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SOCIAL EXPECTATIONS AND UNCERTAINTY IN AN
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CARDIOVASCULAR CORRELATES OF SOCIAL EXPECTATIONS AND UNCERTAINTY IN AN EXPANDED MIXED-MOTIVE INTERACTION WITH COMMUNICATION

By

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ABSTRACT

CARDIOVASCULAR CORRELATES OF
SOCIAL EXPECTATIONS AND UNCERTAINTY IN AN
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This study explored interactions between cardiovascular, social and perceptual processes. It was an attempt to replicate and extend the findings of Van Egeren (1979b) by repeating his basic experiment, with the addition of perceptual variables. The experimental design allowed the study of 1) social expectations in mixed-motive situations; 2) cardiovascular correlates of uncertainty in interpersonal interactions; and 3) aspects of coronary-prone behavior pattern theory. Sixty subjects classified as Type A or Type B interacted in pairs by pressing buttons which transmitted messages through a television screen. Heart rate and digital blood volume pulse were computer-monitored throughout the interactions. Partners could cooperate, compete, reward, punish or withdraw on each interaction and could send one of fifty-five messages communicating feelings, requests and behavioral intentions between interactions. Prior to each interaction subjects attempted to predict their partner's behavior. They also recorded the subjective certainty of their prediction and their feelings about the predicted behavior. Pre- and post-task questionnaires probed subjects' goal orientations, feelings about interpersonal influence, and feelings about their partner.

The striking results of the earlier experiment were not replicated, though the patterns were similar. Type A and Type B pairs of subjects did not behave very differently but interactions between Type A's were less trusting and more challenging and were experienced as more competitive. Type A subjects revealed more competitive goals and selfish intentions than did Type B's, whose goals were more cooperative and intentions egalitarian. Type A's also attached greater importance to their ability to influence others than did Type B's. This finding is discussed in terms of the Type A's need for control. Some support is provided for the idea that Type A's tend to expect others to compete with them, whereas Type B's expect others to cooperate. Digital vasomotor reactivity was found to be most closely associated with the competitiveness of a subject's interaction partner. No significant relationship was found between cardiovascular activity and subjective uncertainty.

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Adequate acknowledgment of Larry Van Egeren's contribution to this dissertation and to my general professional development is impossible in this brief note. If I am eventually successful in my efforts to make a contribution to medical science, much of the credit must belong to him.

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CHAPTER I

INTRODUCTION

Context and Aims of This Research

An awareness is growing within the medical profession that the study of man strictly as a biological organism is inadequate to provide full understanding of biological functioning and disease processes. This perspective is particularly cogent when considering the major chronic diseases of our day, e.g., cardiovascular and cerebrovascular diseases, cancer, diabetes, rheumatoid arthritis, peptic ulcer, and bronchial asthma. Mounting evidence from diverse sources (animal, clinical, and epidemiological) is convincingly demonstrating that psychological, social, and environmental factors play important roles in the development and course of many disease processes. One's interpersonal environment is gaining recognition as a powerful influence of physical as well as mental health. Indeed, the distinctions between psyche and soma are being broken down and an integrated, biopsychosocial (Engel, 1977) approach to health is emerging.

For such an approach to grow and flourish, however, it must be built upon a solid scientific foundation. Our empirical understanding of the complex interrelationships between social, psychological, and biological phenomena is growing rapidly but is still quite rudimentary. Animal research has illuminated mechanisms leading from social stressors to physiological responses to sustained pathophysiological changes and

disease. Epidemiological research has demonstrated linkages between human social processes such as social mobility and social change and the incidence of hypertension and heart disease. Clinical evidence has led to the discovery of relationships between certain personality types and behavior patterns and specific disease processes. Yet we still have little solid empirical understanding of the dynamic interplay between psychological and social processes, normal adaptive physiological responses to social interactions, and the development of lasting pathophysiological effects.

Coronary heart disease (CHD) has, since 1950, been the leading cause of premature death among American adults between the ages of 24 and 65 (Lynch, 1977). The social cost imposed by heart disease, in mortality, hospitalization, and impairment, is well recognized and staggering in magnitude. Social and psychological factors related to lifestyle are increasingly being implicated as important precursors of CHD. Two such factors—social and geographical mobility and the Type A behavior pattern delineated by Friedman and Rosenman (1974)--have been the focus of much scientific investigation. There is strong evidence that both of these variables can contribute to the development of CHD; and Ostfeld (1967) has suggested that the two may be related. However, very little is known about the mechanisms by which these factors affect the body and contribute to cardiovascular disorder.

Lack of knowledge must not be allowed to impede the scientific exploration of these factors. "At the present state of knowledge it would be fatuous--even tragic—to dismiss a social or psychological precursor of disease simply because the mode of action in the body cannot be specified" (Ostfeld, 1967). Indeed, this state of affairs

should encourage research specifically designed to explore how social change or a Type A behavior pattern may interact with physiological systems. They may influence CHD through effects on known risk factors such as high blood lipids, high blood pressure, or cigarette smoking and eating patterns. They may also have other direct physiological consequences for cardiovascular functioning; or may operate through still other mechanisms. Despite mounting epidemiological evidence linking these variables to CHD, we still have little knowledge of the intervening mechanisms.

The search for mechanisms requires the development of new scientific tools that will allow the simultaneous study of psychological, social and physiological processes in controlled laboratory settings. A recently developed "computer-controlled interpersonal analysis system" (CIPAS) weds computer technology with games of strategy to study psychosocial-physiological interactions and may be an invaluable tool in attempts to understand the links between psychosocial phenomena and cardiovascular disorder. This dissertation reports one experiment in which CIPAS was used to explore questions raised by the established associations between social change, the Type A behavior pattern and coronary heart disease.

Literature on the coronary-prone behavior pattern will be reviewed in the following pages, along with the epidemiological literature on CHD and hypertension and experimental literature on environmental control and physiological arousal. Research in each of these areas has suggested that attention to social expectations and/or interpersonal perception may shed some light on the mechanisms linking social processes to cardiovascular dysfunction. The

interpersonal process analysis system used in this experiment readily lends itself to the study of perceptual, social and physiological processes and will be described in detail following the literature review. A discussion of available experimental results based on CIPAS will then lead directly to the formulation of the specific hypotheses tested in this experiment.

One purpose of the research described here was to explore, in a controlled laboratory setting, some of the cardiovascular consequences of a variable to be called "social uncertainty". Interest in this variable emerged out of the epidemiological literature linking mobility and social change to CHD. Briefly summarized, it has been demonstrated that social change leading to a breakdown of traditionally defined norms of behavior is associated with increased risk of hypertension and heart disease. Ostfeld (1967) theorized that the disruption of traditional patterns of behavior leads to many more events (presumably interpersonal events) in which there exists an implication of threat and uncertainty of outcome, wherein flight or fight are inappropriate responses and mental vigilance is called for. He suggests that events of this nature evoke cardiovascular pressor responses which, if repeated often enough over a period of time, can lead to permanent hypertension and increased risk of CHD.

In the present experiment an attempt was made to create in a laboratory setting realistic interpersonal events in which there exists the possibility of loss and uncertainty of outcome. Furthermore, by matching or mismatching Type A and Type B behavior types an attempt was made to observe interactions in which varying degrees of uncertainty

were experienced by participants. Measures of cardiovascular functioning were closely monitored throughout the interactions. If social change contributes to CHD through the cardiovascular consequences of uncertainty, we expected to observe in this experiment a correlation between increased cardiovascular reactivity and increased uncertainty concerning the outcomes of interpersonal events. It was hoped that the utilization of Type A and Type B subjects would shed additional light on these behavior patterns and perhaps reveal a relationship between social uncertainty and the coronary-prone Type A behavior pattern.

Research of this nature is vital if we are to further expend our knowledge of how variables such as social change or a specific behavior pattern contribute to the development of CHD. Epidemiological research has provided extensive information on the influences of these variables on heart disease distribution, but considerable work is still necessary before we can approach a precise description of the social processes that may play a role in the etiology of the disease. The epidemiological method is limited in attempts to answer etiological questions because direct causal links are difficult to establish, and the epidemiological approach cannot shed light on the dynamic interplay between social and biological phenomena. The data have clearly demonstrated that such links exist and have illuminated some of the social factors and biological results that are linked; but carefully controlled laboratory studies on human subjects are also necessary if we are to precisely identify and measure social processes and directly relate such processes to physiological responses relevant to disease.

Background

The coronary-prone behavior pattern

In the late 1950's two cardiologists--Meyer Friedman and Ray Rosenman--began to suspect that emotional stress factors played a role in the development of coronary artery and heart disease. On the basis of clinical impressions and some early research findings (Friedman & Rosenman, 1957; Friedman, Rosenman & Carroll, 1958) they developed the concept of a coronary prone, Type A behavior pattern (Friedman & Rosenman, 1959). The behavior pattern is described as

> an action oriented complex that can be observed in any person who is aggressively involved in a chronic, incessant struggle to achieve more and more in less and less time, and if required to do so, against the efforts of other things or other persons (Friedman & Rosenman, 1974, p. 84).

The Type A person is characterized by 1) an habitual sense of time urgency; 2) a preoccupation with numbers as measures of prowess and achievement; 3) an underlying insecurity of status; and 4) excessive aggressiveness and hostility expressed in a tendency to seek out competition and confrontation. A Type B pattern was also proposed and is defined as the opposite of Type A--characterized by an absence of time urgency, a much less driven and less number oriented achievement drive, and a much less competitive demeanor.

The original assessment technique for determining the presence or absence of the Type A behavior pattern was a face-to-face interview developed by Friedman and Rosenman (1959). The interview technique utilizes voice quality and psychomotor stylistics in identifying four subgroups, labelled A_1, A_2, B_3, and B_4. Reliability studies, however, have raised questions about the ability of the interview to differentiate

four specific subgroupings. Global ratings of individuals as Type A or Type B have proven more reliable (Price, 1979). Attempts to make the assessment of coronary-prone behavior more objective and less time-consuming have resulted in a paper-and-pencil questionnaire--the Jenkins Activity Survey (JAS)--which has been validated against the interview procedure (Jenkins, Rosenman & Friedman, 1967). Although Jenkins, Rosenman and Zyzanski (1974) have cautioned that the JAS yields too many false positives and false negatives to be useful clinically, the instrument has been widely used in large screenings to identify extreme scoring Type A's and Type B's for experimentation.

In order to scientifically explore the relationship between behavior and CHD, an extensive epidemiological investigation--the Western Collaborative Group Study--was begun in 1960 (Rosenman, Friedman, Strauss, Wurm, Kositchek, Hahn & Werthesen, 1964). This study and its subsequent follow-up studies (in 1966, 1970, 1975, and 1976) have demonstrated a significant relationship between the Type A behavior pattern and the occurrence of CHD, with myocardial infarctions (MI) occurring two to five times as often in Type A's as in Type B's.

The mechanisms through which a Type A behavior pattern contributes to the development of CHD are still only poorly understood. Some of the known risk factors for CHD--such as high concentrations of blood lipids and catecholamines, high blood pressure, and reduced blood clotting time--have been shown to correlate with Type A behavior (Friedman, 1969; Friedman, Rosenman & Byers, 1964; Rosenman, Friedman, Strauss, Wurm, Jenkins & Messinger, 1966). However, we still lack specific knowledge of the interrelationships between environmental factors, Type A behavior, acute physiological changes accompanying such

behavior, and the development of permanent damage to coronary vessels.

Friedman and Rosenman (1971) have described the Type A behavior pattern as emerging "only when certain challenges or conditions of the milieu arise which elicit a particular response or complex of responses in certain susceptible individuals" (p. 302). Recent laboratory research has explored some of the environmental conditions which elicit Type A behavior. On an exercise treadmill Type A's worked harder than Type B's and reported less fatigue; and they responded with more aggression when their competence and mastery were questioned (Carver, Coleman and Glass, 1976). Glass, Snyder, and Hollis (1974) found that Type A's, as compared to Type B's, had more difficulty responding slowly to obtain a reward and showed more irritation and impatience when their decision-making efforts were interrupted and delayed. Van Egeren (1979b) has shown that in an expanded mixed-motive type dyadic interaction, Type A's were more aggressive and competitive than Type B's, but their level of competitiveness was dependent upon that of their partner.

Glass and his coworkers have suggested a relationship between Type A behavior and "helplessness" (Seligman, 1975) or loss of control. On the basis of a number of experiments (Glass, Snyder and Hollis, 1974; Krantz, Glass and Snyder, 1974) they concluded that "the Type A behavior pattern is primarily a coping strategy aimed at achieving and maintaining control over the environment" (Van Egeren, 1976). The implication is that Type A's have exaggerated needs for control which are frustrated in their attempts to control such things as time and other people. Humans and animals have been shown to react to helplessness and loss of control with behavioral and physiological signs of distress (Seligman, 1975; Glass and Singer, 1972; Weiss, 1968). Type A people, with their

excessive needs to maintain a sense of control over their environment, may be especially sensitized to the threat of loss of control. The accompanying physiological signs of distress (e.g., excess sympathetic response, increased blood lipids, etc.) may eventually lead to permanent coronary vessel damage.

A few studies have demonstrated linkages between the Type A behavior pattern or its eliciting environmental stimuli and physiological changes potentially relevant to the disease process. Van Egeren (1979b) found that along with greater competitiveness and aggressiveness in social interactions between two Type A individuals, compared to interactions between Type B's, there was also greater digital vascular arousal (vasoconstriction). However, when Type B individuals interacted with Type A's, they too showed increased digital vasoconstriction. Vasomotor responsiveness appeared to be more related to the actual competitiveness of the social interactions in progress than to the behavior pattern "type" of the interactants. Van Egeren (1979b) suggests that "if Type A individuals experience greater digital vascular arousal in their social relationships than Type B's, the difference is due more to the competitive quality of relationships among Type A's than to hyperreactive vascular systems" (p. 16). Dembroski, MacDougall, Herd and Shields (1979) have demonstrated a relationship between the Type A behavior pattern and enhanced physiological reactivity (increased systolic blood pressure and heart rate) to social challenge. Type A individuals, as compared to Type B's reacted to conditions of high challenge with physiologic responses suggestive of increased sympathetic nervous system (SNS) activation. The authors suggest that the difference between Type A's and Type B's is not a basic physiological difference but is

rather a perceptual difference; i.e., Type A's relative to Type B's have a lower threshold for the perception of challenge. Presumably, under conditions of sufficiently high challenge, Type B's would show the same SNS activation that Type A's show to less severe challenges.

In Van Egeren's (1979b) relatively free-wheeling social transactions Type A individuals may well more readily perceive their partner's behavior as challenging, to which they respond with increased competitiveness and vascular arousal. In both paradigms, the elicited physiological response may correspond to a felt need to maintain or regain control over the environment--a need that is expressed in Van Egeren's study in increased competitive behavior and attempts to dominate the other person. In both Dembroski, et al.'s and Van Egeren's paradigms, an attempt to study directly the perceptual processes of Type A's and Type B's appears to be a necessary next step.

The epidemiology of coronary heart disease

Extensive epidemiological research has identified a number of known precursors of CHD. Among the "definite" risk factors are high blood lipids, especially cholesterol and triglycerides, high blood pressure, cigarette smoking, obesity and high blood sugar. Recent research has increasingly implicated social and psychological factors in the development of CHD. Such factors have also been associated with increased CHD risk due to elevated blood pressure and blood cholesterol levels.

Sociocultural change and incongruity are social factors that have been extensively explored and empirically linked to CHD and hypertension. The terms sociocultural change and incongruity were introduced by Smith (1967) as general ideas to encompass a variety of independent variables

including rapid culture change, cultural mobility, social and geographical mobility, and social change. Sociocultural change refers to a process of alteration over time in social and/or cultural elements of a system, while sociocultural incongruity refers to a lack of integration or consistency among such elements. Research suggests that the experience of change or incongruity has a stressful impact on persons, but little attention has been devoted to the variables intervening between change and incongruity and an individual's perceptions, attitudes, or physiological responses to particular experiences.

In a pioneering pair of studies Tyroler and Cassel explored the postulate that "rapid culture change is likely to have deleterious health consequences when it leads to the development of incongruities between the culture of the population at risk and demands and expectations of the new social situation" (Tyroler & Cassel, 1964, p. 167). In a study of rural mountaineers employed in a modern factory (Cassel & Tyroler, 1961), they found that children of previous factory workers showed less morbidity than "first generation" factory workers. The two groups were matched in ethnic stock, work demands and environment, age, sex and marital status. However, first generation workers were suggested to be more likely to experience incongruity between their culturally provided attributes and the demands of the factory situation. In a second study (Tyroler & Cassel, 1964), rural white males in North Carolina were found to exhibit a marked increase in CHD mortality as the index of urbanization of their county increased. Again, the explanation presented was based on the increased incongruity that developed between the rural culture of these men and their social situation as urban influence is strengthened.

Subsequent studies have found links between increased rates of CHD and other kinds of sociocultural incongruities and change--major changes in occupation or place of residence, discrepancies between culture of orientation and current cultural setting, and emancipation from an orientation based on tradition. Syme and his colleagues have shown that workers from a rural or farm background who hold white-collar jobs suffered from CHD much more frequently than workers from the same background who remained in agricultural or blue collar positions (Syme, Hyman, & Enterline, 1964). Discontinuity between culture of childhood and adult situations was also associated with CHD as was occupational mobility (Syme, Borhani & Buechley, 1965). Wardwell, Hyman & Bahnson (1964) studied the effects of "emancipation from traditional orientation", suggesting that stress can result from a non-traditional environment in which persons have a great choice of roles and ambiguous standards and expectations. Their data supported a link between emancipation from tradition and CHD.

Shekelle, Ostfeld and Paul (1969) have directly tested the hypothesis that CHD incidence is associated with incongruity in social status. This research was a part of the Hawthorne Works cohort study on the epidemiology of CHD (Paul, Lepper, Phelan, Dupertuis, MacMillan, McKean and Park, 1963). Seven variables of social status were measured and Shekelle et al. used these variables to define five types of incongruity in social status. Four of these types of incongruity were found to be significantly related to an increased incidence of CHD. Men who had a difference of three points or more between the highest and lowest ratings assigned to the seven variables of social status had more than twice the risk of CHD than men who did not have this attribute.

