Psychosocial stress: An experimental approach: Life events, coping, and psychobiological functioning

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PSYCHOSOCIAL STRESS: AN EXPERIMENTAL APPROACH

Life events, coping, and psychobiological functioning

PROEFSCHRIFT

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To Tini, Rens, and Bregje

PREFACE

The project reported here was supported by the Netherlands Organization for the Advancement of Pure Research (ZWO, grant 58-61).
At this point, I would like to express my sincere gratitude to all those people who contributed to the completion of this project.
My first debt is to Joop Hettema who was involved with from the very beginning, and who may be considered the 'Auctor Intellectualis' of the project 'Experimental Psychodiagnostics' of which the studies reported here formed a part. The encouraging discussions with him, both in the practical phase of the experiment and during the writing of this text, were very helpful.
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I myself take full responsibility for any errors that still remain.

Last but not least, I acknowledge with thanks all my colleagues and friends at Tilburg University who contributed by creating an amicable, pleasant, and stimulating atmosphere.

I would like to conclude by apologizing to my wife Tini and my children Rens and Bregje for all those times that I was not with them.

CONTENTS

LIST OF ABBREVIATIONS

A	: Adrenaline
ACL	: Adjective checklist
ACTH	: Adrenocorticotropic hormone
ADH	: Anti-diuretic hormone
ANOVA	: Analysis of variance
ANS	: Autonomic nervous system
CDI	: Coping dominance index
ECG	: Electrocardiogram
E-coping	: Emotion focused coping
E-scale	: Subscale of the WCC to measure E-coping
FSH	: Follicle stimulating hormone
GAS	: General adaptation syndrome
GSL	: Galvanic skin level
hGH	: Human growth hormone
HR	: Heart rate
HRV	: Heart rate variability
IBI	: Inter-beat-interval (between ECG R-waves)
LES	: Life experience survey
LH	: Luteinizing hormone
MQ	: Maastricht questionaire
NA	: Noradrenaline
ns	: not significant
PCA	: Principal component analysis
P-coping	: Problem focused coping
PNS	: Parasympathetic nervous system
PRL	: Prolactin
P-scale	: Subscale of the WCC to measure P-coping
PTT	: Pulse transit time
S	: index for HRV (time domain measure)
SBP	: Systolic blood pressure
SNS	: Sympathetic nervous system
SRE	: Schedule of recent experiences
TSH	: Thyroid stimulating hormone
TWA	: T-wave amplitude (of the ECG)
WCC(gen)	: "general" version of the Ways of Coping Checklist
WCC(spe)	: "specific" version of the Ways of Coping Checklist

Chapter I

HISTORICAL VIEW OF THE STRESS FIELD

1.1. *Introduction*

The concept of stress is familiar to both laymen and professionals of several disciplines. Psychology, medicine, sociology, physiology, biochemistry, and dentistry (*cf.* Morse and Furst, 1982, Morse *et al.*, 1983) all devote substantial resources to the study of stress. Within these disciplines a distinction is made between the clinical, epidemiological and experimental approaches. This leads to a great variety of phenomena studied and of particular interest expressed by scientists of different disciplines. This also brings about the disadvantage that stress is defined in several ways, leading to great confusion and controversy.

Payne, Jick, and Burke, in their 1982 article entitled "Whither stress research? An agenda for the 1980s", conclude that "Despite the impressive quantity, understanding of the stress phenomenon remains rather limited". Whereas some investigators focus their attention on more fundamental issues, others deal with more practical questions, *e.g.*, individual and community health, work efficiency, and job satisfaction. Such a great diversity makes it difficult to give a comprehensive review on what is known about stress. Rather, it forces one to making choices both with regard to the theoretical position taken and the class of variables to be studied. Payne *et al.* (1982) therefore point to the need of making choices about the "who", "how" and "what" in stress research. In addition, they emphasize the need of an integration of several approaches.

In the present book an overview is presented of the theoretical developments of the stress concept. It will be shown that physiology and psychology both have contributed to the understanding of stress phenomena. However, until recently, this seemed to occur independently, psychology concentrating mainly on the input side, whereas physiology focused its attention on the output side (Mikhail, 1981). Mikhail's pro-

posal implies the integration of these two approaches into a "holistic" theory. In this synthesis, psychology defines the circumstances in which there is "stress"; in contrast, physiology describes what responses occur.

