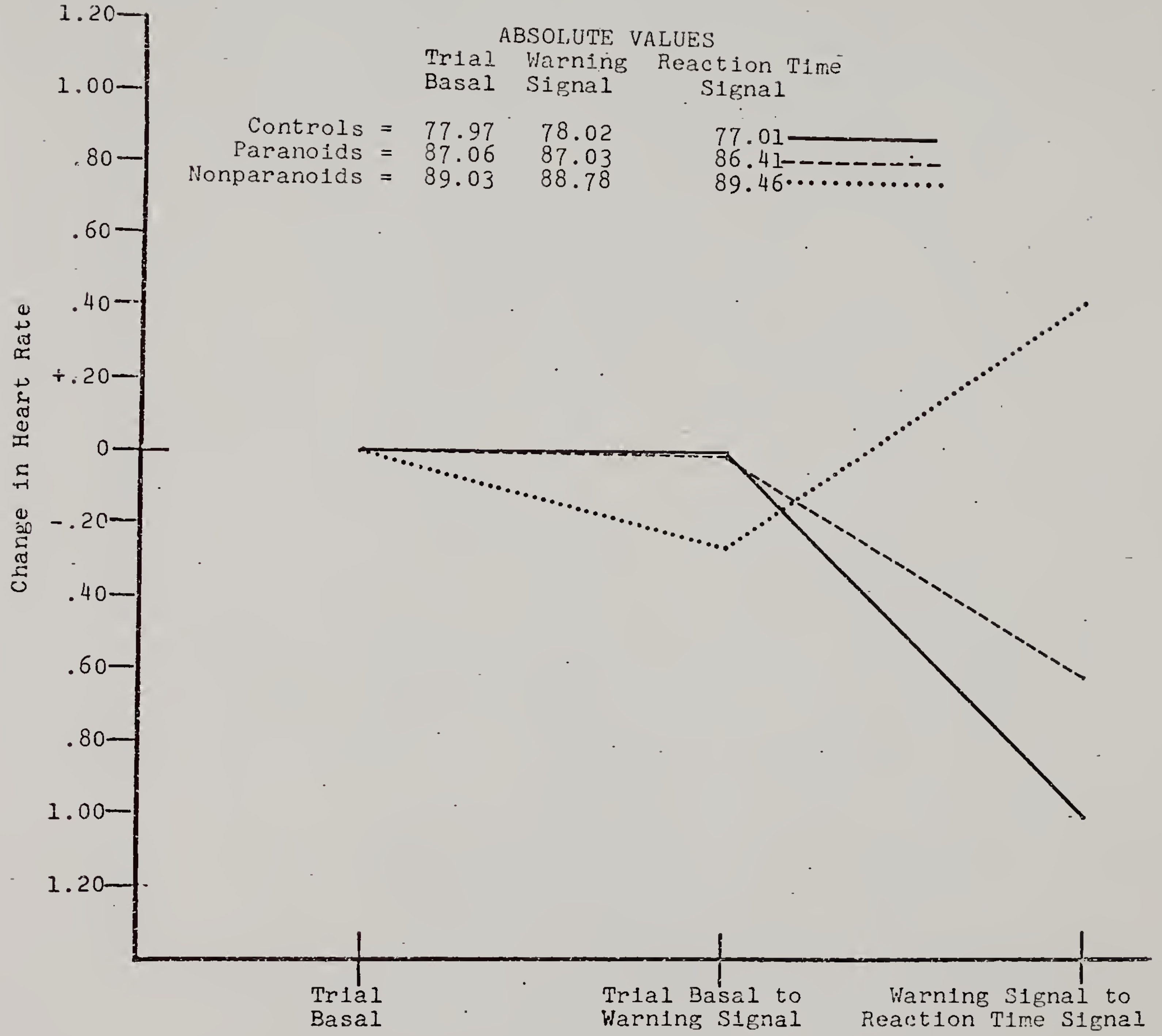

Figure 6. Condition 4: fixed preparatory interval 5 with four additional lights at one second intervals following the warning signal.