If social change and incongruity are related to the incidence of CHD, one might wonder whether social stability can provide some immunity from the disease. In a series of studies on Italian-American communities in eastern Pennsylvania, Bruhn and his colleagues provide evidence that social stability and cohesiveness are in fact associated with a very low incidence of early death from myocardial infarction (Bruhn, 1965; Bruhn, Chandler, Miller & Lynn, 1966; and Bruhn, Philips & Wolf, 1972). Bruhn et al. studied the town of Roseto, which was characterized by an unusually cohesive and stable social structure. Populated by Americans of Italian descent who were socially isolated from the Anglo-Saxon inhabitants of the region, the family units in Roseto were extremely close and mutually supportive, as was the community as a whole. Social roles and functions within families and the community were essentially unchanged from the traditions of the "old country".

The conventional risk factors for CHD in Roseto--diet high in animal fat, cigarette smoking, sedentary life-style, and obesity--were found not to differ from neighboring areas. Yet the incidence of death from myocardial infarction (MI) was strikingly lower. This seeming immunity from MI appeared to be lost when Rosetans left the community--their relatives living in other eastern towns and cities revealed signs of CHD comparable to other Americans; and the populace of a neighboring community, which was quite similar to Roseto in all respects except for social stability, did not share the Rosetans' freedom from cardiovascular disease.

Although the data reviewed thus far may be open to a variety of interpretations and explanations, the weight of the evidence does suggest a direct association between sociocultural incongruities and risk of CHD. Cassel (1967) has suggested that research must now focus on the processes underlying the association. He suggests further that increased understanding of such processes requires rejection of a simple, unicausal model of disease. Cassel views disease as occurring when the adaptive responses by the organism to stimuli are inappropriate in kind, amount, or both. He appears to favor a model which assumes that "certain social situations are the 'vehicles' containing the causative 'agents' of cardiovascular disease" (p. 47); but he suggests expanding this model to include "the possibility that the consequences of exposure to the social situations may vary at different times and places, and that these differences may be a function both of the processes involved in the situation and the attributes of the people exposed" (p. 44, emphasis mine).

One "attribute of people exposed" that the epidemiological literature has solidly linked to increased risk of CHD is the Type A behavior pattern. Laboratory research has suggested that Type A individuals have low thresholds for the perception of social challenge; and the experience of "high challenge" is apparently linked to increased SNS activation (Dembroski, et al., 1979). The relationships of sociocultural incongruities and the Type A behavior pattern to CHD may be intertwined in that increased experience of high "social challenge" is a likely consequence of sociocultural incongruity and change, while Type A individuals display greater susceptibility to such experiences. Rosenman (1974) has been careful to speak of Type A not as a

"personality type" but as a "behavior pattern" elicited from susceptible individuals by certain stimuli. The type of social situations which elicit Type A behavior may well be quite similar to the types of social situations more frequently encountered by individuals experiencing sociocultural change or incongruity. The absence of such "stressful" social situations in a stable social environment like Roseto may well immunize even the more highly susceptible Type A individuals from increased CHD risk.

Epidemiological data linking sociocultural incongruity and the Type A behavior pattern to CHD provide a useful basis for speculation about the interrelated roles these two factors may play in the disease process. However, as Cassel suggested in 1967, research must now focus on the process linking psychosocial factors to physiological systems and disease. Those aspects of social interaction which evoke relevant behavioral and physiological responses in susceptible individuals must be precisely identified and measured. Available evidence suggests that the translation of social behavior into physiological response is probably moderated by perceptual process. The simultaneous study of social interaction, interpersonal perception and cardiovascular functioning appears to be the necessary next step to illuminate the linkages established in the epidemiological literature on CHD.

The epidemiology of essential hypertension

Sociocultural change and incongruity have also been strongly linked in the epidemiological literature to the development of hypertension, a known precursor of CHD. Recent studies into the etiology of essential hypertension have focussed increasingly on how individuals interact with their interpersonal environments and how the interaction

is related to the development of hypertension (Benson & Gutman, 1974). Extensive data (see Henry & Cassel, 1969 for a partial review) have provided considerable evidence that social change and a resulting departure from traditionally defined norms of behavior is related to elevated blood pressure. Stamler et al. (1967) found a number of specific attitudes associated with environmental change (such as disliking one's new neighbors, a desire to have gone elsewhere, a desire to actually move but uncertainty as to one's chances) were also associated with higher blood pressures and a greater incidence of hypertension. These attitudes all are indicative of and perhaps contribute to a difficult adjustment in a new environment. Benson and Gutman (1974), citing the higher incidence of hypertension in urban settings, among blacks, in higher income groups, and in "high stress" neighborhoods, as well as evidence from animal experiments, suggest that elevated systemic arterial blood pressure is "consistently related to environmental situations which require continuous behavioral adjustments on the part of the individual" (p. 15). Conflict and uncertainty elicited by such demanding environmental situations seem to be associated with pressor responses which may increase arterial blood pressure.

Henry and Cassel (1969) review anthropological data which suggest that hypertension results from a failure of the individual to meet the demands of the environment with adaptive behavior. Social and cultural change increase the incidence of such failures since expectations acquired earlier no longer apply to new environmental conditions. As a result, aspirations are blocked and individuals experience increased uncertainty that they will be able to satisfy behavioral urges through

programmed goals. Henry and Cassel theorize that psychosocial stimulation of this type leads to a chronic activation of the physiological defense-alarm reaction, which can lead to essential hypertension.

Ostfeld (1967) postulates a relationship between uncertainty, pressor responses, and hypertension. Reviewing anthropological and epidemiological data he observes that

> there has been an appreciable increase in uncertainty of human relations as man has gone from the relatively primitive and more rural to the urban and industrial. Contemporary man, in much of the world, is faced every day with people and situations about which there is uncertainty of outcome, wherein appropriate behavior is not prescribed and validated by tradition, where the possibility of bodily or psychological harm exists, where running or fighting is inappropriate, and where mental vigilance is called for (Ostfeld and Shekelle, 1967, p. 329).

According to Ostfeld (1967) such situations evoke pressor responses and the increasing incidence of situations having these five characteristics accounts for the greater incidence of hypertension in modern societies.

Naditch (1974) has explored the relationship between relative discontent, locus of control, and the incidence of hypertension in a large sample of American urban blacks. She found that among highly discontented subjects there was a dramatic increase in the incidence of hypertension with an increasingly external locus of control. External locus of control is described by Naditch as a perception that rewards and punishments do not occur because of one's own actions, but are due instead to forces outside of one's control such as fate, luck, chance, or powerful others.

Summary

The common theme running through the work just reviewed is the suggestion of a relationship between the development of essential hypertension and 1) the disruption of social expectancies; 2) the resultant experience of uncertainty; and 3) the perception of an inability to control or influence environmental stimuli. These same three factors can also quite plausibly be applied to the relationship, described earlier, between sociocultural change and incongruity and CHD. Coronary heart disease is more prevalent among societies in which there exists incongruity between the culture of the group and the demands and expectations of the prevailing social situation. It is also more prevalent among individuals undergoing major changes in occupation or residence, individuals who are moving away from "traditional orientations", and individuals of uncertain social status. In each of these situations the individual is likely to experience a disruption of social expectations, uncertainty regarding prescribed behavior, and increased uncertainty about the achievement of personal goals through social behavior.

Social expectations and uncertainty are perceptual variables that may well be deeply involved in social and psychophysiological behavior. Laboratory explorations of perceptual processes such as expectations and uncertainty in interpersonal interactions, with simultaneous attention to cardiovascular functioning, may well begin to shed some light on the intervening variables linking sociocultural change and incongruity to coronary heart disease and hypertension.

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Other Studies

Our interest in social expectations and uncertainty is supported by available animal and human psychophysiological evidence. Henry and Ely (1976) have extensively studied the biochemical differentiation of dominant and subordinate members of newly established murine colonies. They found that during the initial stages of colony development the dominants and subordinates both showed strong, but differing, neuroendocrine responses, differences that they attribute to the animals' differing perceptions of their environment. Subordinates generally had higher corticosterone levels during the first week or so of colony life. However, when a stable social hierarchy began to emerge after a month or so, these elevated levels returned to normal, perhaps because the "emerging dominant is not longer challenged and the expectations of all colony members are reliably met" (p. 965). A similar sequence of changes was found for dominants. They showed much greater rises in adrenal medullary content of phenylethanolamine N-methyltransferase, an enzyme responsible for synthesis of epinephrine from norepinephrine. Eventually, however, "the colony stabilizes expectations, role behavior becomes fixed, and corresponding with this the neuroendocrine responses subside to control levels" (Henry & Ely, p. 967, emphasis mine).

However, if the colonies were closed so that the subordinates could not be driven out (a disruption of normal social processes) the blood pressure of dominant animals soon became significantly elevated, despite continued near normal neuroendocrine functioning. The development of "hypertension" in these animals suggests that the disruption of normal social role expectations in a colony can have a pathophysiological effect on colony members.

Levine, Goldman and Coover (1972) studied directly the effects of expectancy on the pituitary-adrenal system. Rats trained to press a lever for water on a continuous reinforcement schedule showed a sharp increase in plasma corticosterone when reinforcement was withheld, and a decrease when reinforcement exceeded expectations. Over repeated trials, however, the intensity of the corticosterone response progressively declined. They suggested that this decrement in physiological response reflected the animal's perception of the situation as becoming progressively more predictable.

Other researchers have found similar decreases in adreno-cortical responses when stressful stimuli are repeatedly administered over a number of days (see Henry & Ely, 1976). Henry and Ely (1976) suggest that with repetition of stress there is a change in the animal's response to the experience. What is at first perceived as a threat is later perceived as perhaps unpleasant but "having a predictable outcome and therefore presenting possibilities for control" (p. 964).

This suggestion--that as the occurrence of stressful stimulation becomes more predictable and is therefore experienced as more controllable, the intensity of the physiological response attennates--is quite similar to the conclusions of Glass and Singer (1972) based on work with human subjects and noise stress. Using yoked control experimental designs Glass and Singer demonstrated that behavioral and autonomic indices of stress are reduced by a) control of the onset and/or offset of stressful stimuli; b) the expectation of having such control; and c) the belief, even if untrue, that one can control the amount and/or occurrence of the stressor by instrumental responding. In other words, when a subject <u>perceives</u> a stressful stimulus as being

uncontrollable, then autonomic indices of stress are maintained at an elevated level.

Similarly, Hokanson, DeGood, Forrest and Brittain (1971) have suggested that the percept of operant control over the influx of aversive stimuli reduces blood pressure levels. They found that availability of an avoidance response while under stress significantly reduced blood pressure relative to yoked controls who experienced identical patterns of stress and avoidance but no control of the avoidance response. Haggard (1943) and Pervin (1963) present data demonstrating a reduction in physiological arousal and subjective anxiety among subjects who felt they had control over the delivery of aversive stimulation to themselves. Using a paradigm similar to that used by Hokanson et al. (1971) but including the personality variable of locus of control, DeGood (1975) presents data suggesting that relevant attitudes and expectancies are a factor in blood pressure responses. He found that diastolic blood pressure elevations were lowest when subjects' expectations (internal or external locus of control) were matched by the actual experimental control conditions.

Obrist, Gaebelein, Teller, Langer, Grignolo, Light, and McCubbin (1978) have studied the influence of conditions which provide subjects varying opportunities to control experimental stressors on heart rate, carotid dP/dt, and blood pressure. One consistent finding was that heart rate, carotid dP/dt, and systolic blood pressure were more elevated (or more sustained once elevated) by conditions allowing presumed or actual control of an aversive stressor with partial certainty of success, than by conditions where avoidance was either certain or impossible. In other words, when the outcome was certain,

whether that outcome was avoidance or non-avoidance, cardiovascular activation was less than when the outcome was uncertain.

Despite the growing animal and epidemiological literatures linking a variety of social processes to cardiovascular disease, none of the laboratory studies on human subjects cited above utilized social stressors. In fact, an extensive search of the literature revealed a striking lack of studies in which any human social behavior was specifically studied in conjunction with the monitoring of physiological systems. Yet it is precisely this type of study that is most needed to further explore the many questions raised but as yet unanswered in the animal and epidemiological literatures. Furthermore, many of the questions raised suggest that specific attention to perceptual processes may be vital to increased understanding. Laboratory studies of Type A behavior, epidemiological studies of CHD and hypertension, and even studies of animal social behavior have all referred to perceptual processes; but few attempts to directly study such processes in humans have been made. Messe, Stollak, Larson and Michaels (1979) review the scanty literature in this area and present some data supporting the importance of interpersonal perception in social behavior.

If we are to make further progress towards defining and measuring those social processes that are relevant to health and disease, human social behavior must be brought into the laboratory where it can be carefully controlled and monitored and where the complex interrelationships among social, perceptual, and physiological processes can be directly studied.

Translating this need into useful and feasible research projects is a difficult task. Indeed, the lack of laboratory studies of social

behavior and physiological functioning is probably due to the tremendous difficulty of bringing real social interaction into the laboratory while maintaining the standards of rigor and control required of good laboratory science. To explore the important issues we must be able to place human subjects in realistic interpersonal situations in which the stimulus configuration can be manipulated, subjects' perceptions explored, and physiological responses closely monitored and directly related to interpersonal events. There are few models available in the literature for the study of social processes under laboratory conditions which permit continuous monitoring of physiological systems. Recently, however, Dr. Lawrence Van Egeren at Michigan State University has developed a computer-controlled psychophysiological research system that may provide the tools necessary to explore in a controlled and systematic fashion the dynamic interplay between social and biological processes.

CIPAS: Computer-controlled Interpersonal Process Analysis System

CIPAS was developed in order to study the cardiovascular effects of two-person social interactions. It combines computer technology with formal game theory (Van Egeren, 1978). The interpersonal interactions utilized in CIPAS are derived from the mathematical theory of games of strategy (Rapoport and Chammah, 1965). A game is defined in game theory as a situation in which there are a) two or more "players", each of whom has b) a set of choices or "strategies"; c) knowledge of outcomes of all choices; and d) a preferential ordering of outcomes. As a simple illustration, consider the following situation. Two

people (players A and B) are brought together. Player A is presented with two choices--"cooperate" or "compete". He is told that if he chooses to COOPERATE he will either lose $1 or win $1, depending upon whether Player B chooses to COOPERATE or COMPETE, respectively. On the other hand, should he choose to COMPETE, he will either win $2 or lose $1, again depending upon Player B's decision. The decision situation is shown below. The left hand number in each cell is the payoff to Player A; the right hand number is the payoff to Player B (Abelson, 1978).

		Player B	
		COOPERATE	COMPETE
Player A	COOPERATE	1,1	-1,2
	COMPETE	2,-1	-1,-1

In the games of interest here both players are shown the payoff table. They make their choices in ignorance of their opponent's choice on a given play. They are told the result of the play and then proceed to the next play. The individual player does not control the situation alone. His behavior, along with the behavior of the other person, controls the payoffs to both of them, hence, the possibilities for cooperation or competition. In the upper left-hand corner of the above matrix is the "best" outcome for both players. If both COOPERATE they both win $1. However, both players are tempted to defect to the COMPETE response which, if the opponent does not also defect, gives them $2 and penalizes the opponent $1. If both players defect simultaneously, both lose $1. A simple game such as this provides incentives for both cooperation and competition. By changing entries in the payoff table, incentives for cooperation or competition can be altered and new interpersonal situations created. In addition, one of the players can be replaced by a confederate who can play a variety

of programmed responses (Abelson, 1978).

In a recent experiment (Van Egeren, 1979b), an expanded game matrix was used to create more complex interactional possibilities. The basic COOPERATE and COMPETE options were preserved. Also included were options to unilaterally give the other person points (REWARD), unilaterally deprive the other person of points (PUNISH), and prevent any gains or losses on a trial (WITHDRAW). A communication system was also designed to allow subjects to communicate feelings, intentions and requests to each other. When the five-choice matrix was used in conjunction with the communication system, extremely involving, realistic and complex social interactions took place within the carefully controlled and closely monitored environment of the psychophysiological laboratory.

CIPAS is a computer controlled interactive system. A small laboratory computer controls the sequence and pace of interactions by prompting participants for responses and displaying the outcomes of their choices or communications on a television monitor. Participants sit side by side separated by a curtain and interact with each other (via the computer and T.V. screen) by pressing buttons on a response panel. The computer provides very fine control over the laboratory conditions while participants interact. It also acquires and stores detailed physiological, behavioral and communication data from both participants and thus allows quick but complex statistical analyses of the dynamic interplay between social and physiological processes.

While formal games as an experimental tool are relatively simple and flexible, the social processes they tap are extremely rich; and when coupled with computer technology the methodology offers some

important advantages for the psychophysiological study of interpersonal stress:

a) interpersonal behaviors are clearly defined and delimited in time;

b) the connection between actions and outcomes is known to the participants;

c) a wide variety of social pressures can be created by manipulating entries within the payoff table as independent variables;

d) a series of plays results in a well-defined behavioral protocol which is amenable to mathematical and statistical analyses;

e) physiological response can be monitored and keyed in time to specific social behaviors and outcomes (Van Egeren, 1976).

Perhaps most importantly in the present context, CIPAS provides sufficient flexibility to include the exploration of perceptual processes in psychophysiological studies. In the complex five-choice game with communication described above, the computer can relatively easily be programmed to probe and record interpersonal perceptions throughout the social interaction. Through careful construction of questions and response options a variety of perception variables amenable to mathematical and statistical analysis can be created within CIPAS.

Until now there have been very few models available for the study of interpersonal processes and person perception under laboratory conditions which permit continuous monitoring of physiological systems. CIPAS provides a methodological framework that can be adapted to test a wide range of hypotheses relevant to a variety of types and aspects of social processes, which can be explored while monitoring a number of different physiological systems. The design of CIPAS allows, and in fact requires, a very precise description and operationalization of

the social processes of interest; and it permits the exploration of linkages among social, perceptual, and physiological processes. If an important goal is, as Cassel (1970) suggests, the precise definition and quantification of social processes relevant to health and the establishment of direct links between such processes and pathophysiological responses, the potential contributions of CIPAS are tremendous.