The present study may be seen as a first attempt toward an experimental approach of psychosocial stress, within the framework of Mikhail's vision of stress as a psychophysiological concept.

1.2. *The stress concept*

Without doubt, Hans Selye (*cf.* Selye, 1976) is the man who popularized the use of the term stress and whose early research has to be considered the foundation on which modern stress research has been built. However, this does not mean that scientists uncritically accepted the doctrines of Selye. To quote Mason (1975a): "There are still workers who accept Selye's views of stress, some who use modifications of them, some who regard them yet as unproven working hypotheses, and some who simply reject or ignore them".

As Mason (1975a) correctly indicates, the term "stress" had a rather common everyday usage prior to the first publication of Hans Selye (1936), who frequently is considered to be the "father" of stress research. For example, about 25 years before, Walter Cannon (1914) rather frequently used the term stress in phrases such as "great emotional stress", or "stress of excitement". Whereas stress in these phrases has to be considered more a psychological concept, in later work Cannon developed the use of an engineering concept of stress and strain in a physiological context. More specificially, he used the term stress for designating the forces that act on the organism and disturb the homeostasis. He then already used the term stress for both physical and emotional stimuli. Probably, the experiment of Cannon and De La Paz (1911) in which cats were exposed to barking dogs was the first one in which it was shown that non-physical stimuli also could be potent triggers for evoking physiological reactions, in particular the release of what later appeared to be the catecholamines by the adrenal medulla. The relevance of this has not to be underestimated. So far, most scientists (and later Selye as well) restricted their research to the use of physical stimuli, such as cold, heat, food deprivation, and hemorrhage.

A discussion now follows of Selye's theory, its criticism, and more recent developments.

1.3. *Physiological stress theories*

1.3.1. *Selye's stress theory*

In a search to discover a new sex hormone, Selye (*cf.* Selye, 1976) found that injections of crude ovarian extracts into rats produced the following outstanding manifestations: (1) enlargement of the adrenal cortex; (2) atrophy of the thymus, spleen, lymph nodes, and all other

lymphatic structures along with certain changes in the blood picture, such as a diminished number of lymphocytes and an almost complete disappearance of eosinophiles; and (3) gastrointestinal ulcers. His disappointment was great when he discovered that these changes were not specific for this ovarian extract, but also were obtained with a variety of other physical stimuli such as extracts of kidney, spleen or any other organ, as well as by cold, pain, irradiation, and formalin injection. As it appeared to him that all stimuli led to the same physiological changes, he decided to call this syndrome the "General Adaptation Syndrome" (GAS), a nonspecific response of the body to any noxious stimulus. An important modification of the theory is that in more recent versions of the theory the phrase "any noxious stimulus" has been replaced by just "any demand".

Selye was struck by the fact that, while nearly all the organs of the body showed signs of degeneration and involution, the adrenal cortex, in contrast, appeared to be enlarged. He assumed that the enhanced activity of this structure was an essential element in the nonspecific adaptive reaction. Selye also postulated the action of the adrenal cortex to be a trigger for the body's defense forces, hence the term "alarm reaction".

Further investigations showed Selye that three temporal phases could be distinguished. First, there was the aforementioned "alarm reaction". Then, upon continued exposure to a stressor, a stage of adaptation or resistance ensued during which the symptoms subsided. Since the adaptability also has its limits, still more prolonged exposure to the same conditions ultimately resulted in the stage of exhaustion leading to death of the organism. For the sake of completeness it should be noted that Selye considered the alarm reaction to consist of two phases:

1. The shock-phase: this is the initial reaction to noxious stimuli. The most striking manifestations are: increased heart rate; depressed temperature; lowered blood pressure; and loss of muscle tone.
2. The counter shock-phase: this can be seen as a rebound phase, during which defensive forces are mobilized. More precisely, this means that there is an increase in the secretion of adrenocorticotropic hormone (ACTH) by the adenohypophysis, stimulating the release of glucocorticoids (*e.g.*, cortisol) from the adrenal cortex.

Two other important concepts in the stress theory of Selye are "the first mediator", and the phenomenon of "conditioning". A good understanding of these concepts is needed to grasp the nucleus of criticism towards the theory, put forward by more psychologically oriented investigators such as Mason (1975b). With "the first mediator", Selye means the channel, by which the information that a state of stress exists is transmitted from the peripheral area primarily affected to the hypophysiotropic area of the hypothalamus. Until his death, Selye took it as proven that transmission surely does not occur via nervous pathways. He also believed that no (class of) chemical messenger(s) or, alternatively, a deficiency in one of the constituents of the blood had been identified. He therefore concluded "it is certainly disappointing that after the many years of research since the first description of the "alarm reaction" during wich we have learned so much about the subse-

quent mediation of the stress response through the hypothalamo-pituitary-adrenal and the sympathetic nervous system, the nature of the first mediator still remains an enigma" (Selye, 1979, p. 14-15).