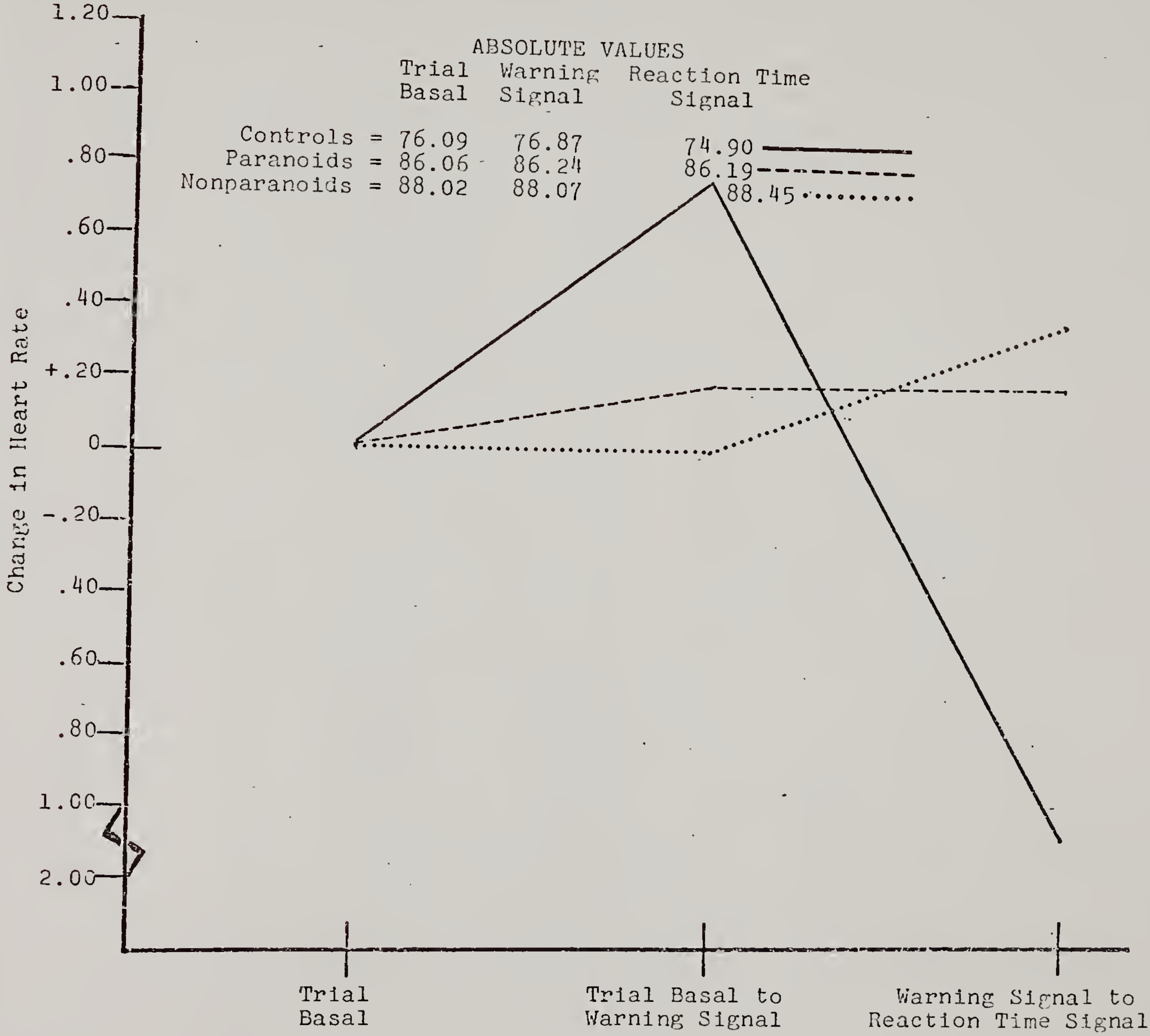

Figure 8. Condition 6: fixed preparatory interval with an additional 25 watt green light as a second reaction time signal placed adjacent to the original reaction time signal between the original warning signal and reaction time signals.