Applications of CIPAS

CIPAS has been employed in three recent experiments which have focussed on cardiovascular changes during interpersonal transactions. Two of these experiments (Van Egeren, 1979a, 1979b) were designed primarily to test hypotheses derived from the Type A behavior theory of coronary proneness (Friedman & Rosenman, 1974). These studies explored the actual interpersonal and cardiovascular behavior of normal, college-age subjects designated as Type A or Type B on the basis of a student version of the Jenkins Activity Survey (Jenkins, 1965). Striking differences were found. Type A subjects were significantly more aggressive and competitive and exhibited greater cardiovascular activation (especially vasoconstriction) during interactions than Type B's. The actual social behavior of Type A's was found to be dependent upon the partner's level of aggressiveness, i.e., when interacting with an aggressive, competitive partner Type A subjects behaved competitively but when interacting with a cooperative partner they became more cooperative. However, engaging in cooperative behavior with a cooperative partner did not lessen the cardiovascular reactivity of Type A's. Type B's, on the other hand, tended to interact cooperatively regardless of the behavior of their partner. However, when interacting with competitive partners the cardiovascular

reactivity of Type B's increased to levels approximating those of Type A's.

Sex membership showed little relationship to social and cardiovascular behavior in one of these experiments (Van Egeren, 1979b). In both experiments the differences between Type A's and Type B's held for both males and females. However, in one experiment (Van Egeren, 1979a), females exhibited greater cardiovascular activation with competitive partners and less activation with non-competitive partners than males.

The third experiment employing the CIPAS methodology focussed on the cardiovascular concomitants of anger induction, anger expression, and uncertainty concerning the consequences of anger expression (Van Egeren, Abelson & Thornton, 1978). Harrassment of subjects by a confederate during an intellectual task resulted in greater expression of subjective feelings of anger and greater cardiovascular activation than did completion of the task without harrassment. Following the intellectual task subjects engaged in a mixed-motive, interpersonal game with the confederate. Exploitation of the confederate was found to be related to increased cardiovascular recovery (lowered diastolic blood pressure). Increased uncertainty regarding the consequences of exploitation or cooperation was related to the maintenance of cardiovascular activation (fast pulse wave transmission and smaller blood pressure decrease).

Analysis of CIPAS results

It is interesting to attempt to integrate this set of findings in terms of social expectations and uncertainty in interpersonal transactions. In discussing the sex differences found in one of his experiments Van Egeren (1979a) discusses the possible influence of

sex-role expectations. In western societies males are expected to be aggressive and females to be non-aggressive (Frodi, Macauley & Thorne, 1977). Van Egeren suggests that males interacting with a cooperative partner may find it more difficult to engage in their sex-role-expected competitive (aggressive) behavior and they thus experience greater distress and arousal. Females, on the other hand, are expected to be cooperative (non-aggressive) and are therefore aroused and distressed by a competitive partner who makes cooperation difficult.

An expanded social expectancy interpretation of these sex differences is suggested by Miller and Holmes' (1975) finding that competitive people tend to expect "typical others" to behave competitively. Females, expected by others to be cooperative, may well tend to expect cooperative behavior in return in interpersonal transactions, whereas males, expected to be competitive, may tend to expect competition. Confrontation with unexpected behavior (competition for females, cooperation for males) may then be experienced as surprising, disconcerting and/or arousing. When forced to engage in a continuing interpersonal interaction with a partner engaging in unexpected behavior, both males and females are likely to experience considerable more uncertainty as to the likely outcomes of the interaction than when engaged with a partner behaving concordantly with expectations. Van Egeren, Abelson, and Thornton (1978) have demonstrated that uncertainty regarding the consequences of behavior in an interpersonal transaction is related to the maintenance of cardiovascular activation.

Pursuing this analysis further, we might suggest that an interaction between two competitors in inherently less stable, and therefore less certain, than an interaction between two cooperators. Using a

simple CIPAS mixed-motive matrix as a model for interaction (see page 39) it is clear that in order for cooperation to begin and be maintained a tacit agreement involving considerable trust must be established. The possibility of a partner's defection to competitiveness is always present, so a pair of rational cooperators must 'believe' in the other's continued cooperation in order to maintain the cooperative agreement. According to Miller and Holmes (1975), cooperators are concerned with mutual payoffs, whereas competitors are concerned only with their own payoffs. Competitors therefore can reach no tacit agreements and cannot establish trust--their best strategy in terms of their own payoffs is to entice their partner to cooperate and then compete themselves. As a result, an interaction between competitors is extremely unpredictable and competitors are likely to experience considerable uncertainty as to their partner's next move. If uncertainty plays a role in cardiovascular arousal we would therefore expect an interaction between competitors to generate considerable arousal. Cooperators, however, are likely to reach an implicit cooperative agreement that alleviates uncertainty and decreases cardiovascular arousal.

Continuing with this analysis, what would we expect to happen when a competitor interacts with a cooperator and vice versa? The competitor competes because he is concerned primarily with his own payoffs and he expects most other people to approach interactions similarly (Miller & Holmes, 1975; Messe and Sivacek, 1979). When confronted with cooperative behavior, then, the competitor is likely to experience some surprise. If the cooperator "martyrs" himself by continuing to cooperate even in the face of competition he may be able to induce cooperation from the competitor (exploitation may induce

guilt and cooperation still yields the competitor positive payoffs). But since the competitor's own best strategy is to induce cooperation and then compete he will be wary of a similar approach by his partner; so even if he goes along with cooperation he expects a competitive response at any moment, cannot therefore develop trust, and thus experiences considerable uncertainty and arousal even when cooperation is established.

A cooperator, on the other hand, cooperates because he is primarily concerned with mutual payoffs; and he expects a similar approach from others (Miller & Holmes, 1975; Messe & Sivacek, 1979). When confronted with competitive behavior, then, the cooperator may experience some surprise; and he is likely to try to induce cooperation since this is so clearly the most mutually advantageous behavior. If this fails, he may revert to competition as a defensive maneuver (Miller & Holmes, 1975); but regardless of behavioral outcome, the cooperator is likely to perceive the competitor as unpredictable and irrational. Uncertainty will be one result and considerable cardiovascular arousal is expected.

The pattern of cardiovascular activity expected on the basis of the preceeding analysis is exactly what was found by Van Egeren (1979b). Competitors (Type A's) interacting with other competitors showed more cardiovascular reactivity than cooperators (Type B's) interacting with other cooperators. They also competed more, showed more distrust, and were less likely to positively respond to a communicated interest in cooperation. Competitors interacting with cooperators were enticed to behave cooperatively but their cardiovascular activity was much the same as when they interacted with other competitors. Cooperators interacting with competitors showed cardiovascular reactivity levels

similar to the competitors, even though cooperative behavior was induced. So the only group which had lowered cardiovascular reactivity was that of cooperators interacting with other cooperators. This was also the only group in which real trust and certainty could be established.

The above discussion, though based on data gathered in the laboratory using CIPAS, is admittedly highly speculative. The speculations appear intriguing enough, however, to suggest that it may be quite fruitful to explore more directly the roles of social expectation and the experience of uncertainty in CIPAS interpersonal interactions. Such an exploration gains greater importance in light of the literature reviewed earlier, which suggests that these variables may play an intervening role in the link between sociocultural incongruity and hypertension and heart disease.

The present research represents an attempt to illuminate the findings reported by Van Egeren (1979b) by repeating his basic experiment with the addition of a perception phase designed to gather information on expectations, uncertainty and perceived utility. The experimental design allows exploration of 1) aspects of Type A behavior pattern theory; 2) Miller and Holmes' (1975) analysis of expectations in mixed-motive situations; and 3) the cardiovascular correlates of uncertainty in interpersonal interactions.

CHAPTER II

DESIGN AND HYPOTHESES

Briefly summarized, the experimental design was as follows (see methods section for details): Subjects were prescreened for the Type A behavior pattern. High (Type A) and low (Type B) scoring subjects were asked to participate in the experiment. Subjects were run in like-sex pairs. Three groups were created by matching or mismatching behavior type as follows: A-A dyads, B-B dyads, and A-B dyads, where A-A dyad refers to two Type A subjects interacting with each other, etc. There were ten dyads in each group, five male and five female.

Subjects interacted for approximately forty minutes (twenty interaction trials) using an expanded mixed-motive interaction matrix. They were permitted to communicate in a limited and controlled fashion between trials. Also between trials they were asked to predict which response-choice their partner would make on the following trial and to rate their degree of confidence or certainty in their predictions. These confidence ratings were used as a direct measure of subjective social uncertainty by averaging each subject's certainty (or uncertainty) over the twenty interaction trials. Subjects were also asked to indicate how they felt about their partner's expected response. Cardiovascular systems (heart rate and finger blood volume) were monitored throughout the interactions. A post-task questionnaire was administered.

Pretask Differences Between Type A and Type B Subjects

1. The motivational orientation of Type A subjects will be significantly more competitive than the motivational orientation of Type B subjects.

Comments. Competitiveness is one of the defining characteristics of the Type A behavior pattern and questions about competitiveness are included in all methods of identifying Type A individuals. In this experiment an independent direct measure of subjects' motivational orientation in a mixed-motive type situation will be administered; and Type A subjects are expected to be more competitive than Type B subjects.

2. Type A subjects, as compared to Type B subjects, will describe the goal orientation of the "typical" person in significantly more competitive terms.

Comments. Following Miller and Holmes (1975), we expect the more competitive Type A subjects to expect "typical others" to behave more competitively than will the more cooperative Type B subjects. If general expectancies play the role in cardiovascular responses of Type A and Type B subjects to social interactions that our above interpretation of CIPAS results suggests, we must be able to establish that Type A's and Type B's do in fact differ in their general social expectancies.

3. Type A's, as compared to Type B's, will attach greater importance to their ability to influence the behavior of people around them.

Comments. Type A people have been described as having excessive needs for achieving and maintaining control

over their environment. The current experiment explores the Type A behavior pattern and its cardiovascular correlates in a specifically interpersonal situation. This hypothesis attempts to expand the Type A need for control to include the interpersonal environment.

Post-task Differences Between Type A and Type B Subjects

1. Type A subjects will describe the goal orientation with which they approached the beginning of the task in significantly more competitive terms than will Type B's.

Comments. This hypothesis applies our expectations about the competitiveness of Type A's to the specific task used in the experiment.

2. Type A's, as compared to Type B's, will describe the goal orientation of the "typical" person in the experimental task in significantly more competitive terms.

Comments. As in 1 above, this hypothesis applies a more general expectation to the specific experimental task.

Post-task Differences Between Dyad Types

1-4. When subjects in Type B-B, Type A-A, and Type A-B pairs are compared they will differ as follows in their mean ratings of their partners:

1. Subjects in Type B-B pairs will rate their partners as more trustworthy;

2. Subjects in Type B-B pairs will rate their partners as warmer;

3. Subjects in Type B-B pairs will rate their partners as less selfish;

4. Subjects in Type B-B pairs will rate their partners as less competitive.

Comments. We have suggested above that only in an interaction between two cooperators can real trust and certainty develop. As a consequence of the trust and certainty we expect in Type B-B pairs, we expect subjects in these dyads to experience their partners as more trustworthy, warm, unselfish and cooperative.

Task Differences Between Dyad Types in Behavior, Physiology and Perceptions

1. Type A-A, Type A-B and Type B-B dyads will differ in mean number of compete responses, with Type A-A dyads competing the most.

2. Type A-A, Type A-B, and Type B-B dyads will differ in mean number of cooperative responses, with Type A-A dyads cooperating the least.

3. Type A-A, Type A-B, and Type B-B dyads will differ in general vasoconstriction with Type B-B dyads showing the least amount of vasoconstriction.

Comments. These three hypotheses are based on the results reported by Van Egeren (1979b).

4. Type A-A, Type A-B, and Type B-B dyads will differ in accuracy of perception, with Type B-B dyads showing the greatest accuracy.

5. Type A-A, Type A-B, and Type B-B dyads will differ in subjective certainty, with Type B-B dyads showing the greatest subjective certainty.

Comments. These two hypotheses state our expectation that interactions between Type B's are more predictable and thus allow the establishment of greater certainty.

6. There will be a significant positive correlation for all subjects between subjective certainty in the experimental task and general vasodilation (return towards resting level in digital pulse amplitude).

Comments. Our interpretation of the literature and previous CIPAS results led us to expect a relationship between certainty and physiological arousal. This hypothesis states the expected relationship.

CHAPTER III

METHOD

Subjects

The subjects were 30 male and 30 female undergraduates enrolled in introductory psychology classes at Michigan State University. These students are offered extra points towards their final course grade in return for their participation in psychological experiments. Subjects participating in this experiment were also paid a small amount of money.

The 60 experimental subjects were chosen from a pool of approximately 200 subjects who were screened for Type A behavior, using the student version of the Jenkins Activity Survey (Krantz, Glass and Snyder, 1974). A copy of this survey is included in Appendix A. The survey was scored by counting one point for every question answered in the direction expected on the basis of Type A behavior pattern theory. This scoring yielded a potential range of 0 to 44. Separate distributions were formed for males and females, and experimental subjects were drawn from the top and bottom 25% of these distributions. High scorers (scores of 17 or greater) were designated Type A and low scorers (scores of 8 or below) were designated Type B. During screening sessions subjects also filled out a brief motivational orientation questionnaire (described below).

Subjects were scheduled to participate in the experiment in pairs. Males were matched with males and females with females. Three types of pairings were used--a Type A with a Type A, a Type B with a Type B, and a Type A with a Type B. There were 10 pairs (5 male and 5 female)

in each of the three different types of pairings. An attempt was made to prevent subjects from seeing their partner's face until the experiment was completed. In only one case did partners know each other prior to their participation in the experiment and in this case the subjects were unaware of their acquaintanceship until after completion of the task.

Payoff Matrix

Subjects interacted with each other on the basis of the payoff matrix which is shown in Figure 1 (from Van Egeren, 1979b). The first number in each box represents payoffs to subject X and the second number are the payoffs to subject Y. Payoffs on a given trial of the interaction are determined by which of the five responses both subjects choose on that trial. If both members of a dyad COOPERATE, they both receive

		SUBJECT Y				
		COOPERATE	COMPETE	PUNISH	REWARD	WITHDRAW
SUBJECT X	COOPERATE	2,2	1,3	-2,0	2,0	0,0
	COMPETE	3,1	-2,-2	-2,0	2,0	0,0
	PUNISH	0,-2	0,-2	-2,-2	2,-2	0,0
	REWARD	0,2	0,2	-2,2	2,2	0,0
	WITHDRAW	0,0	0,0	0,0	0,0	0,0

Figure 1. Payoff Matrix For Social Interactions.

two points on that trial. If they both COMPETE, they both lose two points. If one COOPERATES and the other COMPETES, the competitor receives three points and the cooperator one point. Note that a subject can unilaterally give two points to his/her partner by REWARDing, can unilaterally take two points from his/her partner by PUNISHing, and can prevent any gains or losses on a trial by WITHDRAWing. Each point was worth five cents. Subjects were paid one dollar plus whatever they earned in their 20 trial interaction.

Procedure

The procedure used in this experiment utilized CIPAS and was based on that described in detail by Van Egeren (1979b). Paired subjects sat side-by-side in comfortable chairs, separated by a ceiling to chair-seat curtain. Eight-button response panels were mounted on the chair arms and a television screen was placed where both subjects could see it comfortably. Subjects interacted, communicated, and recorded their perceptions by pressing the labelled buttons on their response panels. They learned how to use the system, after reading brief orientation instructions (see Appendix C) and signing a research consent form, by reading detailed instructions typed on 86 index cards. These index cards took the subjects in a step-by-step fashion through each phase of the procedure. They introduced and explained the payoff matrix and demonstrated how to use the buttons to interact, communicate and record perceptions. The instructions concluded with two guided practice trials in which subjects demonstrated to the experimenter that they had mastered the system. Nearly all subjects mastered the procedure within 20 to 40 minutes. Two pairs had to be replaced due to the apparent

failure of two individuals to properly understand the system.

After the experimenter was reasonably certain that both subjects understood the procedures, electrodes and transducers were applied. Subjects were asked to sit quietly and relax for approximately ten minutes, at the end of which four samples of physiological activity were obtained. The experimental task began about one minute after the last sample was completed. The four samples were averaged to give a single preinteraction or resting sample.

The CIPAS routine utilized in this experiment involved interaction, communication and perception phases. Because of the complexity of the three phase task, the laboratory computer was programmed to display messages introducing each phase (PERCEPTION PHASE, INTERACTION PHASE, COMMUNICATION PHASE). In the interactive phase the computer prompted subjects for responses (COOPERATE, COMPETE, etc.) by displaying MAKE DECISION and MAKE RESPONSE messages on the television screen. A six second physiological sample was recorded from each subject prior to the MAKE DECISION message and is referred to as the pretrial sample. After both subjects pressed their chosen responses the computer displayed the trial outcome and cumulative point totals. Another six second physiological sample was recorded at this time and is referred to as the outcome sample.

Following the interactive phase both subjects were given an opportunity to communicate. Subjects could choose to send one of fifty-five possible messages; and they could ACCEPT or REFUSE to see their partner's messages. Messages were sent by a combination of three button presses. Three types of messages--feelings, intentions, and requests--could be sent. There were fifteen available feelings messages

(WHEN YOU COOPERATE/COMPETE/PUNISH/REWARD/ or WITHDRAW, I FEEL ANGRY/ HURT or PLEASED), fifteen requests messages (WILL YOU COOPERATE/COMPETE/ PUNISH/REWARD/ or WITHDRAW, MORE/LESS/ or THE SAME?) and twenty five intentions messages (IF YOU COOPERATE/COMPETE/PUNISH/REWARD/ or WITHDRAW, I WILL COOPERATE/COMPETE/PUNISH/REWARD/ or WITHDRAW). After each subject had communicated or chosen not to (by simply waiting without responding for 11 seconds) the perception and interaction phases of the next trial followed. Subjects interacted for 20 trials and communicated on as many of those trials as they wished. All physiological samples, behavioral responses, and communications were collected and stored by the computer (see Van Egeren, 1979b for additional details of the interaction and communication phases).