The second point refers to what Selye means with "conditioning". Contrary to the use in Pavlovian or Skinnerian sense, this term is used to express that conditions are set for something to take place or, the other way around, for something not to occur. More precisely, conditioning factors determine which organ or tissue will be damaged, when the organism is exposed to sustaining stressors. Conditioning factors may be internal (such as age, sex, genetic predispositions) or external (*e.g.*, diet, drugs, climatological situation). This may explain why a nonspecific response can result in very different "diseases of adaptation", as Selye (1979) called them. The weakest link in the chain will break when the state of the organism is debilitated due to prolonged exposure to stressors. This notion seems to be closely related to the old clinical concept "locus minoris resistentiae".

Summarizing the main points in Selye's theory:

a. stress is defined as "the nonspecific response of the body to any demand made upon it". The term stressor refers to stimuli that evoke this nonspecific response.
b. this response, called the General Adaptation Syndrome, is characterized by (1) increased adreno-cortical activity; (2) degeneration of the thymus and lymphatic structures; and (3) hemorrhage and ulceration of the stomach and other parts of the gastrointestinal tract.
c. in time, three phases can be distinguished: (1) the alarm phase; (2) the stage of resistance; and (3) the stage of exhaustion. The alarm phase consists of a shock-phase and a countershock-phase.

Conditioning factors determine which specific disease of adaptation ultimately will manifest itself, after prolonged exposure to a stressor.

1.3.2. *The Irritation Syndrome*

At the same time Selye was developing his stress concept, in France a similar concept was put forward by Reilly and coworkers (*op.cit.* Smelik, 1959). This concept is known as the "Irritation Syndrome" or the "Phenomena of Reilly". Decourt (*op.cit.* Smelik, 1959) lists the conclusions from the investigations by Reilly as follows:

- As compared to other tissues, the autonomic nervous system (ANS) seems far more susceptible to noxious stimulation.
- The ANS is linked with the cells of the reticulo-endothelial, lymphoid and endocrine systems. All of these systems react interdependently.
- The organism has the capability to react nonspecifically to noxious stimuli at a distance.
- Whereas reactions to stimuli of long duration and moderate intensity may be antagonized succesfully by compensatory mechanisms, strong and short stimuli may cause vasodilatation, edema, hemorrhages and necrosis.
- The general excitation of the sympathetic nervous system (SNS) after the administration of intense and noxious stimuli leads to cellular lesions. Next, these lesions activate the neuro-endocrine system, espe-

cially the pituitary-adrenocortical axis and the sympathetic-adrenal system.

Smelik (1959) discusses the relationship between the findings and concepts of the French group of Reilly and those of Selye. This author then refers to Decourt as the main critic of Selye's work and summarizes his objections as follows:

- The assertion of Selye that his notion of the "alarm reaction", which is defined as the nonspecific response to any noxious stimulus, would be new in history is not true.
- The histological lesions ("gastrointestinal ulcers") observed by Selye are identical with the phenomena of Reilly.
- Whereas Selye had produced the just mentioned lesions by administration of large amounts of noxious substances, Reilly used small amounts of the same agents to stimulate the sympathetic nerves directly, leading to the same pathological consequences.
- Reilly showed that the "unknown first mediator" is nothing else than the SNS, which is extremely susceptible to noxious stimulation;
- The observation that the administration of massive doses of desoxycorticosterone acetate leads to intestinal ulcers is not convincing. The same lesions can be produced by injection of small amounts of the same substance in the vicinity of the splanchnic nerves.

The reply of Selye to this criticism quoted by Smelik (1959) is very interesting. Selye confesses that the one-sidedness of his theory is related to the limitations of his knowledge of other disciplines such as neurology, rather than that he is convinced of the fact that the GAS is solely an endocrine phenomenon.

This section concludes with the following quotation from Smelik (1959): "The general impression of the historical development of both concepts is that they started from different random observations on either endocrine or autonomic nervous phenomena and consequently have developed to generalized theories which were still limited by their own starting points. It is interesting to see how the research in both fundamentally different lines came to meet each other in another field, namely the central nervous system" (Smelik, 1959, p. 31).