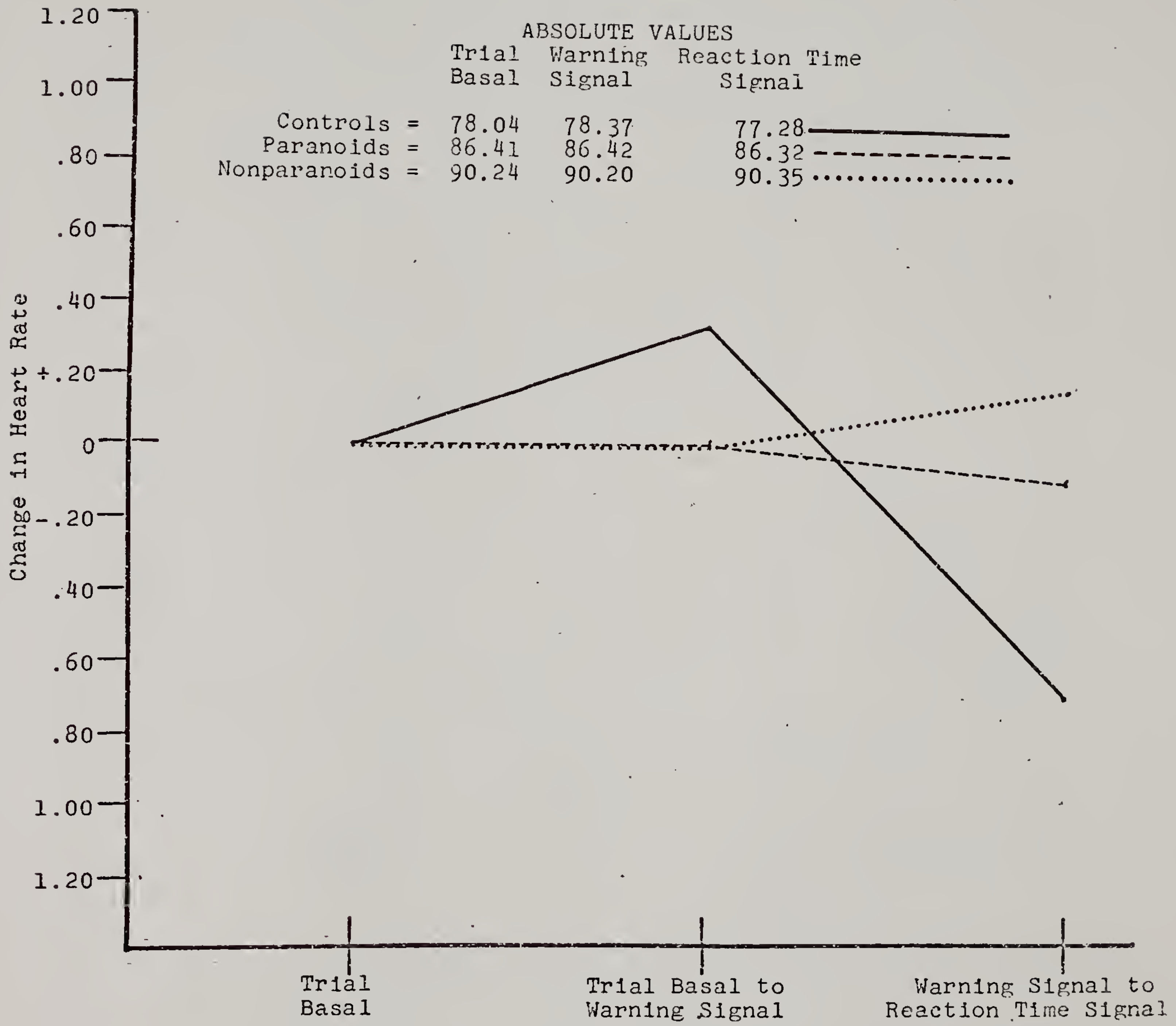

Figure 9. Overall conditions.