The third phase--perception--was inserted in the routine prior to the interaction period. During the perception period the subject was asked to 1) predict which of the behavioral responses their partner would choose in the upcoming interaction; 2) rate their degree of confidence or certainty that the partner would behave as expected; and 3) record their feelings about the partner's expected behavior (desirability rating). After initiating the PERCEPTION PHASE, the computer asked the subjects, WHAT DO YOU THINK THE OTHER PERSON WILL DO? Subjects responded by pressing COOPERATE, COMPETE, PUNISH, REWARD, or WITHDRAW. The computer then displayed the question, HOW CERTAIN ARE YOU? Subjects responded by pressing one of four buttons labelled 25%, 50%, 75%, or 100%. They were then asked, HOW DO YOU FEEL ABOUT THAT? Desirability was rated on an eight point scale ranging from -4 (dislike very much) to +4 (like very much), with +1 and -1 representing relative indifference. The computer allowed subjects as much

time as they needed to answer the questions, waiting for both subjects to respond before continuing. All responses were stored by the computer. After a 10 second wait following completion of the perception phase the computer continued with the interaction and communication phases as described above.

Following completion of 20 trials, electrodes and transducers were removed and subjects filled out another brief questionnaire. They were then debriefed, paid, and shown their own polygraph records. A brief explanation of the experiment and their physiological responses to it was provided.

Instruments and Measures

Pretask and posttask questionnaires

All subjects filled out a brief motivational orientation questionnaire at the same time they were screened for Type A behavior (at least one week prior to participation in the experiment). Motivational orientation was defined according to the geometric model described by Griesinger and Livingston (1973). This model proposes a motivational vector which has both magnitude and direction. The magnitude of this vector depends upon the size of payoffs and the direction corresponds to the notion of motivational orientation. Using a paired-comparison questionnaire (see Appendix B) each subject's preferred vector was determined from among nine possible orientation vectors. The nine vectors cover the following range of motivations: punishing, competitive, independent, cooperative, and altruistic, with the punishing and altruistic vectors oriented 180 degrees apart (see Figure 2). The cooperative vector represents maximization of joint gain and the

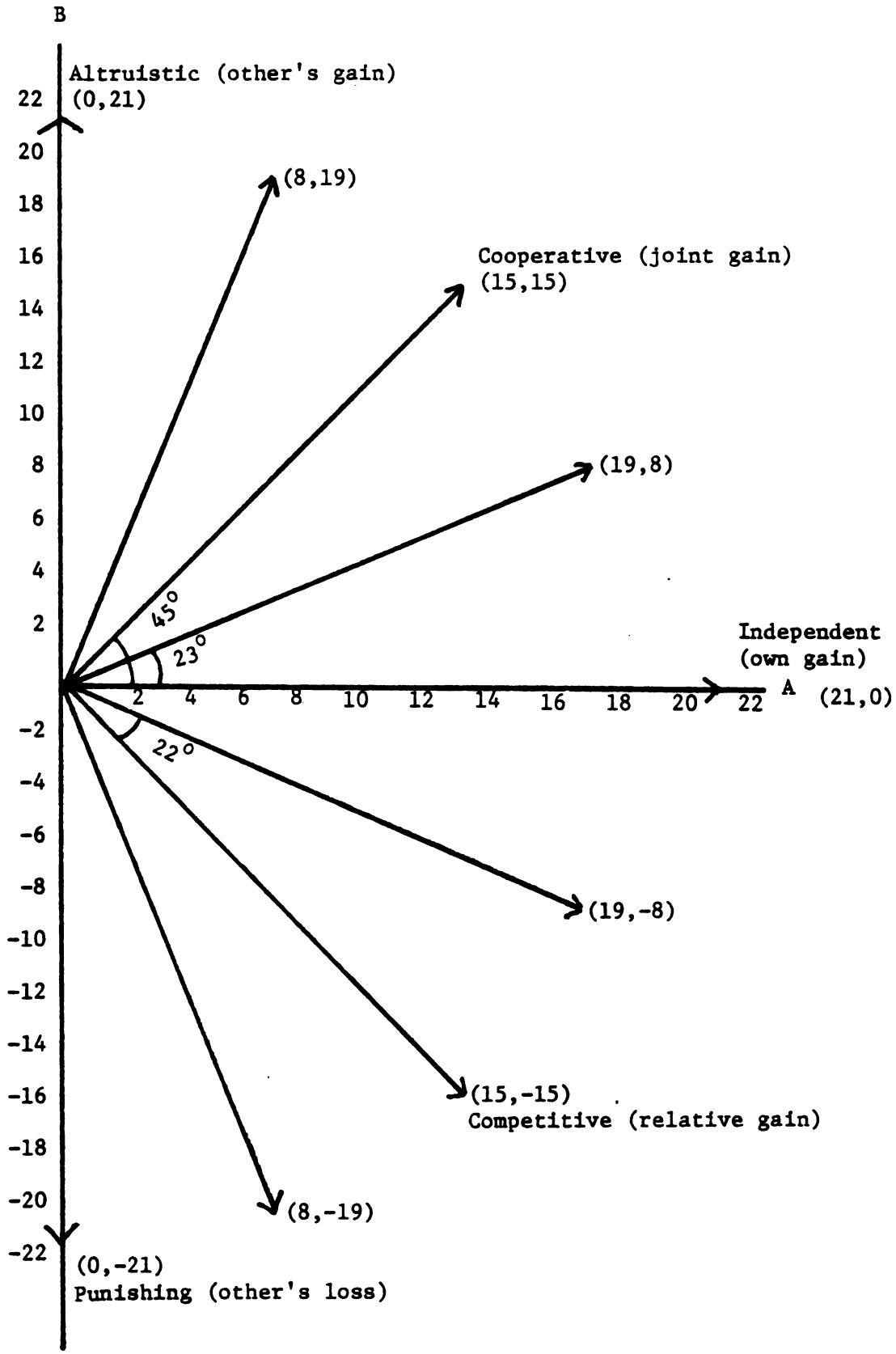

Figure 2. Motivational orientation vectors for Subject A. (Values along the x-axis represent payoffs to Subject A; values along the y-axis represent payoffs to Subject B).

competitive vector represents maximization of differences in gain. Defining values for the nine vectors were chosen to ensure that they all had equal magnitudes and that they divided the 180 degree range into approximately equal 22.5 degree segments.

The competitiveness of each subject's motivational orientation was defined as the geometric projection of the S's preferred vector defining the competitive orientation. This value was calculated as 21 x cosine θ, where 21 is the approximate length of all vectors and θ is the angle between the preferred vector and the competitive vector.

Four additional questions were included in the motivational orientation questionnaire. Subjects were given sentence descriptions of five motivational orientations (altruistic, cooperative, independent, competitive, and punishing) and were asked to indicate their own orientation and their guess as to the "typical" person's orientation. Variables based on these two questions will be called <u>own goal competitiveness</u> and <u>typical other's goal competitiveness</u>, respectively. Defining values for these variables are included in Appendix E. The final two questions probed attitudes about interpersonal influence.

Subjects also filled out a short questionnaire following the experimental task (see Appendix D). Questions were asked about 1) the subject's goals at the beginning and end of the task; 2) how closely and with how much difficulty they were able to maintain their initial goal; 3) the subject's perception of their partner's goal in the task and of the "typical" person's goal in such a task; and 4) the subject's perceptions of his/her partner on scales of trustworthiness, warmth, selfishness, competitiveness, and similarity to self. Defining values for variables based on these questions are included in Appendix E.

Measures based on CIPAS

For every subject run in this experiment the computer stored a complete record of his/her perceptions, interactions and communications for each of 20 trials. A great number of questions can be answered by using the record for frequency counts, averages, and percentages, e.g., how often did a subject compete or fulfill requests, how much average certainty did he/she experience, how accurate were S's predictions? Deeper insight into the interactive nature of subject's behavior can be provided by the "state-dependent propensity measures" described by Van Egeren (1979b). Other derived variables can be constructed to provide information on the relationships between communications and behaviors, perceptions and behaviors, perceptions and communications, etc. Thirty-four such variables were calculated and analyzed in this experiment. These variables are listed and described in Appendix E.

Physiological measures

The physiological measures utilized in this experiment were identical to those described by Van Egeren (1979b). His descriptions are reproduced below.

Electrocardiogram. A single lead (V_5) was recorded with Grass silver disk electrodes and electrolyte. The output of a Grass 7P3 cardiotachometer was sampled by the computer at a sampling rate of 10 Hz and converted to heart rate in beats per minute (BPM) after scaling the output in calibration sample units. Calibration samples were taken before each subject was run. Heart rates within each 6 second sample were averaged.

Finger blood volume pulse. Relative changes in blood volume pulse were recorded using a transmissive photoplethysmograph transducer placed

on the first phalanx of the left hand little finger. The output of a driver amplifier coupled to a Grass 7P1 preamplifier was computer-sampled at 20 Hz. A computer routine for the analysis of blood volume pulses computed the trough and peak of the pulse associated with each heart beat. The term "pulse amplitude" will refer to peak-minus-trough values of the finger pulsatile waveform. The pulse amplitude is directly related to arterial tone of vessels in the skin which is under partial sympathetic regulation. Pulse amplitudes were expressed in units of the preinteraction sample values by dividing average values of a sample by average values of the preinteraction sample and multiplying this ratio by 100.

Respiration. Tracings of respiratory excursions were recorded using a mercury-in-rubber strain gauge placed around the chest. These tracings were used to detect the changes in cardiovascular activity caused by respiratory maneuvers (breath holding, sighs, etc.). Samples with such changes were edited from the data record. The tracing itself was not scored.

CHAPTER IV

RESULTS

Tests of Hypotheses

Pretask differences between Type A and Type B subjects

Hypothesis 1: The motivational orientation of Type A subjects will be significantly more competitive than the motivation orientation of Type B subjects.

Results: Type A and Type B subjects did not differ significantly in the competitiveness of their motivation orientation, as measured using the geometrical model described above, F (1,58)=1.03, p = .16.[1] The mean for Type A's was 8.5 and the mean for Type B's was 6.7, with larger values representing greater competitiveness.

Hypothesis 2: Type A subjects, as compared to Type B subjects, will describe the goal orientation of the "typical" person in significantly more competitive terms.

Results: Type A's and Type B's also did not differ significantly in their expectations about the typical person's orientation, F (1,58)<1. Both groups, on the average, expected the typical person to adopt an independent orientation in the described task, i.e., "to work independently, for himself, ...concerned only with his own earnings."

Hypothesis 3: Type A's, as compared to Type B's, will attach significantly greater importance to their ability to influence the behavior of people around them.

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[1]All tests of hypotheses are one-tailed tests. Group means and significance tests for all hypotheses are tabled in Appendix F.

Results: Type A subjects did attach significantly greater importance to their ability to influence the behavior of people around them, F (1,58) = 7.68, p = .004. On a self-rating scale ranging from one to four, with one indicating "of no importance" and four indicating "very important", the mean for Type A's was 3.2, and the mean for Type B's was 1.7.

Post-task differences between Type A and Type B subjects

Hypothesis 1: Type A subjects will describe the goal orientation with which they approached the beginning of the task in significantly more competitive terms than will Type B's.

Results: When asked, upon completion of the experiment, to choose the motivational orientation that best described their goal at the beginning of the task, Type A subjects chose more competitive goals to a significantly greater extent than Type B subjects, F (1,58) = 2.86, p = .046.

Hypothesis 2: Type A's, as compared to Type B's, will describe the goal orientation of the "typical" person in the experimental task in significantly more competitive terms.

Results: The test of this hypothesis approached but did not reach significance, with Type A subjects tending to expect the typical person to choose a more competitive goal than Type B subjects, F (1,58) = 2.56, p = .055.

Post-task differences between dyad types

Hypotheses 1-4: When subjects in Type B-B, Type A-A, and Type A-B pairs are compared they will differ as follows in their mean ratings:

1. Subjects in Type B-B pairs will rate their partners as more trustworthy;

2. Subjects in Type B-B pairs will rate their partners as warmer;

3. Subjects in Type B-B pairs will rate their partners as less selfish;

4. Subjects in Type B-B pairs will rate their partners as less competitive.

Results: Only hypothesis 4 was confirmed. Subjects in Type A-A, Type A-B and Type B-B dyads differed in their mean rating of their partner's competitiveness, F (2,57) = 2.57, p = .023, with subjects in Type B-B dyads rating their partners as least competitive.

Task differences between dyad types in behavior, physiology and perceptions

For comparisons of the behavioral interactions of the three groups, responses were averaged over the 20 trials of the experiment before group means were computed. Because the behavior of a given dyad were interdependent, responses were also averaged for each pair and the analyses based on dyads rather than individuals.

Hypothesis 1: Type A-A, Type A-B and Type B-B dyads will differ in mean number of compete responses, with Type A-A dyads competing the most.

Hypothesis 2: Type A-A, Type A-B and Type B-B dyads will differ in mean number of cooperate responses, with Type A-A dyads cooperating the least.

Results: The three groups did not differ significantly in the mean number of competitive or cooperative responses, F (2,27) <1 for both variables. The mean percentage of prosocial responses (cooperate or reward) given by Type B-B dyads (78%) was greater than that given by Type A-A dyads (69%); and contrary to expectations, Type A-B dyads gave the smallest percentage of prosocial responses (63%). These

group differences, however, were not significant, F (2,27) = 1·08, p = .35.

Hypothesis 3: Type A-A, Type A-B and Type B-B dyads will differ in general vasoconstriction (average between-trial digital pulse amplitude expressed as percentage of resting level), with Type B-B dyads showing the least amount of vasoconstriction.

Results: The groups showed no significant differences in general vasoconstriction, F (2,27) <1. Type B-B dyads did show the greatest return towards resting level in digital blood volume (75%) as compared to A-A and A-B dyads (65%), but this difference was not significant, F (1,26) = 1.28, p = .13.

Hypothesis 4: Type A-A, Type A-B and Type B-B dyads will differ in accuracy of perception, with Type B-B dyads showing the greatest accuracy.

Hypothesis 5: Type A-A, Type A-B and Type B-B dyads will differ in subjective certainty, with Type B-B dyads showing the greatest subjective certainty.

Results: Group differences on these variables were not significant. Type B-B dyads did show greater subjective certainty (75%) and accuracy of perception (66%) as compared to Type A-B and A-A dyads (certainty = 69% and accuracy = 54%), but these differences failed to reach significance, F (1,26) = 1.30, p = .13 and F (1,26) = 1.68, p = .10, respectively.

Hypothesis 6: There will be a significant positive correlation for all subjects between subjective certainty in the experimental task and general vasodilation (return towards resting level in digital pulse amplitude).

Results: The correlation between subjective certainty and general vasodilation was small and not significant, $r = .11$, $p > .05$.

Additional Findings

In order to extract a maximum amount of information from the data, a number of additional variables were analyzed. All Type A subjects were compared to all Type B subjects on variables related to interpersonal influence and goals. Pretask measures were also used to test the randomness of assignments to like-type or mixed-type interaction pairs. The following two sections summarize these analyses.

Task and post-task variables allowed the study of social interactions, communications, effects of communications on interactions, and perceptions. Additional sections report results for each of these categories. Of special interest within each category are comparisons of Type A and Type B subjects when they are engaged with a partner of their own type. To provide a complete picture, it was also necessary to ask how both Type A's and Type B's differed when they interacted with the same type versus opposite type partners. Analyses were run comparing Type A's who interacted with other Type A's (A-A's) to Type A's who interacted with Type B's (A(B)'s), and comparing B's who interacted with B's (B-B's) to B's who interacted with A's (B(A)'s).

Following the psychosocial data, results based on the physiological data are reported. The chapter is concluded with an overall summary of the findings.

Differences between Type A and Type B subjects: Interpersonal Influence and goals

All subjects filled out the pretask questionnaire at the time they were screened for the Type A behavior pattern--at least one week prior

to participation in the experiment. On two pretask variables those subjects designated Type A were found to differ from those designated Type B. Group means and significance tests for the comparison of Type A and Type B subjects appear in Table 1. Type A subjects, as compared to Type B's, believed that they generally had more influence on the behavior of people around them, F (1,58) = 3.78, p = .027. As reported above, Type A's attached greater importance to their ability to influence others than did Type B's, but A's and B's did not differ in the competitiveness of their motivational orientations, nor in the competitiveness of the goals they would choose for themselves or "typical others" in a mixed-motive task.

Immediately following completion of the experiment subjects were again asked about their own goals and "typical others" goals in a mixed-motive task. The comparison of Type A's to Type B's in responses to these questions now revealed differences (Table 1). Type A's described the goal they chose for themselves at the beginning of the experimental task in significantly more competitive terms, F (1,58) = 2.86, p = .046; and they tended to attribute more competitive goals to a "typical other", F (1,58) = 2.56, p = .055.

In order to shed additional light on the goal choices of Type A and Type B subjects, all Type A's were compared to all Type B's on one task variable that provides insight into subjects' actual goals during the experimental task--egalitarian vs. selfish intention. This variable is based on a subject's behavior given that he expects the other person to behave prosocially on the next trial of the task. It is defined as the probability that S will behave prosocially minus the probability that he will behave antisocially. Antisocial behavior, when prosocial

Table 1. Interpersonal influence and goals: Means and F tests for comparisons between Type A and Type B subjects.

Measure	Type A's	Type B's	F	p
Pretask measures				
Competitiveness of motivational orientation	8.5	6.7	1.03	0.156
Influence on others	4.0	3.6	3.78	0.027
Importance of influence	3.2	2.7	7.68	0.004
Own goal competitiveness	2.7	2.6	1	—
Typical other's goal competitiveness	3.1	3.1	1	—
Post-task measures				
Beginning goal competitiveness	2.7	2.3	2.86	0.046
Typical other's goal competitiveness	3.0	2.7	2.56	0.055
Task intentions				
Egalitarian vs. selfish intentions	0.38	0.74	7.71	0.007

Note. All tests are one-tailed, with df = 1,58.

behavior is expected from the other, is suggestive of selfish intentions and a competitive goal orientation in that it is the response most likely to maximize the difference between self-gain and other's gain. Prosocial behavior, when prosocial behavior is expected from the other, is suggestive of egalitarian intentions and a cooperative goal orientation in that it is the response most likely to lead to mutual gain. The difference between Type A's and Type B's on this variable

was highly significant, F (1,58) = 7.71, p = .007. Type B's were nearly twice as likely as Type A's to behave in an "eaglitarian" rather than "selfish" fashion. This difference was maintained for both sexes regardless of whether subjects were interacting with like-type or opposite-type partners.