1.3.3. *Criticisms on Selye's stress theory*

Selye's theory became rather popular in the medical and physiological sciences. It was strongly attacked, however, by Mason (1971, 1975a, 1975b) and Mikhail (1981). Some of the criticism has been refuted by Selye, other points, however, appear to embarrass him. The main criticisms are summarized below.

1. The nonspecific response has been found using various physical stressors such as heat, cold, and pain. Selye overlooks that all these stressors share one common thing: they induce emotional arousal. Therefore, it can be assumed that the nonspecific response is caused by this emotional stressor. If this can be taken as valid, the inclusion nonspecific is no longer warranted. In addition, emotional arousal can replace the concept of "first mediator". This means

that it is not necessary to look for a transmitter system between the periphery and hypothalamus.

2. The notion of a nonspecific response is incompatible with the concept of "physiological homeostasis", as formulated by Cannon. This means that those physiological reactions will be triggered which meet the specific demands of the environment. For example, a cold environment leads to a response aimed at conservation and production of body heat, whereas a hot environment elicits a physiological reaction pattern which will result in an increased loss of body heat and diminished production of it.

3. The use of the term "nonspecific" is not appropriate. The pituitary-adrenal axis, just as probably all other hormones, indeed responds to a variety of stressors. However, taken into account the actions of several hormones together (multihormonal patterns), the results of studies by Mason (Mason, 1975c; Mason *et al.*, 1976) suggest that there are complex interactions between various stimuli and multihormonal patterns.

4. If stress has to be defined as a nonspecific response, how is it possible that this can result in such various diseases as tuberculosis, asthma, sexual disturbances, cancer, psychiatric disturbances, and many others.

5. In addition, other criticisms, addressing the specific use of the term stress and the historical development of the concept were put forward by Mason (1975b).

More recently, Smelik (1982) enumerates the following points:

6. Selye attributed a central role to the corticosteroids in the resistance and defense mechanisms of the body; however, these hormones appear to lower rather than increase the resistance of the organism in some instances.

7. Selye overlooked the very important role of the sympathico-adrenal axis in the confrontation with stressors.

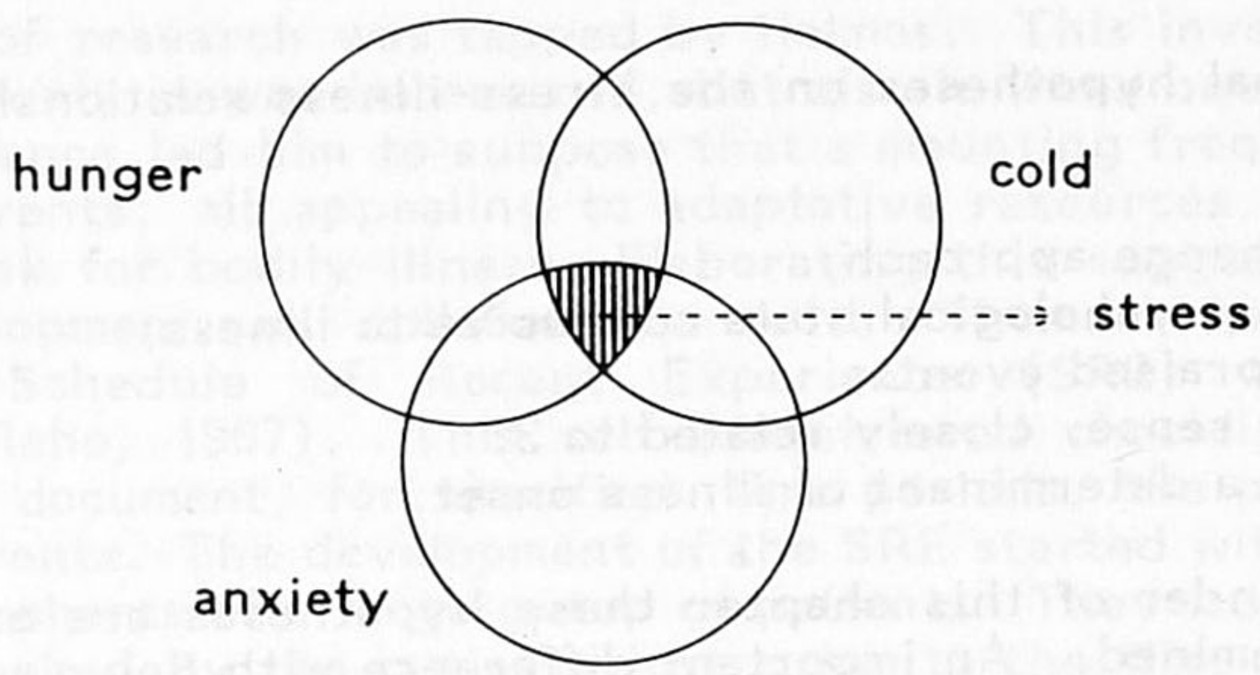
Finally, there is the estimate of Mikhail (1981):