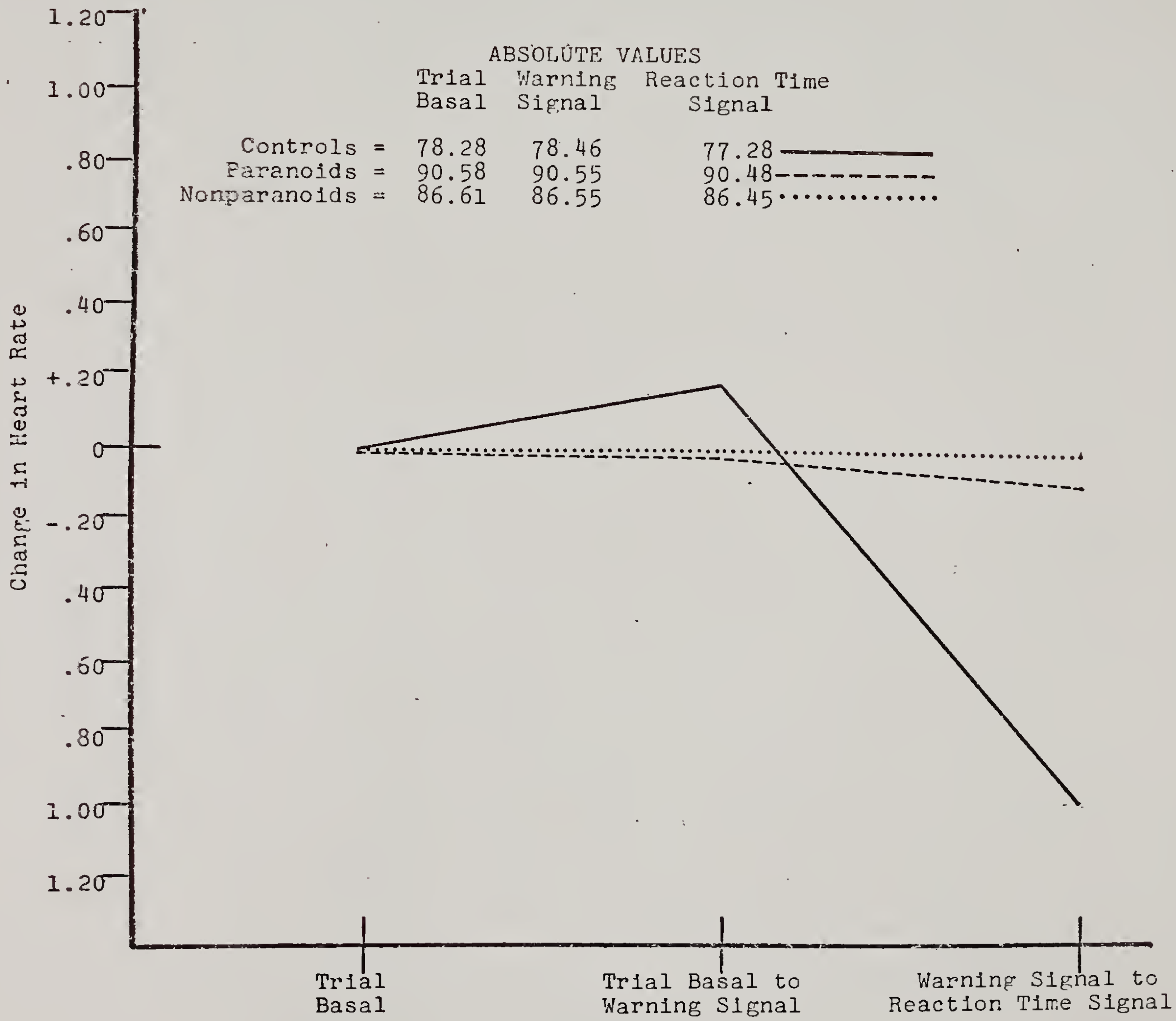

Figure 10. Average of conditions 1 and 4, fixed interval; 3 and 5, variable interval.

Appendix 1

1. Does he tend to suspect or believe on slight evidence or without good reason that people and external forces are trying to or now do influence his behavior control his thinking?

   1--No unjustified suspicions
   2--Will admit suspicion when pressed
   3--Easily admits suspicion
   4--Openly states others are trying to control him
   5--Has firm conviction that he is influenced or controlled

2. Does he have perceptions (auditory, visual) without normal external stimulus correspondence?

   1--None
   2--When pressed admits hallucinations
   3--Easily admits hallucinations
   4--Openly admits frequent hallucinations
   5--Openly hallucinates

3. Does he tend to suspect or to believe on slight evidence or without good reason that some people are against him (persecuting, conspiring, cheating, depriving, punishing) in various ways?

   1--No unjustified suspicions expressed
   2--When pressed expresses belief that he is conspired
   3--Frequently inclined to suspect
   4--Frank inclination to believe in persecution
   5--Strongly expresses conviction of persecution

4. On the basis of the integration of the verbal productions of the patient, does he exhibit thought processes which are confused, disconnected or disorganized?