Differences between subjects assigned to like-type or mixed-type pairs

The assignment of subjects to like-type (A-A or B-B) or mixed-type (A-B) pairs was made primarily on the basis of scheduling concerns and the need to fully utilize all available laboratory time. Pretask measures other than classification as Type A or Type B were ignored in scheduling subjects. Some attempts were made to avoid systematic differences in assignments, e.g., by assigning mixed-type and like-type pairs equally to afternoon and evening time slots. It was hoped that these efforts would be sufficient to avoid any significant differences between those subjects assigned to interact with same-type partners and those assigned to interact with opposite type partners. As a partial check on the success of these efforts the five pretask variables were used to compare Type A's assigned to A-A pairs to Type A's assigned to A-B pairs and to compare Type B's assigned to B-B pairs to Type B's assigned to A-B pairs. Only one significant difference was found. Type A's assigned to interact with other A's differed significantly from Type A's assigned to interact with B's on the pretask measure of motivational orientation, F (1,36) = 5.01, p = .032. However, the Sex X Type interaction was also significant for this variable, F (1,26) = 6.08, p = .020. The main effect difference is entirely accounted for by the female subjects. The original data reveal that two of the five female Type A's assigned to interact with Type B's had unusually competitive motivational orientations.

Social interactions

Interaction behaviors were averaged over the 20 trials of the experiment for each subject before group means were computed. Contrary to expectations, the Type A and Type B pairs of subjects did not interact very differently. Type A pairs did appear to compete, punish and withdraw more often and to reward less often, but differences did not reach significance on any of the five interactive behaviors. Group means and significance tests appear in Table 2. No sex differences or Sex X Type interactions were found for these variables.

Following Van Egeren (1979b), Type A and Type B pairs were also compared on four state-dependent propensity measures. These variables provide greater insight into the interactional nature of subjects' behaviors by quantifying behavioral sequence patterns taking place between subjects. The four variables are labelled trust vs. betrayal, forgiveness vs. retaliation, repentance vs. exploitation, and conciliation vs. distrust. Their derivation is described in detail by Van Egeren (1979b) and summarized in Appendix E. The results of the comparison between Type A and Type B pairs on these variables appear in Table 2. The groups differed significantly only on conciliation vs. distrust, F (1,16) = 3.16, p = .045. Type A pairs showed more distrust than conciliation, i.e., following a mutual antisocial interaction Type A's were more likely to again respond antisocially than prosocially. Type B's showed as much conciliation as distrust; they were as likely to respond prosocially as they were to respond antisocially following a mutual antisocial interaction. Conciliatory behavior allows the avoidance of long strings of antisocial interaction. The sex and Sex X Type interaction were not significant for

Table 2. Social interactions and communications; Means and F tests.

Measure	Type A's		Type B's		AA vs. BB[a]		AA vs. A(B)[b]		BB vs. B(A)[b]	
	A(B)	AA	BB	B(A)	F	p	F	p	F	p
Interaction										
Cooperate	43	56	57	53	<1	—	2.14	.152	<1	—
Compete	24	18.3	13.5	17.5	<1	—	<1	—	<1	—
Punish	10.5	9.3	5.5	7	<1	—	<1	—	<1	—
Reward	16	13	21.3	14	1.13	.150	<1	—	<1	—
Withdraw	6.5	3.5	3	8.5	<1	—	1.71	.199	2.47	.124
Trust vs. betrayal	.24	.35	.70	.74	2.20	.075	<1	—	<1	—
Forgiveness vs. retaliation	-.43	.19	-.05	.19	1.90	.090	7.73	.010	<1	—
Repentance vs. exploitation	.05	.31	.22	.23	<1	—	1.40	.246	<1	—
Conciliation vs. Distrust	.08	-.25	0.0	.03	3.16	.045	2.62	.114	<1	—
Communications										
Messages sent	11.9	11.6	13.3	10.8	<1	—	<1	—	<1	—
Messages refused	.1	.5	.4	0.0	<1	—	2.20	.147	1.67	.205
Requests	1.4	2.8	2.7	1.8	<1	—	1.95	.172	1.27	.268
Angry feelings	.5	.8	.5	.3	<1	—	<1	—	<1	—
Hurt feelings	0.0	.7	.6	.5	<1	—	3.31	.077	<1	—
Pleased feelings	1.2	1.9	2.4	1.2	<1	—	1.40	.246	2.47	.215
Prosocial intentions	6.8	4.7	6.3	5.8	<1	—	1.68	.204	<1	—
Antisocial intentions	2.0	0.9	0.9	1.2	<1	—	5.20	.029	<1	—
Communications-Interactions										
Requests satisfied	.15	.23	.41	.27	<1	—	<1	—	<1	—
Feelings respected	.12	.32	.56	.33	1.13	.150	<1	—	1.04	.320
Threats challenged	-.15	.02	-.33	-.22	4.34	.025	<1	—	<1	—
Composite										
Dominance	.54	.50	.48	.49	1.08	.160	3.08	.088	<1	—

Note. Unless otherwise indicated units of measurement are probabilities. Units for communications variables are frequency scores. The five interaction behaviors (cooperate, compete, etc.) are expressed as percentages of total responses.

[a]All tests are one-tailed with df = 1, 16.

[b]All tests are two-tailed with df = 1, 26.

any of the four state-dependent propensity variables.

What happened when Type A's and Type B's interacted with each other? Type B subjects behaved in much the same way whether they were interacting with Type A or Type B partners (Table 2). Type A subjects who interacted with Type B partners differed significantly from Type A's who interacted with Type A partners on one interaction variable--forgiveness vs. retaliation, $\underline{F}$ (1,26) = 7.73, $\underline{p}$ = .01 (Table 2). Following a partner's antisocial response Type A's interacting with B's were more likely than not to respond antisocially. The sex main effect and Sex X Type interaction were not significant.

When male and female Type A subjects were compared to each other two behavioral differences emerged. Male Type A's punished more and rewarded less than female Type A's, $\underline{F}$ (1,26) = 5.27, $\underline{p}$ = .028, and $\underline{F}$ (1,26) = 5.68, $\underline{p}$ = .023, respectively. Group means for male and female Type A subjects on these and other selected variables appear in Table 3.

Social communication

No significant differences between Type A and Type B pairs were found for any communication variables. Group means appear in Table 2 and were computed after averaging communicative behaviors over the 20 trials for each subject. Type A and Type B dyads communicated quite similarly both in terms of the numbers and types of messages sent.

Type A subjects who interacted with Type B partners sent more antisocial intentions messages, or "threats", than did Type A's interacting with other A's, $\underline{F}$ (1,26) = 5.20, $\underline{p}$ = .029. Antisocial intentions took the form "If you X, I will Y", where Y is an antisocial

response (Van Egeren, 1979b). A significant Sex X Type interaction, F (1,26) = 7.16, p = .012, and the group means (see Table 3) reveal that this difference is due entirely to male subjects. Both male and female Type B subjects tended to communicate the same with Type A and Type B partners.

Female Type A subjects, as compared to male Type A's, sent significantly fewer messages about withdrawing, F (1,26) = 4.43, p = .043.

Effects of communications on interactions

Four variables were examined in an attempt to reveal relationships between subjects' interactive behaviors and the types of communication taking place between partners. Interest focussed on the effects of communication--which may be viewed as a form of social influence--on immediately subsequent behaviors. The four communication - interaction relationships studied were: 1) behaviorally satisfying requests, i.e., doing what the partner requested be done; 2) behaviorally respecting feelings, i.e., doing what the partner communicated would be pleasing or not doing what was communicated to be hurtful or angering; 3) behaviorally challenging threats, i.e., behaving antisocially when the partner communicated an intent to respond antisocially to such behavior; and 4) behaviorally keeping a prosocial intentions message sent and not disconfirmed, i.e., behaving prosocially after indicating an intention to do so and receiving explicit (a similar return message) or implicit (no message) confirmation from the partner. The full derivation of these variables is described by Van Egeren (1979b) and summarized in Appendix E.

Group means and significance tests for these variables appear in Table 2. Type A and Type B pairs differed significantly on one of them--threats challenged in behavior, F (1,16) = 4.34, p = .025. The positive value for Type A's on this variable indicates that they were more likely than not to challenge a threat. That is, immediately after being informed by their partner that an antisocial response would be answered antisocially, Type A's tended to behave antisocially. Type B's in this situation tended to respond prosocially. Prosocial behavior in response to threats would tend to reduce the likelihood of long strings of mutually negative interaction.

Table 3. Group means for male and female Type A subjects

Measure	Males		Females	
	A(B)	AA	A(B)	AA
Cooperate	36	58.5	50	53.5
Compete	28	18.5	20	18
Punish	19	11	2	7.5
Reward	11	7	21.5	19
Withdraw	6	5	7	2
Altruistic vs. spiteful intention	-.49	-.16	.17	.08
Antisocial intentions messages	3.0	0.5	1.0	1.2
Prosocial intentions kept vs. not kept	-.10	.44	.73	.43

On the measure of agreement keeping --prosocial intentions kept vs. not kept--the sex main effect and Sex X Type interaction approached

Table 4. Interpersonal perception: Means and F tests.

Measure	Type A's		Type B's		AA vs. BB[a]		AA vs. A(B)[b]		BB vs. B(A)[b]	
	A(B)	AA	BB	B(A)	F	p	F	p	F	p
Perceptions										
Subjective certainty	71	71	75	64	<1	—	<1	—	2.90	.049[c]
Accuracy of perception	53	55	66	51	<1	—	<1	—	2.48	.062[c]
Expected Utility	151	137	196	78	<1	—	<1	—	4.03	.052
Actual Utility	1.71	1.53	2.20	.70	<1	—	<1	—	5.60	.024
Prosocial appetite	.31	.45	.55	.45	1.23	.140	2.45	.126	1.76	.193
Communications-perceptions										
Expectation of kept intentions	.52	.51	.60	.69	<1	—	<1	—	<1	—
Expected satisfaction of requests	.10	.15	.50	-.25	6.02	.025	<1	—	13.06	.002
Expected respect of feelings	.14	.39	.46	.22	<1	—	2.41	.129	1.05	.315
Interactions-perceptions										
Expectation of trust vs. betrayal	.46	.60	.78	.39	1.18	.290	<1	—	3.73	.061
Expectation of repentance vs. exploitation	-.12	.27	.23	.03	<1	—	2.12	.154	<1	—
Expectation of forgiveness vs. retaliation	.20	.11	.14	-.22	<1	—	<1	—	2.67	.112
Expectation of conciliation vs. distrust	.04	-.06	-.02	.04	<1	—	<1	—	<1	—
Perceptions-interactions										
Egalitarian vs. selfish intentions	.32	.42	.74	.74	1.99	.090	<1	—	<1	—
Altruistic vs. spiteful intentions	-.16	-.04	-.15	-.30	<1	—	<1	—	<1	—
Post-task perceptions										
Influence on other	3.9	4.4	3.5	4.0	9.06	.002	1.65	.203	2.07	.159
Satisfaction with influence	2.9	2.9	2.9	2.9	<1	—	<1	—	<1	—
Ratings of other:										
similarity to self	3.7	3.4	3.3	3.4	<1	—	<1	—	<1	—
selfishness	2.8	2.5	2.2	2.7	<1	—	<1	—	<1	—
competitiveness	3.2	3.0	2.3	3.5	2.51	.059	1	—	6.64	.015
trustworthiness	4.0	3.6	4.2	4.0	3.00	.044	<1	—	<1	—
warmth	4.1	3.6	4.0	3.6	1.41	.120	1.78	.192	1.35	.254
End goal competitiveness	2.6	2.9	2.2	2.7	7.21	.005	<1	—	3.43	.072
Typical other's goal competitiveness	3.5	2.8	2.7	2.8	<1	—	4.52	.041	<1	—

Note. Units of measurement are probabilities, except for perception and post-task perception variables which have arbitrary units.

[a]All tests are one-tailed; df = 1, 36 for post-task variables; df = 1, 16 for all other variables

[b]All tests are two-tailed; except where otherwise noted; df = 1, 26 for all variables.

[c]One-tailed tests.

significance, F (1,26) = 3.13, p = .085, and F (1,26) = 3.30, p = .077, respectively. It should be noted that male Type A's who interacted with B's were the only subjects that more often than not failed to follow through on a prosocial agreement that they had originated (see Table 3).

Perceptions

Perceptual variables provide another level of insight into the process of social interaction. Information about subjective expectancies and desires allows the exploration of motivational factors which lie behind the behavioral strategies employed by subjects. Analysis of perception-communication-behavior relationships focussed on the effects of a partner's communications and behaviors on subjects' expectations, and the relationship between a subject's expectations and his/her subsequent behavior. The latter relationship is of special interest because it provides data from which a subject's goals or intentions can be deduced.

Five "perception" variables were calculated for each subject based on subjective expectations and desirability ratings. These variables answered the following questions: 1) how certain is a subject of the partner's behavior? (subjective certainty); 2) how accurate is the subject in predicting the partner's behavior? (accuracy of perception); 3) how certain is the subject of being how pleased by the partner's behavior? (expected utility); 4) how pleased is the subject by the partner's actual behavior, as measured on accurately predicted responses? (actual utility); and 5) how desirable to the subject is the partner's prosocial behavior? (prosocial appetite).

Three "communication-perception" variables were calculated to analyze the effects of the partner's communications on subjects'

expectations. These variables addressed questions of whether subjects expected partners to behaviorally follow through on their stated intentions (expectation of kept intentions) and to be responsive to the subject's stated requests (expected satisfaction of requests) and feelings (expected respect of feelings).

Four "interaction-perception" variables explored the effects of behavior on expectations, using the four state-dependent propensity measures described above. These variables are expectation of trust vs. betrayal, expectation of forgiveness vs. retaliation, expectation of repentance vs. exploitation, and expectation of conciliation vs. distrust.

Two "perception-interaction" variables were calculated to allow analysis of subjects' intentions by studying the effects of their expectations on their own behavior. The variable egalitarian vs. selfish intention was described above and asked whether the subject behaved pro- or antisocially when he/she expected the partner to behave prosocially. The variable altruistic vs. spiteful intention asked how the subject behaved when he/she expected the partner to behave antisocially. The computation of all of these variables is described in Appendix E.

Group means and significance tests for all 14 perception based variables appear in Table 4. Differences between Type A and Type B dyads reached significance on only one variable, expected satisfaction of requests. Type B pairs expected their requests to be behaviorally honored by their partners to a significantly greater extent than did Type A pairs, $\underline{F}$ (1,16) = 6.02, $\underline{p}$ = .025. Type A's expected their Type A partners to disregard a request about as often as they expected him/her to satisfy it. Type B's more often than not expected their Type B partner to satisfy their requests. Although differences

between Type A and Type B pairs did not reach significance on the other 13 perception based variables, they were in the direction expected on the basis of Type A theory in every case.

Type A subjects who interacted with Type B partners did not differ from Type A's who interacted with A's on any perception based variable (see Table 4). Female Type A's differed from male Type A's in altruistic vs. spiteful intentions, F (1,26) = 8.19, p = .008. The female A's were more likely than their male partner to behave antisocially.

As reported above, Type B subjects behaved and communicated the same when interacting with Type A and Type B partners. On perception vased variables, however, there were a number of significant differences between Type B's interacting with A's and Type B's interacting with B's (see Table 4). Type B's interacting with A's showed less subjective certainty, F (1,26) = 2.90, p = .049 (one-tailed test); they experienced less actual utility, F (1,26) = 5.60, p = .024; and they expected requests to be satisfied less often, F (1,26) = 13.06, p = .002. Differences between B(A)'s and B-B's approached significance on three more variables, with B(A)'s being less accurate in perceptions, F (1,26) = 2.48, p = .062 (one-tailed test); expecting less utility, F (1,26) = 4.03, p = .052; and expecting less trust as opposed to betrayal, F (1,26) = 3.73, p = .061. Group means for male and female Type B subjects, on selected variables, appear in Table 5. On the variables subjective certainty, expected utility, and actual utility the male B(A) group had by far the lowest values, but the sex main effects and Sex X Type interactions were not significant. Male Type B's interacting with A's were the only subjects to more often than not

expect requests to not be satisfied.

Table 5. Group means for male and female Type B subjects.

	Males		Females	
Measure	B(A)	BB	B(A)	BB
Cooperate	52	56	54	57.5
Compete	15	12.5	20	14.5
Punish	11	5	3	6
Reward	12	20.5	16	22
Withdraw	10	6	7	0.0
Satisfaction with influence	2.2	2.8	3.6	3.0
Rating of other's selfishness	3.8	2.2	1.6	2.1
Other's goal competitiveness	3.2	2.2	2.0	2.2
End goal competitiveness	3.0	1.8	2.4	2.5
Subjective certainty	58.8	69.3	70.0	80.9
Expected Utility	16.8	155	140	236
Actual utility	.02	1.93	1.38	2.46
Expected satisfaction of requests	-.70	.39	.20	.60

The post-task questionnaire administered to subjects following completion of the experiment provided additional probes into subjects' perceptions of their partner, themselves and their interaction. Although as reported above, few differences were found between Type A and Type B dyads in behavior and communication patterns, a number of differences appeared in post-task perceptions (see Table 4). Subjects in Type A pairs, as compared to subjects in Type B pairs, believed they had more influence on their partner's behavior, F (1,36) = 9.06, p = .002; but they were equally satisfied with the amount of influence they believed they had, F (1,36) < 1. If communication is seen as a form of social

influence then the effects of communication on behavior provides some indication of actual influence during the task. As reported above, Type A pairs did not differ significantly from Type B pairs in having requests satisfied or feelings respected. The Type A pairs in fact had lower values on these variables (Table 2).

Subjects in Type A pairs, when compared to subjects in Type B pairs, also perceived their partner as significantly less trustworthy, F (1,36) = 3.00, p = .044; and they tended to perceive their partner as more competitive, F (1,36) = 2.51, p = .059 (one-tailed tests). They also described their own goal at the end of the task in significantly more competitive terms, F (1,36) = 7.21, p = .005.