8. Selye's theory is not formulated in a testable form. To be testable, the theory must state the conditions which constitute a stressor independently of the stressor's effect. To put it another way, the present theory labels a stimulus as a stressor, dependent on whether it induces the stress syndrome. No adequate definition or description has been given of the characteristics of a stimulus to be a stressor. The theory only speaks about "any demand made upon the body".

In 1975 Selye replied to much of the criticism. Concerning the question of emotional arousal and the first mediator, Selye pointed to evidence that stress reactions occur in organisms without a nervous system, and even in plants. Futhermore, he discusses a phenomenon in surgery

called "stress of anesthesia". He therefore concluded that it is not necessary to postulate the involvement of higher (cognitive) functions.

With respect to the seeming contradiction between the nonspecific stress response and the homeostatic principle, he replied that these concepts are not mutually exclusive, but in his view, go hand in hand. Selye agreed that every stressor brings about certain specific physiological responses. However, in addition to these specific changes, all stressors also share one common complex of responses; and it is just this complex of responses that Selye refers to as "stress". This can be illustrated clearly by means of use of so called Venn diagrams, as shown by Henessy and Levine (1976).



Here also, the alternative of Mason is to add the psychological dimension and to introduce the concept of emotional arousal, which mobilizes energy to support behavioral actions, directed at finding more comfortable surroundings.

The question of the reactivity of nearly all hormones to multiple stimuli has been dealt with by Selye in the following way: In the first place, he emphasized the relativity of concepts such as specificity and nonspecificity. For example, the number of "side-effects" varies. Secondly, he also stated that the phenotypes of stress may be various because of the already mentioned conditioning factors.

The last mentioned criticism by Mikhail (1981), in my opinion, is a very fundamental criticism which is hard to refute. Later on we will see the solution of Mikhail to save the theory.

In short, this section dealt with the criticism of Selye's theory and how he had replied to it. The specific psychological elements in the criticism concern (1) the neglect of the possible role of emotional factors, and (2) the lack of interest of the input-side. To put it another way, "it (the theory) does not state the necessary and sufficient conditions for the induction of stress" (Mikhail, 1981, p. 12).

In the next section a discussion is given of the early attempts of clinicians and epidemiologists to understand the situation in which the

stress response occurs. In addition, the way that psychology entered the stress field is shown.

1.4. *Psychological approaches in stress research*

Psychological research and theorizing on stress has concentrated specifically on linking stress and disease. The studies can be divided into two broad categories: (1) theories and models addressing general susceptibility to illness; and (2) those that focus on the development of specific diseases. In the first case, it is predicted that the general susceptibility to illness is affected. In the latter case, physiological mechanisms that are supposed to be of relevance for the development of specific diseases are examined.

Four principal hypotheses on the stress-illness relationship can be distinguished:

1. the life change approach;
2. a specific psychological state conducive to illness;
3. stress appraised events;

and, in some sense, closely related to 3:

4. coping as a determinant of illness onset.

In the remainder of this chapter these hypotheses are extensively and critically examined. An important difference with Selye's terminology is that, whereas Selye used the term stress to refer to a physiological *response* to an agent (called stressor), in psychology and medicine the term traditionally was used to denote a *stimulus* or *situation* which evokes certain (behavioral, psychological and/or physiological) responses. These responses then sometimes are referred to as strains. Often an adjective is added to define the nature of the stimulus *e.g.*, psychosocial stress, heat stress, stress of bereavement.