   1--As normal
   2--Slight disorganization
   3--Mild disorganization
   4--Marked disorganization
   5--Complete disorganization

5. Does he have an exaggeratedly high opinion of himself or an unjustified belief or conviction of having unusual ability, knowledge, power, wealth or status?

1--No expressed high opinion of himself
2--When pressed expresses a high opinion of himself
3--Frequently expresses a high opinion of himself
4--Open conviction of unusual power, wealth, etc.
5--Strongly expresses conviction of grandiose or fantastic power, wealth, etc.

6. How incongruous are his emotional responses? e.g., giggling or crying for no apparent reason or not showing any emotion when emotion would be appropriately shown.

1--As normal
2--Slightly different from normal
3--Responses somewhat incongruous
4--Distinctly incongruous
5--Very markedly incongruous

7. Does he tend to suspect or believe on slight evidence or without good reason that some people talk about, refer to or watch him?

1--No unjustified suspicions
2--Will admit suspicion
3--Easily admits suspicion
4--Openly states that he is watched
5--Has firm conviction of being watched

8. How well oriented is he as to time? For instance, does he know (a) the season; (b) the month; (c) the calendar year; (d) the day of the week; (e) how long he has been in hospital?

1--As normal
2--Occasional confusion
3--Slight confusion
4--Frequent confusion
5--Marked continuous confusion

9. Compared to others how openly hostile is he? Does he show hostility or a high degree of ill will, resentment, bitterness or hate?

1--No open hostility
2--Relatively little hostility
3--Some hostility
4--Rather hostile
5--Very hostile

10. Does he assume or maintain peculiar, unnatural, or bizarre postures?

1--None
2--On rare occasions
3--For short periods
4--Frequently
5--All the time

11. How well is he able to describe events leading up to his present hospitalization? Does he know (a) that he is in a hospital; (b) why he was admitted?

1--As normal
2--Sometimes makes errors
3--Slight confusion
4--Very muddled
5--Completely confused

DIRECTIONS FOR HEART RATE--REACTION TIME TASK

NOW, WHILE WE'RE CHECKING YOUR HEART RATE, I WANT TO SEE HOW FAST YOU ARE. IN FRONT OF YOU IS A PANEL WITH A NUMBER OF LIGHTS ON IT (E INDICATES LIGHTS) AND HERE (BY Ss RIGHT OR LEFT HAND) IS A KEY FOR YOU TO PRESS DOWN. YOUR JOB WILL BE TO PRESS DOWN THIS KEY AS FAST AS YOU CAN AS SOON AS THIS GREEN LIGHT COMES ON. A COUPLE OF SECONDS BEFORE THE GREEN LIGHT COMES ON THIS HELLOW LIGHT WILL GO ON AND OFF ONCE. THAT MEANS THE GREEN LIGHT WILL BE COMING ON IN A VERY SHORT TIME. THE GREEN LIGHT WILL STAY ON UNTIL YOU PRESS THIS KEY DOWN--SO WHEN YOU SEE THE GREEN LIGHT COME ON PRESS THIS KEY DOWN WITH YOUR FINGER AS FAST AS YOU CAN. SOMETIMES THESE OTHER LIGHTS WILL COME ON AND GO OFF ALSO. WHEN THIS HAPPENS YOUR JOB WILL STILL BE TO PRESS THE KEY DOWN AS FAST AS YOU CAN WHEN THE GREEN LIGHT COMES ON. ANY QUESTIONS? OK, NOW WE'LL BEGIN. REMEMBER, THIS YELLOW LIGHT WILL COME ON VERY BRIEFLY AND THEN SOON AFTER THAT THE GREEN LIGHT WILL COME ON AND YOU'RE TO PRESS THIS KEY DOWN WITH YOUR FINGER AS SOON AS THE GREEN LIGHT COMES ON.

NOW A GREEN LIGHT WILL ALSO COME ON BEHIND THE WINDOW IN THE CENTER OF THE PANEL. JUST AS BEFORE THE YELLOW LIGHT WILL WARN YOU THAT THE GREEN LIGHT BEHIND THE WINDOW WILL BE COMING ON SOON. REST YOUR FINGER LIGHTLY ON THE LEVER AGAIN AND WHEN YOU SEE THE GREEN LIGHT COME ON PRESS THE LEVER DOWN WITH YOUR FINGER AS QUICKLY AS YOU CAN. WATCH CLOSELY NOW.

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