Type A subjects interacting with Type B partners differed from Type A's interacting with A's on only one post-task perception variable--they described the goal of a "typical other" in a mixed-motive task in significantly more competitive terms, F (1,26) = 4.52, p = .041. Type B subjects revealed a number of perceptual differences when they interacted with Type A, as opposed to Type B partners. Sex differences also emerged on post-task perception variables for Type B subjects. For nearly all of the sex and type main effects, however, the Sex X Type interaction was also significant. Reference to the group means (see Table 5) reveals that significant findings are due primarily to the male Type B subjects interacting with Type A partners. Type B's who interacted with A's rated their partner as significantly more competitive than did B's who interacted with B's, F (1,26) = 6.64, p = .015 (Table 4). They also tended to describe their own goal orientation at the end of the task in more competitive terms, F (1,26) = 3.43, p = .072. The Sex X Type interaction was significant for the latter variable,

F (1,26) = 4.79, p = .036, with male subjects producing the main effect differences.

Male Type B subjects were more frustrated than Type B females by the amount of influence they had on their partner, F (1,26) = 11.56, p = .003, but this difference resulted from the large difference between male and female Type B's who interacted with Type A's. The Sex X Type interaction for this variable was significant, F (1,26) = 6.50, p = .016. Male B's also rated their partner as more selfish than did female B's, F (1,26) = 8.04, p = .009, and described their partner's goal orientation in the task in more competitive terms, F (1,26) = 5.20, p = .029; but again, significant interactions, F (1,26) = 6.70, p = .015 and F (1,26) = 4.79, p = .036, respectively, and the group means reveal that the sex main effect is due primarily to the difference between male and female Type B's who interacted with Type A's.

Comparisons of Type A and Type B subjects who interacted with each other

Because the interactions between Type A and Type B subjects appeared interesting and quite different from those reported by Van Egeren (1979b), they were further analyzed by comparing Type A subjects to their Type B partners. Overall, differences on the five behavioral variables did not reach significance, though Type A's tended to compete more and cooperate less than the Type B's. Differences between Type A's and their Type B partners were significant on two variables--trust vs. betrayal, F (1,16) = 4.72, p = .039, and dominance, F (1,16) = 7.50, p = .014. Dominance is a composite measure of interpersonal performance described by Van Egeren (1979b) as "behaviors indicative of attempts to control and guide the other person" (p. 10). Type A's, as compared to Type B's, were less trustworthy and more dominant. On both of these

variables the differences between A's and B's held for both sexes but were much larger for males. In the interactions between Type A and Type B subjects, the Type A partner appeared more likely to give the first antisocial response, F (1,16) = 3.56, p = .074. Male Type B's were the least likely to initiate antisocial behavior.

Table 6. Group means and significance tests for comparisons between male Type A and Type B partners.

Measure	Type A's	Type B's	F	p[a]
Cooperate	36	52	1.23	.299
Compete	28	15	3.45	.089
Punish	19	11	2.37	.160
Reward	11	12	1	—
Withdraw	6	10	1	—
Trust vs. betrayal	.03	.57	4.36	.068
Forgiveness vs. retaliation	-.63	.06	10.49	.012
Prosocial intentions kept vs. not kept	-.10	.70	5.21	.050
Dominance	55.5	48.6	11.15	.010
Expected utility	148	16.8	5.23	.050
Actual utility	1.74	.02	7.10	.028
Prosocial appetite	20.8	38.0	2.19	.174
Egalitarian vs. selfish intention	.27	.79	6.62	.016

[a]Tests are all two-tailed, df = 1, 8.

When males were analyzed separately, additional significant differences were found on forgiveness vs. retaliation, egalitarian vs. selfish intention, expected and actual utility, and prosocial intentions kept vs. not kept. Group means and significance tests appear in Table 6. Male Type A's, as compared to their Type B partners, were less

forgiving, more likely to seek a competitive advantage, more pleased with their partner's behavior, and less likely to behaviorally follow through on expressed prosocial intentions.

Physiology

In analyzing the physiological data, three basic types of comparisons were made: Type A pairs were compared to Type B pairs; A's who interacted with A's were compared to A's who interacted with B's; and B's who interacted with A's were compared to B's who interacted with B's. One additional comparison, between A's and B's who interacted with each other, was also made.

Interest focussed on changes from the resting (preinteraction) period to the pretrial period. During the preinteraction period subjects were sitting quietly and resting. During the pretrial period subjects were presumably sitting quietly, waiting for the next trial to begin. Changes from resting to pretrial periods reflect the general effects of the experimental situation and the social interaction taking place. Also analyzed were changes from the pretrial period to the outcome period. These represent the short term effects of seeing the interaction outcomes displayed. The data and significance tests are presented in Table 7.

In the comparison of Type A dyads to Type B dyads no significant sex differences were found, so the sexes were combined in subsequent analyses. Preinteraction mean heart rates were: 74 beats per minute (BPM) for male Type A dyads, 72 BPM for male Type B dyads, 69 BPM for female Type A dyads, and 68 BPM for female Type B dyads. No significant sex, type, or Sex X Type interaction effects were found in resting heart rate levels.

Heart rates were averaged over the 20 trials and HR changes from the preinteraction to the pretrial periods and from the pretrial to the outcome periods were computed. Type A and Type B dyads did not differ significantly on either of these HR change variables.

The photoplethysmograph method of blood volume measurement results in arbitrary units. Interest focussed on vasoconstriction and dilation relative to resting levels, so all blood volume levels during the experiment were expressed as percentages of the subject's resting value (as in Van Egeren, 1979b). In other words, preinteraction blood volume (or pulse amplitude) levels were arbitrarily set at 100% and used as the baseline for comparisons of pretrial and outcome levels. A pretrial value of 100% indicated a complete return to resting levels.

Nearly all subjects responded to the announcement of the beginning of the experiment (which followed a ten minute rest) with a strong decrease in finger blood volume, indicating an increase in vasoconstrictor tone (Van Egeren, 1979b). For most subjects, finger blood volume slowly returned towards the resting level during the course of the experimental task, suggesting a slow release of vasoconstrictor tone. Mean pretrial volume levels averaged over the 20 trials were 77% for Type B dyads and 71% for Type A dyads. Although it appears small, this difference approached significance, $\underline{F}$ (1,16) = 2.19, $\underline{p}$ = .078.

What happened when Type A's and Type B's interacted with each other? It appears that cardiovascular responses to these interactions were somewhat dependent upon the sex of the reactants. Type A's who interacted with Type B's did not differ significantly from Type A's who interacted with Type A's in heart rate or blood volume changes.

Table 7. Group means and F tests for heart rate and pulse amplitude changes.

Measure	Type A's		Type B's		AA vs. BB[a]		AA vs. A(B)[b]		BB vs. B(A)[b]	
	A(B)	AA	BB	B(A)	F	p	F	p	F	p
Heart Rate										
preinteraction	72.0	75.9	74.7	72.2	<1	—	1.00	.327	<1	—
Heart Rate Change										
preinteraction to pretrial	2.3	.80	.54	2.9	<1	—	<1	—	3.75	.061
pretrial to outcome	.69	.33	.86	1.96	<1	—	<1	—	<1	—
Digital Pulse Amplitude Change										
preinteraction to pretrial	-20	-29	-23	-44	2.19	.078	1.32	.260	4.45	.042
pretrial to outcome	-19	-25	-22	-15	<1	—	1.14	.300	1.41	.245

[a]Tests are one-tailed, df = 1,16.

[b]Tests are two-tailed, df = 1,26.

However, female A(B)'s showed a nearly complete return to baseline in pretrial blood volume (20 trial average = 93%) while male A(B)'s maintained considerable constriction over the 20 trials (mean pretrial level = 68% of baseline).

Type B's who interacted with Type A's did differ significantly from Type B's who interacted with Type B's, with B(A)'s apparently showing greater cardiovascular arousal than B-B's. Pretrial pulse amplitude values averaged over 20 trials were 57% for B(A)'s and 77% for B-B's; this difference was significant, F (1,26) = 4.45, p = .042. The sex main effect and Sex X Type interaction were not significant at the .05 level.

The difference between B(A)'s and B-B's also approached significance in changes in mean heart rate from resting to pretrial periods, F (1,26) = 3.75, p = .061. Type B's interacting with Type A's showed a mean increase of nearly 3 BPM (averaged over 20 trials) while Type B's interacting with other Type B's showed a mean increase of less than 1 BPM. A nearly significant Sex X Type interaction, F (1,26) = 3.58, p = .067, revealed that the main difference occurred for male subjects, with male B-B's showing a mean decrease in heart rate from preinteraction to pretrial periods, while male B(A)'s showed an increase of 4.5 BPM.

No significant group differences were found in heart rate or blood volume changes from pretrial to outcome periods.

When Type A's and Type B's who interacted with each other were compared to each other on physiological variables no significant differences were found.

Summary

Interactions between two Type B subjects were relatively cooperative as expected. The Type B-B group means on the five behavioral variables were nearly identical to those found for Type B's by Van Egeren (1979b). Interactions between two Type A subjects appear to have been somewhat more competitive in nature than Type B-B interactions, but they were more cooperative than expected and less competitive than those found for Type A's by Van Egeren (1979b). Despite the decreased competitiveness of the Type A's in this experiment, the cardiovascular findings were quite similar to, though less striking than, those of Van Egeren (1979b). Type B pairs showed a more complete release of vasoconstrictor tone during the experiment than did Type A pairs, with no differences found in heart rate acceleration or deceleration.

When Type A's interacted with Type B's, sex differences became important. The female A-B interactions were relatively cooperative as expected and were behaviorally quite similar to the A-B interactions reported by Van Egeren (1979b). Male A-B interactions, however, were considerably less cooperative than expected due to the decreased cooperativeness and increased competitiveness of the Type A subjects in these interactions. The male Type A's who interacted with Type B's in this experiment in fact behaved quite similarly to the Type A's who interacted with other Type A's in Van Egeren's experiment. Compared to the male Type A's who interacted with other Type A's in this experiment, those A's who interacted with B's were less forgiving and more retaliatory, more "threatening", less likely to follow through on prosocial agreements, and more dominant. Male Type B's confronted with these apparently more competitive partners did not behave significantly

differently from Type B's who interacted with other Type B's. If anything, they appear to have responded not by increasing competitiveness or decreasing cooperativeness but by punishing and withdrawing more. However, the perception and post-task questionnaire variables reveal that they did perceive their interactions differently. Type B's who interacted with Type A's, when compared to Type B's who interacted with Type B's, experienced their partner as more competitive, experienced less subjective certainty, and were less pleased with their partner's expected and actual behavior. They also responded with significantly greater cardiovascular arousal, as measured by blood volume changes from resting to pretrial levels. These last three findings--less subjective certainty, less expected and actual utility, and greater arousal for B(A)'s as compared to B-B's--held for both males and females. For all three variables the male B(A)'s had the most extreme score. These male B(A)'s also appear to have responded with greater heart rate accelerations than did Type B's who interacted with other Type B's.

CHAPTER V

DISCUSSION

The results of this experiment do not provide solid support for the proposition that subjective certainty plays an important role in cardiovascular responses to social interactions but neither did they contradict this idea. The experimental group which appeared to engage in the most predictable interactions and which experienced the greatest certainty (Type B pairs) did also appear to experience the greatest digital vasomotor relaxation. However, group differences did not reach significance on these variables. Those experimental subjects who experienced the greatest uncertainty and were least accurate in predicting their partner's behavior (Type B's interacting with A's) did also show the greatest cardiovascular arousal (heart rate and digital vasoconstriction); but the direct correlation between subjective certainty and vasodilation was small and not significant.

The lack of significant correlation between certainty and vasodilation could stem from the large increments used in the certainty rating scale. In rating their certainty about the accuracy of their predictions subjects could choose among only four ratings (25%, 50%, 75% and 100%). Observation and post-task questioning revealed that some subjects expressed 100% certainty when they felt less than 100% certain, because they did feel more than 75% certain. Another group of subjects apparently pressed the 75% button when they really felt more certain, because they did not feel 100% certain. The lack of any rating choices between 75% and 100% may well have made the scale

a relatively unreliable index of subjective certainty. Replication of the experiment with a revised scale ranging from 50% (indicating a "50-50 guess") to 100% in increments of 10% might yield a stronger correlation between subjective certainty and digital vasomotor activity.

The experiment provided stronger but still equivocal support for hypotheses related to the Type A behavior pattern. Predictions about the pretask competitiveness of Type A subjects' motivational orientation and their expectations for the "typical" person's goal orientation were not confirmed. However, after completion of the task, Type A subjects did describe their beginning goal in more competitive terms than did Type B subjects; and Type A's also then expected the "typical" person to approach the task more competitively than did Type B's.

It appears that questions about subjects' goals and expectations concerning others' goals were better able to differentiate Type A's and B's immediately following the experimental task than they were a week or more prior to participation in the experiment. Rosenman (1974) has stressed the situational nature of the Type A behavior pattern. The Type A tendencies of the Type A subjects in this experiment may have been more readily accessible following the challenging interpersonal interaction than when they were confronted only with a pencil and paper test.

The fact that the Type A behavior pattern is elicited only by appropriate environmental stimuli makes its assessment using only a pencil-and-paper test somewhat difficult. The Jenkins Activity Survey (JAS) types individuals primarily on the basis of response content, without apparently eliciting "Type A behavior", whereas typing by the original interview method of assessment utilizes elicited expressive cues (Scherwitz, Berton, and Leventhal, 1977). MacDougall, Dembroski

and Musante (1979) have compared the student version of the JAS to the standard interview technique and found only a weak correlation. They suggest that in experiments relying exclusively on the JAS to assess Type A behavior "caution should be exercised in interpreting negative or equivocal findings."

The JAS, as a pencil-and-paper, self-report measure, may well be more subject to distortion than the structured interview, which utilizes voice and psychomotor stylistics in assessing the Type A pattern. The accuracy of the JAS may be further compromised in an academic setting, where the multiple-choice format is similar to course-work examinations and academic competition and pressure could serve to inflate Type A scores. Waldron, et al. (1978) have in fact reported that JAS measured Type A scores tend to increase from the beginning to the end of the semester for women and that students with greater evidence of academic pressure showed more increase in Type A scores.

If Type A scores were in fact inflated in this experiment, then the results must indeed be interpreted with caution. The finding that Type A subjects had more competitive, but not significantly more competitive, pretask motivational orientations can perhaps be attributed to an artificial elevation of Type A scores which put questionable Type A individuals into the Type A pool. Since our screening device did not produce clearly differentiated groups of "competitors" and "cooperators", the prediction regarding social expectations based on Miller and Holmes (1975) loses some of its validity.

Miller and Holmes found that people who classify themselves as competitors tend to expect "typical" others to be competitive, whereas people who classify themselves as cooperators tend to expect "typical"

others to be cooperative. In the present experiment, Type A's did not, at the time of screening, classify themselves as more competitive than Type B's and did not then expect the "typical" person to be more competitive. However, upon completion of the experimental task Type A's did describe themselves in more competitive terms than Type B's, and they did then tend to expect the "typical" person to be more competitive. This finding suggests the possibility that competitive expectations follow competitive self-perceptions or behavior, perhaps for the purpose of self-justification. Such a conclusion is supported by the finding that, among Type A subjects, those who interacted with Type B's expected more competitiveness from "typical others" than did those who interacted with Type A's. This same group of subjects--Type A's interacting with Type B's--was the most competitive in its own behavior; and it was the only group which appeared to expect the typical person to be more competitive following the task than it did prior to it.

Given that we have called into question the accuracy of our screening device, we might speculate that when Type is more rigorously determined, Type A's would reveal more competitive motivational orientations than Type B's, would then describe themselves more competitively, and would then expect the typical person to be more competitive. Clarification of this issue requires further research.

Despite some possible weakening of the effects due to unreliable typing, Type A subjects in this experiment did still differ from Type B subjects. The Type A's did, as predicted, attach greater importance to their ability to influence the behavior of people around them. This finding lends support to Glass's (1977) hypothesis that the Type A pattern refelcts a need to maintain control over environmental stimuli,

including other people. In the mixed-motive type situations used in this experiment an individual cannot alone control his payoffs. Outcomes are dependent upon the behavior of both interactants. The only way to control one's own payoffs is by influencing the behavior of one's partner. Perhaps reflecting their greater need for control, Type A's, as compared to Type B's, believed that they had more influence over their partner in the experiment, even though there is no evidence that they actually had more influence. Type A's and Type B's felt equally satisfied with the amount of influence they believed they had, indicating that Type B's felt equally content having less impact on their partner.

Looking at behavioral, communication, and physiological data from the experimental task, predictions based upon Van Egeren's (1979b) findings were not supported. Differences between Type A dyads and Type B dyads did not reach significance. Type A-B dyads did not behave cooperatively as predicted; they were in fact the most competitive group, due primarily to the male A-B pairs. Except for the male A(B) subjects, however, the basic pattern of results is quite similar to that found by Van Egeren (1979b). The behavioral and physiological differences between Type A and Type B pairs were generally in the expected directions, with Type A's competing and punishing more, rewarding less and showing more digital vasoconstriction. Type A pairs, as compared to Type B pairs, were less conciliatory and more distrusting, more likely to betray prosocial aggreements, more likely to challenge threats in behavior, and less likely to expect their requests to be satisfied. Subjects in Type A pairs also rated their partner as less trustworthy and more competitive than did subjects in Type B pairs. These differences strongly suggest that less cooperation and trust was

experienced in interactions between Type A subjects than in interactions between Type B subjects. Yet there was no difference between Type A's and Type B's in the actual number of cooperative responses made.

The lack of cooperation and trust in interactions involving Type A subjects appears to have been a function of the different conditional strategies employed by Type A and Type B subjects, rather than their actual behavioral responses. Type A's and Type B's may have cooperated equally but they appear to have used cooperation differently. Such a conclusion was supported impressionistically by comments made by Type A subjects following the experiment. They frequently expressed frustration that the structure of the payoff matrix seemed to force them to cooperate in their own self-interest, even though they would have preferred to compete. As suggested by Van Egeren (1979b), Type A subjects appear to employ strategies aimed at gaining a competitive advantage over their partner, whereas Type B's employ strategies aimed at equitable payoffs. This conclusion was strongly supported in the experiment by the striking overall difference between Type A and Type B subjects in egalitarian vs. selfish intentions. On trials on which they expected their partner to behave prosocially, Type B subjects were far more likely than Type A subjects to reciprocate with a prosocial response, which yielded <u>mutual gain</u>. Type A's were more likely than Type B's to respond antisocially, which yielded a <u>competitive advantage</u> to the antisocial responder. This pattern held regardless of whether the A's and B's were interacting with the same-type or opposite-type partners, suggesting that it reflects stable, mixed-motive response tendencies within Type A and Type B individuals, rather than interaction-elicited behavior.