1.4.1. *The life change approach*

1.4.1.1. *Historical perspective*

One of the important founders of the psychological approach was the psychosomatically oriented clinician Harold Wolff. He and several of his associates (*e.g.*, Hinkle and Holmes) have researched the area of psychosocial stress (note the use of the term "stress" as a stimulus) and disease. In their experiments, they used emotion-inducing interviews as a major tool. It appeared that patients with psychosomatic complaints such as migraine, backache, but also hayfever, developed their symptoms during the interviews when talking about particular emotional events in their lives. Among the most spectacular illustrations of this approach are the observations on Tom, a subject with a gastric fistula as a result of a surgical operation. An interesting finding was the differential reaction of the stomach to various emotions such as depression

and rage. This work established that almost any organ system could be affected by purely psychological stimulation.

Hinkle (*cf.* Hinkle, 1974) tried to extend the evidence from within the laboratory to the field and studied how health is influenced by changes in the cultural or social milieu or interpersonal relationships. His results indicated that people (telephone operators) who stayed in good health during a 20-year period perceived their work differently, *i.e.*, more positively, as compared to those who had many illnesses.
Studies on Chinese and Hungarian refugees warranted similar conclusions. These findings led to the hypothesis that people who remain free from illness have certain personality characteristics that help insulate them from the effects of their life experiences.

Another field of research was tapped by Holmes. This investigator was interested not only in *who* becomes ill, but also in *when* one becomes ill. Clinical experience led him to suppose that a mounting frequency of several social events, all appealing to adaptative resources, greatly enhanced the risk for bodily illness. Elaborating this suggestion led him to the development in collaboration with Thomas Rahe, of the Holmes-Rahe Schedule of Recent Experience (SRE) questionnaire (Holmes and Rahe, 1967). This self-administered checklist allows the respondent to document, for specified time periods, the occurrence of various life events. The development of the SRE started with the analysis of the life charts of a large group of patients. They isolated the life events experienced by the patients just prior to the time of illness onset. This resulted in a list of 43 events, such as "death in the family", "divorce", and "trouble with the boss", but also "change in recreation", "vacation", and "christmas".
The next step was to assess the significance of these events. Therefore, life change unit (l.c.u.) scores were obtained by having different groups of subjects rate for each item the amount of readjustment - independent of desirability, or emotions induced by the item - they thought would be required. The item "marriage" was employed as a standard or anchor point in these ratings. This item was given an arbitrary value of 500. Subjects were asked to assign values above or below 500, dependent on whether, in their opinion, the specific event required more or less readjustment than marriage. These values were averaged and divided by the constant 10. To illustrate, this resulted in the following values: "death of a spouse" is given a value of 100, "divorce" a value of 73, "being fired at work" a value of 47, "pregnancy" a value of 40, "change in residence" a value of 20, and "christmas" yielded a score of 12. These "amounts of change" for each life event are represented in the Social Readjustment Rating Scale.
In this way, a total life stress score can be obtained by determining which events the respondent has experienced and, next, summing the life change units associated with these events.
The major contribution of Holmes and Rahe was in adapting a psychophysical procedure of magnitude estimation to quantify the stressfulness of an event, and in using consensual weights to avoid circularity in stress ratings.
Since its development, the SRE has been used in numerous studies to determine the relationship between life changes and indices of health and adjustment. To mention a few, sudden cardiac death (Rahe and

Lind, 1971), pregnancy, birth complications, and myocardial infarction all have been used as health related variables. Mostly, low but significant correlations were found between scores on the SRE and several indices of health and illness.
It has to be noted that in some sense the use of the SRE fits in the Selyean view because it does not take into account whether an event is judged as positive or negative by individuals; it merely provides an operationalization of "any demand", which according to the theory of Selye evokes the stress response.

Another attempt to evaluate the impact of life changes is the Life Experience Survey (LES). This questionnaire was recently developed by Sarason *et al.* (1978). The major differences with the SRE are twofold. First, it provides both negative and positive life change scores. Second, it takes into account the subjective evaluation of the life events concerning the desirability and the impact of events. In addition, in the revised version, the subjects have to indicate whether the life events were "good" or "bad". They also have to rate: (1) what extent the events affect(ed) their lives; (2) what degree the events were expected to happen; and (3) how much control the respondent had over the event's occurrence.
Although the number of studies using the LES is restricted as yet, the picture emerges of a valid and meaningful distinction between positive and negative events. This seems to be corroborated by the results of investigations in which other more recent developed inventories were used (Cullen, 1984).