The difference in conditional strategies employed by Type A and Type B subjects was also evidenced in this experiment in interactions between Type A's and Type B's. Type A's in these interactions appeared to seek a competitive advantage by behaving antisocially even when prosocial behavior was expected from the other, and by "intending" prosocial behavior, perhaps to entice prosocial behavior from the other, but actually delivering an antisocial response. Male Type A's appear to have maintained such competitive behavior despite an apparent lack of competitive response from their Type B partners. The Type B's seemed to have perhaps escalated aggressive (punish) and defensive (withdraw) maneuvers, but they appeared reluctant to enter into competitive contests with their partners. In post-task discussions Type A's sometimes directly criticized their Type B partner for not competing. Type B's tended to express more interest in mutual gain and "getting along".

Of special interest is the finding that Type A's and Type B's interacting with each other differed significantly in trust vs. betrayal but did not differ in expectations of trust vs. betrayal. Type B's were much more likely than Type A's to maintain prosocial interaction patterns, but A's and B's expected about the same amount of follow-through on these implicit prosocial aggreements. The Type B's overestimated the likelihood of their Type A partners to maintain cooperative interaction patterns, whereas Type A's underestimated the likelihood of their Type B partners to maintain cooperative interaction patterns. In other words, Type A's expected more betrayal then they received and Type B's expected more trustworthiness than they received.

In the theoretical discussion above it was suggested that in interactions between competitors and cooperators, the competitor would be unable to "trust" his opponent's cooperative behavior since his own best strategy is to induce cooperation and then compete; and he would be wary of such an approach by his partner. This is apparently exactly what happened. The Type A's did not believe their Type B partners would continue to cooperate as consistently as they did; and this expectation may have made it difficult for them to shift their own behavior in a cooperative direction. The Type B's, on the other hand, kept expecting (or perhaps hoping) that their Type A partners would maintain prosocial interaction patterns even though they did not. These findings lend some support to the contention that Type B's tend to expect more cooperation from others, while Type A's tend to expect more competition. Whether these expectations lead to competitive behavior or result from behavioral tendencies is uncertain and requires further research for clarification.

Digital vasomotor responses between interaction trials were also similar in pattern to those found by Van Egeren (1979b) but were not as large. Type A pairs showed greater vasoconstriction from pretask to pretrial periods than did Type B pairs; and this difference approached significance. Van Egeren (1979b) found that digital vasomotor responses were more closely associated with the actual competitiveness of social transactions in progress. In the present experiment, A-A dyads appear to have competed less than Van Egeren's (e.g., averaging 3.7 as compared to 5.5 compete responses in 20 trials) and they showed a corresponding decrease in preinteraction to pretrial vasoconstriction (-28% as compared to -45%). Type B dyads in this experiment competed about the

same as Van Egeren's (2.7 and 2.6 compete responses per 20 trials, respectively), and showed a similar amount of vasoconstriction (-23% and -18%, respectively). These results support the suggestion that if Type A subjects experience greater digital vascular arousal in their social relationships than Type B's, the difference is more likely due to their greater competitiveness than to physiological differences in their vascular systems.

Type B subjects who interacted with Type A partners exhibited the greatest vasoconstriction, from pretrial to preinteraction periods, of all experimental groups. Compared to Type B's in B-B dyads, Type B's in A-B dyads showed greater vascular and cardiac responses. Averaged over the entire 30 to 40 minute interaction, heart rate for the B's in A-B dyads was nearly 3 BPM higher during pretrial than resting periods (4.5 BPM for males). Type B subjects in A-B dyads were the only group to exhibit preinteraction to pretrial digital pulse amplitude changes comparable to those found by Van Egeren (1979b) in Type A dyads (-44% and -45%, respectively). Interestingly, the Type A's in our A-B dyads were the only group to compete comparably to Van Egeren's A-A dyads (means of 4.8 and 5.5 compete responses per 20 trials, respectively), suggesting that digital vasomotor responses may be even more closely tied to the competitiveness of <u>one's partner</u> than to the competitiveness of the interaction taking place.

Despite the consistencies between the results reported here and those reported by Van Egeren (1979b), the very striking behavioral, communicative, and physiological findings of the earlier experiment were not fully replicated. Type A pairs in this experiment were less competitive and male Type A subjects interacting with Type B partners were more

competitive when compared to similar subjects in Van Egeren's study. The only significant procedural difference between the two experiments was the insertion of the perception phase in the present study. Although it is possible that the additional phase altered the flow of interaction and communication or affected subject's cognitive orientations to the task in such a way as to alter their behavior, it is highly unlikely that the perception phase would have opposite effects on Type A's interacting with other A's and Type A's interacting with B's.

An intriguing explanation for the present failure to replicate the earlier findings (Van Egeren, 1979b) is suggested by the discussion above of the JAS and a seasonal difference between the two experiments. As suggested earlier, the Type A scores in this experiment may have been inflated by academic pressures. Van Egeren (1979b) utilized identical screening procedures but his subjects were screened near the beginning of the fall academic term. Waldron, et al.'s (1978) finding that academic pressure raises Type A scores suggests that in identifying Type A individuals the JAS may give more "false-positives" during mid-year and/or mid-term than earlier in the term or year. That is, scores are more likely to be artificially inflated by academic pressures during the middle of winter term than they are at the very beginning of the academic year. If so, then the subject pool for this experiment had more false-positive Type A's in it than did Van Egeren's pool.

Comparison of group means between the two experiments reveals that Type A's in this experiment did, in general, behave less likely "prototypical" Type A's than those in Van Egeren's experiment. Type A's interacting with each other in this experiment appear to have been generally less competitive, less punishing, more cooperative, more

trustworthy, less dominant, and more responsive to their partner's requests and feelings than were Van Egeren's Type A's who interacted with each other. They seemed "less A" and this impression held for both males and females. However, male Type A subjects interacting with Type B's in this experiment appear strikingly similar to Van Egeren's Type A's who interacted with each other in behavior, trustworthiness, dominance, and responsiveness to their partner. In the present experiment, those Type A subjects who interacted with Type B's, as compared to Type A's interacting with A's, were significantly less forgiving, more threatening, and more dominant.

If there were more false-positive Type A's in the subject pool, then the behavior of the male Type A's interacting with B's remains difficult to explain. They were not more competitive in pretask motivational orientation than other Type A's in the experiment. Their Type B partners did not behave differently from other Type B's. They were in fact the group least likely to initiate antisocial interaction--in only one of the five male A-B pairs did the Type B subject give the first antisocial response. It is possible that even with many false-positive Type A's in the subject pool, by chance or some as yet unaccounted for process, fewer false A's ended up in the male A(B) group. Why the male A(B)'s behaved competitively despite the apparent lack of eliciting stimuli from their Type B partners is another question that remains unanswered. Dembroski, MacDougall, Herd and Shields (1979) have identified a subgroup of Type A individuals who tend to perceive even mild environmental challenges as highly challenging (high hostile/competitive Type A's). Measurement of this dimension may have shed some light on the differential competitiveness of the two groups of

Type A's in this experiment. Other perceptual factors may also have been involved. One Type A subject who interacted with a Type A partner took pains to point out to the experimenter that he cooperated not because he liked to cooperate but because he perceived that as the only to quickly and safely gain points and money. The cooperativeness of their Type B partners may have given A(B)'s more freedom to make gains by competing in an exploitative fashion.

Given the complexity of the social interactions involved in these experiments, the possible unreliability of screening instrument used, the likely existence of Type A subgroups, and the seasonal differences between this experiment and Van Egeren's (1979b), it is unlikely that any single factor can be found to account for the differences between the two sets of results. The apparent differences are quite intriguing, however, and await further research to clarify the issues discussed above. Further replication attempts are needed, utilizing the original structured interview assessment technique in conjunction with the JAS, and with attention paid to Dembroski, et al.'s (1979) additional dimension labelled hostility/competition. An attempt to directly measure perception of social challenge would be a useful addition to the perception phase of this experiment. Additional documentation of seasonal and school year variations in JAS scores is also needed.

Summary

The results of this experiment strongly support the notion that in mixed-motive type social interactions digital vasomotor activity is more closely tied to the competitiveness of the interaction--or, more specifically, to the competitiveness of one's partner--than to the pre-interaction behavior pattern of the interactants. If in their social

relationships Type A individuals experience greater digital vascular arousal than Type B's, the difference is probably not due to vascular differences. Rather, Type A subjects appear more likely to elicit competitive behavior from other Type A individuals. As a result, they are likely to be confronted with far more competitiveness in social transactions than Type B's, which apparently leads to increased digital vasomotor activity.

Type B individuals seem to avoid engaging in competitive behavior and are therefore less likely to elicit competitiveness from others. When they are confronted with competitiveness they seem far more reluctant than Type A's to enter into competitive contests, preferring to punish and withdraw than to compete. The tendency of Type B's to punish rather than compete in response to competitiveness is substantiated by another recent experiment (Van Egeren, 1980). In response to identical preprogrammed competitive strategies Type A subjects competed more than they punished, whereas Type B's punished more than they competed. Despite the behavioral differences, however, confrontation with a competitor elicits similar vasomotor responses in A's and B's.

Results of the present experiment also suggest that A's and B's may perceive the world in different ways. Whether to justify their own competitiveness or for some other reason, Type A's do appear to expect more competitiveness from others than do Type B's. Their tendency to overestimate the competitive intentions of a cooperative partner suggests that they are relatively wary of being put at a competitive disadvantage, perhaps because this threatens their sense of mastery and control, and they may thus feel a need to be ever vigilant in their social transactions. Their need for mastery and control in

social interaction is reflected in the importance they attach to their ability to influence the behavior of people around them. The needs for control and excessive vigilance may lead them to actually experience greater influence over others than do Type B's in identical situations.

We suggested earlier that only in interactions between two Type B subjects can real trust develop. The data support this contention and suggest that it is due to both behavioral and perceptual tendencies. Type A's tend to behave in a less trustworthy and more distrusting fashion, and when interacting with each other can expect from their partner less responsiveness to communicated requests. But even when their partner appears willing to behave in a trustworthy fashion, the Type A's find it difficult to trust--they keep expecting to be betrayed. The expectation of betrayal is likely to make it quite difficult for them to shift to a cooperative strategy even if they should want to. Type B's, on the other hand, tend to expect more cooperativeness and more trust in mixed-motive social interactions, making it easier for them to establish mutually cooperative and trusting interaction patterns.

Trusting, cooperative interaction patterns appear to be less arousing cardiovascularly, at least in terms of digital vasomotor activity. The actual competitiveness of a partner's behavior appears to be the strongest determinant of digital vasoreactivity in the mixed-motive type situations used in this experiment. The contributions that a perceptual variable such as subjective uncertainty may make to increased cardiovascular arousal remains unclear and awaits further research for clarification.

APPENDICES

APPENDIX A

THE JENKINS ACTIVITY SURVEY

Form T

Medical research is trying to track down the causes of several diseases which are attacking increasing numbers of people. This survey is part of such a research effort.

Please answer the questions on the following pages by marking the answers that are true for you. Each person is different, so there are no "right" or "wrong" answers. Of course, all you tell us is strictly confidential--to be seen only by the research team. Do not ask anyone else about how to reply to the items. It is your personal opinion that we want.

Your assistance will be greatly appreciated.

For each of the following items, please circle the number of the ONE best answer:

1. Do you ever have trouble finding time to get your hair cut or styled?

   a. Never
   b. Occasionally
   c. Almost always

2. Does college "stir you into action"?

   a. Less often than most college students
   b. About average
   c. More often than most college students

3. Is you everyday life filled mostly by:

   a. Problems needing solution
   b. Challenges needing to be met
   c. A rather predictable routine of events
   d. Not enough things to keep me interested or busy

4. Some people live a calm, predictable life. Others find themselves often facing unexpected changes, frequent interruption, inconveniences or "things going wrong". How often are you faced with these minor (or major) annoyances of frustrations?

   a. Several times a day
   b. About once a day
   c. A few times a week
   d. Once a week
   e. Once a month or less

5. When you are under pressure of stress, do you usually:

   a. Do something about it immediately
   b. Plan carefully before taking any action

6. Ordinarily, how rapidly do you eat?

   a. I'm usually the first one finished
   b. I eat a little faster than average
   c. I eat at about the same speed as most people
   d. I eat more slowly than most people

7. Has you spouse or some friend ever told you that you eat too fast?

   a. Yes, often
   b. Yes, once or twice
   c. No, no one has told me this

8. How often do you find yourself doing more than one thing at a time, such as working while eating, reading while dressing, figuring out problems while driving?

   a. I do two things at once whenever practical
   b. I do this only when I'm short of time
   c. I rarely or never do more than one thing at a time

9. When you listen to someone talking, and this person takes too long to come to the point, do you feel like hurrying him along?

   a. Frequently
   b. Occasionally
   c. Almost never

10. How often do you actually "put words in his mouth" in order to speed things up?

    a. Frequently
    b. Occasionally
    c. Almost never

11. If you tell your spouse or a friend that you will meet them somewhere at a definite time, how often do you arrive late?

    a. Once in a while
    b. Rarely
    c. I am never late

12. Do you find yourself hurrying to get places even when there is plenty of time?

    a. Often
    b. Occasionally
    c. Rarely or never

13. Suppose you are to meet someone at a public place (street corner, building lobby, restuarant) and the other person is already 10 minutes late. Will you:

    a. Sit and wait?
    b. Walk about while waiting?
    c. Usually carry some reading matter or writing paper so you can get something done while waiting?

14. When you have to "wait in line", such as at a restaurant, a store, or the post office, do you:

    a. Accept it calmly?
    b. Feel impatient but do not show it?
    c. Feel so impatient that someone watching could tell you were restless?
    d. Refuse to wait in line, and find ways to avoid such delays?

15. When you play games with young children about 10 years old, how often do you purposely let them win?

    a. Most of the time
    b. Half of the time
    c. Only occasionally
    d. Never

16. Do most people consider you to be:

    a. Definitely hard-driving and competitive?
    b. Probably hard-driving and competitive?
    c. Probably more relaxed and easy going?
    d. Definitely more relaxed and easy going?

17. Nowadays, do you consider youself to be

    a. Definitely hard-driving and competitive?
    b. Probably hard-driving and competitive?
    c. Probably relaxed and easy going?
    d. Definitely more relaxed and easy going?

18. How would your spouse (or closest friend) rate you?

    a. Definitely hard-driving and competitive
    b. Probably hard-driving and competitive
    c. Probably more relaxed and easy going
    d. Definitely more relaxed and easy going

19. How would your spouse (or best friend) rate your general level of activity?

    a. Too slow. Should be more active.
    b. About average. Is busy much of the time.
    c. Too active. Needs to slow down.

20. Would people who know you well agree that you take your work too seriously?

    a. Definitely yes
    b. Probably yes
    c. Probably no
    d. Definitely no

21. Would people who know you well agree that you have less energy than most people?

    a. Definitely yes
    b. Probably yes
    c. Probably no
    d. Definitely no

22. Would people who know you well agree that you tend to get irritated easily?

    a. Definitely yes
    b. Probably yes
    c. Probably no
    d. Definitely no

23. Would people who know you well agree that you tend to do most things in a hurry?

    a. Definitely yes
    b. Probably yes
    c. Probably no
    d. Definitely no

24. Would people who know you well agree that you enjoy "a contest" (competition) and try hard to win?

    a. Definitely yes
    b. Probably yes
    c. Probably no
    d. Definitely no

25. Would people who know you well agree that you get a lot of fun out of life?

    a. Definitely yes
    b. Probably yes
    c. Probably no
    d. Definitely no

26. How was you "temper" when you were younger?

    a. Fiery and hard to control
    b. Strong, but controllable
    c. No problem
    d. I almost never got angry

27. How is your "temper" nowadays?

    a. Fiery and hard to control
    b. Strong, but controllable
    c. No problem
    d. I almost never get angry

28. When you are in the midst of studying and someone interrupts you, how do you usually feel inside?

    a. I feel O.K. because I work better after an occasional break
    b. I feel only mildly annoyed
    c. I really feel irritated because most such interruptions are unnecessary

29. How often are there deadlines in your courses? (If deadlines occur irregularly, please circle the closest answer below).

    a. Daily or more often
    b. Weekly
    c. Monthly
    d. Never

30. Do these deadlines usually

    a. Carry minor pressure because of their routine nature?
    b. Carry considerable pressure, since delay would upset things a great deal?

31. Do you ever set deadlines or quotas for yourself in courses or other things?

    a. No
    b. Yes, but only occasionally
    c. Yes, once per week or more

32. When you have to work against a deadline, is the quality of your work:

    a. Better
    b. Worse
    c. The same (pressure makes no difference)

33. In school do you ever keep two projects moving forward at the same time by shifting back and forth rapidly from one to the other?

    a. No, never
    b. Yes, but only in emergencies
    c. Yes, regularly

34. Do you maintain a regular study schedule during vacations such as Thanksgiving, Christmas, or Easter?

    a. Yes
    b. No
    c. Sometimes

35. How often do you bring your work home with you at night or study materials relative to your courses?

    a. Rarely or never
    b. Once a week or less often
    c. More than once a week

36. How often do you go to the university when it is officially closed (such as night or weekends)? If this is not possible, circle here: 0

    a. Rarely or never
    b. Occasionally (less than once a week)
    c. Once or more a week

37. When you find yourself getting tired while studying, do you usually

    a. Slow down for a while until your strength comes back
    b. Keep pushing yourself at the same pace in spite of the tiredness

38. When you are in a group, do the other people tend to look to you to provide leadership?

    a. Rarely
    b. About as often as they look to others
    c. More often than they look to others

39. Do you make yourself written lists of "things to do" to help you remember what needs to be done?

    a. Never
    b. Occasionally
    c. Frequently

IN EACH OF THE FOLLOWING QUESTIONS, PLEASE COMPARE YOURSELF WITH THE AVERAGE STUDENT AT THE UNIVERSITY. PLEASE CIRCLE THE MOST ACCURATE DESCRIPTION.

40. In amount of effort put forth, I give

Much more effort	A little more effort	A little less effort	Much less effort

41. In sense of responsibility, I am

Much more responsible	A little more responsible	A little less responsible	Much less responsible

42. I find it necessary to hurry

Much more of the time	A little more of the time	A little less of the time	Much less of the time

43. In being precise (careful about detail), I am

Much more precise	A little more precise	A little less precise	Much less precise

44. I approach life in general

Much more seriously	A little more seriously	A little less seriously	Much less seriously

Thank you for your cooperation.

APPENDIX B

PRETASK QUESTIONNAIRE

You will now be asked to answer a number of questions based on the following scenario:

Imagine that you are interacting with another person in a situation that allows you both to earn or lose some money. In this interaction you will be making a series of decision; each decision can lead to an increase or a decrease in your earnings. Each decision involves deciding which of three different colored buttons you wish to press. Your earnings or losses depend upon both your decision and the other person's decision; neither of you can control your own earnings alone. You must decide which button to press, however, without knowing the other person's choice.

On the basis of each decision a number of different payoffs are possible. The combination of buttons pressed by you and the other person determines which payoff you will receive; and each payoff involves a combination of gains and/or losses for you and the other person. For example, if you both press your blue buttons you both earn 15¢ on that trial.

We are interested now in finding out how you would approach this task and what types of payoffs you would prefer if given a choice.

In each item below you will find listed a pair of alternative payoffs. You are asked to indicate which payoff of each pair you would prefer if forced to choose between the two. Circle (a) if you would prefer alternative (a); circle (b) if you would prefer alternative (b). Negative signs indicate losses.

1.	(a) you earn 19¢ while other person earns 8¢	or	(b) you earn 8¢ while other person earns -19¢
2.	(a) you earn 15¢ while other person earns -15¢	or	(b) you earn 8¢ while other person earns -19¢
3.	(a) you earn 8¢ while other earns 19¢	or	(b) you earn 15¢ while other earns -15¢
4.	(a) you earn 19¢ while other earns -8¢	or	(b) you earn 15¢ while other earns 15¢
5.	(a) you earn 21¢ while other earns 0¢	or	(b) you earn 15¢ while other earns -15¢
6.	(a) you earn 19¢ other earns 8¢	or	(b) you earn 0¢ other earns -21¢
7.	(a) you earn 8¢ other earns 19¢	or	(b) you earn 19¢ other earns 8¢

8.	(a) you earn 19¢ other earns -8¢	or	(b) you earn 8¢ other earns -19¢
9.	(a) you earn 0¢ other earns 21¢	or	(b) you earn 8¢ other earns -19¢
10.	(a) you earn 15¢ other earns -15¢	or	(b) you earn 19¢ other earns -8¢
11.	(a) you earn 21¢ other earns 0¢	or	(b) you earn 0¢ other earns -21¢
12.	(a) you earn 15¢ other earns -15¢	or	(b) you earn 0¢ other earns -21¢
13.	(a) you earn 21¢ other earns 0¢	or	(b) you earn 8¢ other earns -19¢
14.	(a) you earn 8¢ other earns -19¢	or	(b) you earn 0¢ other earns -21¢
15.	(a) you earn 19¢ other earns -8¢	or	(b) you earn 0¢ other earns -21¢
16.	(a) you earn 0¢ other earns 21¢	or	(b) you earn 19¢ other earns -8¢
17.	(a) you earn 15¢ other earns 15¢	or	(b) you earn 19¢ other earns 8¢
18.	(a) you earn 0¢ other earns 21¢	or	(b) you earn 15¢ other earns -15¢
19.	(a) you earn 0¢ other earns 21¢	or	(b) you earn 19¢ other earns 8¢
20.	(a) you earn 19¢ other earns 8¢	or	(b) you earn 15¢ other earns -15¢
21.	(a) you earn 8¢ other earns 19¢	or	(b) you earn 21¢ other earns 0¢
22.	(a) you earn 0¢ other earns 21¢	or	(b) you earn 21¢ other earns 0¢
23.	(a) you earn 8¢ other earns 19¢	or	(b) you earn 8¢ other earns -19¢
24.	(a) you earn 8¢ other earns 19¢	or	(b) you earn 0¢ other earns -21¢
25.	(a) you earn 15¢ other earns 15¢	or	(b) you earn 0¢ other earns -21¢

26.	(a) you earn 15¢ other earns 15¢	or	(b) you earn 15¢ other earns -15¢
27.	(a) you earn 8¢ other earns 19¢	or	(b) you earn 15¢ other earns 15¢
28.	(a) you earn 0¢ other earns 21¢	or	(b) you earn 15¢ other earns 15¢
29.	(a) you earn 0¢ other earns 21¢	or	(b) you earn 0¢ other earns -21¢
30.	(a) you earn 15¢ other earns 15¢	or	(b) you earn 8¢ other earns -19¢
31.	(a) you earn 8¢ other earns 19¢	or	(b) you earn 19¢ other earns -8¢
32.	(a) you earn 15¢ other earns 15¢	or	(b) you earn 21¢ other earns 0¢
33.	(a) you earn 0¢ other earns 21¢	or	(b) you earn 8¢ other earns 19¢
34.	(a) you earn 19¢ other earns 8¢	or	(b) you earn 19¢ other earns -8¢
35.	(a) you earn 21¢ other earns 0¢	or	(b) you earn 19¢ other earns -8¢
36.	(a) you earn 19¢ other earns 8¢	or	(b) you earn 21¢ other earns 0¢

Please answer the following general questions based on the same scenario.

1. Which of the following goals best describes your general approach to the task?

   a. I will work independently, for myself. I will be concerned only with my own earnings.
   b. I will work to cooperate with the other person. I will be concerned with my earnings and the other person's earnings.
   c. I will work to compete with the other person. I will be concerned with earning as much more than the other person as I can.
   d. I will work for the other person. I will be concerned only with the other person's earnings.
   e. I will work against the other person. I will be concerned only with minimizing the other person's earnings.

2. Which of the following goals do you think the <u>typical</u> person would choose in approaching this task?

   a. He would work independently, for himself. He would be concerned only with his own earnings.

b. He would work to cooperate with the other person. He would be concerned with his earnings and the other person's earnings.
c. He would work to compete with the other person. He would be concerned with earning as much more than the other person as he can.
d. He would work for the other person. He would be concerned only with the other person's earnings.
e. He would work against the other person. He would be concerned only with minimizing the other person's earnings.

3. How much influence do you have in general on the behavior of people around you?

a. A great deal
b. More than a little
c. Just a little
d. Very little
e. None

4. How important to you is your ability to influence the behavior of people around you?

a. Very important
b. Somewhat important
c. Of little importance
d. Of no importance

APPENDIX C

ORIENTATION INSTRUCTIONS GIVEN TO SUBJECTS

Orientation to Experiment

We are interested in the behavioral and physiological processes of interpersonal interactions. You will be interacting with another person by pressing buttons on a response panel. All of your interactions with the other person will be communicated through the T.V. screen in front of you. Your button presses will affect what appears on the screen. You will be shown how the buttons work later.

Interacting with another person by pressing buttons may seem strange at first. However, once you see how it works, it is relatively easy. You will have a chance to practice before we begin.

We will be recording some physiological changes during the experiment using methods which are neither harmful nor painful. It is important that you move around as little as possible during the experiment if we are to get good recordings.

Most people are curious about what we find. At the end of this recording session we will go over your physiological recordings so that you can see what they look like. When the experiment is over we will have a more complete picture of results and will be happy to share those with you.

Personal Communication from the Experimenter

There are many different ways people have for relating to, or dealing with, other people. We are interested in these different patterns of interacting. We assume that each pattern has its own set of strengths and weaknesses and that they indicate personal preferences in our approach to people. There is no right or wrong to these preferences for relating. We hope that by participating in the experiment you will help us learn about your own preferences in interacting with other people.

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APPENDIX D

POST-TASK QUESTIONNAIRE

Please answer the following questions by circling the answer that most closely resembles your own feelings.

1. Which of the following goals best describes your approach to this task (think back to how you felt at the beginning of the task)?

   a. I will work independently, for myself. I will be concerned only with my own earnings.
   b. I will work to cooperate with the other person. I will be concerned with my earnings and the other person's earnings.
   c. I will work to compete with the other person. I will be concerned with earning as much more than the other person as I can.
   d. I will work for the other person. I will be concerned only with the other person's earnings.
   e. I will work against the other person. I will be concerned only with minimizing the other person's earnings.

2. How closely did you stick with your chosen goal during the task?

   a. Very closely
   b. Somewhat closely
   c. Not very closely
   d. Not at all

3. How difficult was it for you to stick to your original goal choice in the face of the other's behavior?

   a. Very difficult
   b. Somewhat difficult
   c. Somewhat easy
   d. Very easy

4. Which of the following goals do you think best describes the other person's approach to this task?

   a. He worked independently, for himself. He was concerned only with his own earnings.
   b. He worked to cooperate with me. He was concerned with his earnings and with my earnings.
   c. He worked to compete with me. He was concerned with earning as much more than me as he could.
   d. He worked for me. He was concerned only with my earnings.
   e. He worked against me. He was concerned only with minimizing my earnings.

5. Which of these goals do you think the typical person would choose in approaching this task?

   a. He would work independently, for himself. He would be concerned only with his own earnings.

b. He would work to cooperate. He would be concerned with his earnings and with the other person's earnings.
c. He would work to compete. He would be concerned only with earning as much more than the other person as he could.
d. He would work for the other person. He would be concerned only with the other person's earnings.
e. He would work against the other person. He would be concerned only with minimizing the other person's earnings.

6. How much incfluence do you feel you had on the behavior of the other person in this task?

a. A great deal
b. More than a little
c. Just a little
d. Very little
e. None

7. How did you feel about the amount of influence you had on the other person's behavior?

a. Very satisfied
b. Satisfied
c. A little frustrated
d. Very frustrated

8. Please rate the other person in this experiment on the following scales:

Not similar to me	1	2	3	4	5	Similar to me
Unselfish	1	2	3	4	5	Selfish
Non-competitive	1	2	3	4	5	Competitive
Trustworthy	1	2	3	4	5	Untrustworthy
Cold	1	2	3	4	5	Warm

9. Which of the following goals best describes your general approach <u>at the end</u> of the task?

a. I was working independently, for myself. I was concerned with my earnings.
b. I was working to cooperate with the other person. I was concerned with my earnings and the other person's earnings.
c. I was working to compete with the other person. I was concerned with earning as much more than the other person as I could.
d. I was working for the other person. I was concerned only with the other person's earnings.
e. I was working against the other person. I was concerned only with minimizing the other person's earnings.

APPENDIX E

DERIVATION AND DESCRIPTION OF EXPERIMENTAL VARIABLES

Pretask Questionnaire Variables

1. Competitiveness of motivational orientation: Derivation described in text. Range is from -14.8 (least competitive) to 21 (most competitive).

2. Influence on others: Subject's answer to the question, "How much influence do you have in general on the behavior of people around you?" Range is from 1 (none) to 5 (a great deal).

3. Importance of influence: subject's answer to the question, "How important to you is your ability to influence the behavior of people around you?" Range is from 1 (of no importance) to 4 (very important).

4. Own goal competitiveness: Subject's choice of an altruistic, cooperative, independent, competitive, or punishing goal as self-descriptive. Range is from 1 (altruistic) to 5 (punishing) with 3 representing the independent orientation and higher scores described as more competitive.

5. Typical other's goal competitiveness: Subject's choice of an altruistic, cooperative, independent, competitive or punishing goal as descriptive of the "typical" person. Range is same as in 4 above.

Post-task Questionnaire Variables

1. Beginning goal competitiveness: Subject's choice of an altruistic, cooperative, independent, competitive or punishing goal as descriptive of his approach at the beginning of the task. Range is same as pretask variable 4.

2. End goal competitiveness: Subject's choice of an altruistic, cooperative, independent, competitive, or punishing goas as descriptive of his approach at the end of the task. Range as in 4 above.

3. Typical other's goal competitiveness: Subject's choice of an altruistic, cooperative, independent, competitive or punishing goal as descriptive of a "typical" person's approach to this task. Range as in 4 above.

4. Influence on other: Subject's answer to the question, "How much influence do you feel you had on the behavior of the other person in this task?" Range is from 1 (none) to 5 (a great deal).

5. Satisfaction with influence: Subject's answer to the question, "How do you feel about the amount of influence you had on the other person's behavior?" Range is from 1 (very frustrated) to 4 (very satisfied).

6-10. Ratings: Subject's ratings of their partner on the following scales:

6. Similarity: 1 = not similar to me . . . 5 = similar to me
7. Selfishness: 1 = unselfish . . . 5 = selfish
8. Competitiveness: 1 = noncompetitive . . . 5 = competitive
9. Trustworthiness: 1 = untrustworthy . . . 5 = trustworthy
10. Warmth: 1 = cold . . . 5 = warm.

CIPAS Variables

Values for the following variables are automatically calculated by the computer after completion of the experiment. For some of these calculations, behaviors are reclassified as prosocial (cooperate or reward) and antisocial (compete, punish or withdraw). Percentages range from 0% to 100% and probabilities range from -1 to +1.

Interactions

1. Cooperate: Percentage of trials on which subject gives the cooperate response.
2. Compete: Percentage of trials on which the subject gives the compete response.
3. Punish: Percentage of trials on which the subject gives the punish response.
4. Reward: Percentage of trials on which the subject gives the reward response.
5. Withdraw: Percentage of trials on which the subject gives the withdraw response.
6. Trust vs. betrayal: Subject's behavior on trials following a mutual prosocial interaction. Probability that S responds prosocially - probability that S responds antisocially.
7. Forgiveness vs. retaliation: Subject's behavior on trials following a trial on which S behaved prosocially but other behaved antisocially. Probability S responds prosocially - probability S responds antisocially.
8. Repentance vs. exploitation: Subject's behavior on trials following a trial on which S behaved antisocially but other behaved prosocially. Probability S responds prosocially - probability S responds antisocially.
9. Conciliation vs. distrust: Subject's behavior on trials following a mutual antisocial interaction. Probability S responds prosocially - probability S responds antisocially.

Communications

10. Messages sent: Number of messages sent by S.
11. Messages refused: Number of messages refused by S.
12. Requests: Number of requests messages sent.
13. Angry feelings: Number of angry feelings messages sent.
14. Pleased feelings: Number of pleased feelings messages sent.
15. Prosocial intentions: Number of messages sent in which S expresses an intention to behave prosocially if the other does so.
16. Antisocial intentions: Number of messages sent in which S expresses an intention to behave antisocially if the other does so.

Communications-interactions

17. Prosocial intentions kept vs. not kept: Probability S behaved prosocially after expressing the intention to do so - the probability S behaved antisocially after expressing intention to behave prosocially.
18. Requests satisfied: Probability that, after receiving a request message, subject behaved as requested.
19. Feelings respected: Probability that, after receiving a feelings message, S gave the response that pleased the other or did not give the response that hurt or angered the other.
20. Threats challenged: Probability that S responds antisocially after receiving an antisocial intentions message - probability that S responds prosocially after receiving an antisocial intentions message.

Perceptions

21. Subjective certainty: average of S's 20 certainty ratings.
22. Accuracy of perception: Percentage of trials on which S's prediction of other's behavior was correct.
23. Expected utility: Product of S's certainty rating and desirability rating averaged over 20 trials. Theoretical range is from -400 (100% certain other will do something I dislike very much) to +400 (100% certain other will do something I like very much).
24. Actual utility: Average desirability rating attached by subject to predictions of other's behavior which were correct.
25. Prosocial appetite: Sum of desirability ratings in which ratings attached to prosocial behaviors are scored positively and ratings attached to antisocial behaviors are scored negatively.

Communications-perceptions

26. Expectation of kept intentions: S's expectation after receiving an intentions message. Probability S expects other to behave as stated - probability S expects other to not behave as stated.

27. Expected satisfaction of requests: S's expectation after S has sent a request message. Probability S expects other to behave as requested - probability S expects other to not behave as expected.

28. Expected respect of feelings: Subject's expectation after S has sent a feelings message. Probability S expects other to respect feelings in his/her behavior - probability S expects other to not respect feelings in his/her behavior.

Interactions-perceptions

29. Expectation of trust vs. betrayal: Variable 6 with S's behavior replaced by S's expectation.

30. Expectation of forgiveness vs. retaliation: Variable 7 with S's behavior replaced by S's expectation.

31. Expectation of repentance vs. exploitation: Variable 8 with S's behavior replaced by S's expectation.

32. Expectation of conciliation vs. distrust: Variable 9 with S's behavior replaced by S's expectation.

Perceptions-interactions

33. Egalitarian vs. selfish intention: Probability S behaves prosocially when expecting other to behave prosocially - probability S behaves antisocially when expecting other to behave prosocially.

34. Altruistic vs. spiteful intention: Probability S behaves prosocially when expecting other to behave antisocially - probability S behaves antisocially when expecting other to behave antisocially.

APPENDIX F

HYPOTHESES: GROUP MEANS AND SIGNIFICANCE TESTS

Table 8. Pre- and post-task differences between Type A and Type B subjects

Measure	Type A's	Type B's	F	p
Pretask				
Competitiveness of motivational orientation	8.5	6.7	1.03	.156
Typical other's goal competitiveness	3.1	3.1	<1	—
Importance of influence	3.2	2.7	7.68	.004
Post-task				
Beginning goal competitiveness	2.7	2.3	2.86	.046
Typical other's goal competitiveness	3.0	2.7	2.56	.055

Note: All tests are one-tailed, df = 1, 58.

Table 9. Differences between dyad types in behavior, physiology and perception.

Measure	A-A Dyads	A-B Dyads	B-B Dyads	F	p
Task behavior					
Cooperate	56	48	57	<1	—
Compete	18	21	14	<1	—
Task physiology					
Vasodilation (% resting level)	63	68	75	<1	—
Task perception					
Accuracy of perception	55	52	66	<1	—
Subjective certainty	71	69	75	<1	—
Post-task perception: ratings					
Trustworthiness	3.5	4.0	4.2	1.68	.19
Warmth	3.6	3.9	4.0	<1	—
Selfishness	2.5	2.8	2.2	1.23	.300
Competitiveness	3.0	3.4	2.3	2.57	.023

Note: Units of measurement are percentages except for post-task variables for which units are arbitrary.

Note: All tests are one-tailed, df = 2, 57 for post-task variables, df = 2, 27 for all other variables.

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