Recent investigations (*cf.* Sarason *et al.*, 1981) have shown that in some cases only the negative change scores are associated with health related variables. To complicate things further these authors have stated "It may be that positive and negative life changes do not have the same relationship to physical illness and to emotional malfunction. It is interesting that (.....) only negative life events tend to correlate with emotional malfunction, such as general psychological distress, depression and anxiety, as well as with behavioral problems, such as lowered grade point average.
In contrast, a number of studies suggest that both positive and negative life changes contribute to physical illness. This may be related to life changes, in general, stressing the body's homeostasis, whereas, only negative life changes may be associated with future dissatisfaction and emotional well-being" (Sarason *et al.*, 1981).

From this review, it can be concluded that, although psychological influences are notable, theory and research were primarily influenced by the medical point of view. For example, some theorists conceived of stress as if it were a kind of pathogen, having the potential to cause disease, just as a particular micro-organism evoking specific symptoms (Cassel, 1974).

A recent development in stress research is the distinction between several classes of stressors. Burchfield (1979) discerns acute, chronic and chronic intermittent stressors. An acute stressor is defined as any event which occurs within a given (usually short) time period and does not reoccur frequently, if at all.

Chronic intermittent stressors refer to discrete stimuli to which the organism is repeatedly exposed, over a given time period, for a specified amount of time (relatively short).
Chronic stressors are chronic stimuli or situations to which the organism is continuously exposed.
Cohen (1981) mentions a fourth category: stress event sequences. This phrase is reserved for certain events that initiate a series of several things happening over an extended period of time.

To mention some concrete examples, a sudden, unexpected accident, or a sudden hospitalization clearly belongs to the first category. Professional acts such as landing an aircraft, parachute jumping, or presenting live programs on TV are examples of chronic intermittent stressors. Having a bad relationship with a partner, ill health, job-or-work-related circumstances may be considered chronic stressors. Burchfield (1979) refers to the necessity of discriminating between these categories, because, according to her, different factors appear to be involved. This categorization of stressors will prove important for the critics on the life event approach, because in most life event scales only one or two categories are represented. Further criticism will be dealt with in more detail in the next section.

1.4.1.2. *Criticism on the life event approach*

Criticisms on (the use of) life event scales - and especially the SRE - are numerous, and address several topics. These include: the psychometric characteristics (reliability and content validity); the use of retrospective designs which may lead to an exaggeration in the appreciation of past events from a need to justify subsequent illness; incompleteness; use of inferior syntax, etcetera (Aagaard, 1984; Rabkin and Struening, 1976; Schroeder and Costa, 1984; Zimmerman, 1983). Below is a focus on those criticisms which address the most fundamental aspects of this approach.

In the first place, there is the inclusion of many items referring directly to health related aspects of human functioning or to possible presymptomatic manifestations of incipient illness (such as "change in sleeping habits" or "change in eating habits") as well as items referring to events that could be the result rather than the cause of psychological disturbances (such as "job loss", "divorce", or "change in number of arguments with spouse"). A critical examination of all items of the SRE led Hudgens (1974) to the conclusion that 29 of the 43 events listed could be viewed as symptoms and/or consequences of illness rather than precipitants.
A second problem has to do with the criterion measures of illness. In this research area several illness indicators have been used: (1) number of visits to a physician (without confirmation of the existence of organic disease); (2) physical symptoms in patients applying for treatment; (3) hospitalization; (4) subject's reports of physical illness or symptoms (without confirmation of the existence of organic disease); and (5) illness confirmed by medical examination in a population sample which also includes people with no complaints of physical symptomatology. Several critics (*cf.* Cohen, 1981) agree that only the last criterion

measure is valid. The other indicators tap *illness behavior* rather than illness, resulting in several possible selection biases.
Another problem (especially with respect to hospitalization as a criterion measure) is that, in many cases, the onset of the symptoms may greatly precede the date of hospitalization. In that case, care must be taken to exclude events happening between illness onset and hospitalization. Here we arrive at the most difficult - if not insolvable - problem. At what moment does a disease begin? Many manifestations of disease are the result of a very slow development of pathological processes (*e.g.*, cancer, myocardial infarction). This means that an exact determination of the time of the onset is not possible.
Yet another - although in some sense related - problem concerns the life event itself. It seems plausible that in many cases the anticipation and the forebodings of the event are stressful rather than the event itself. This has been suggested in a study by Kasl *et al.* (1975). Their results showed that the negative consequences of an event can predate the actual date of occurrence. In another study by Fulton and Gottesman (1980), it was found that the actual mourning process often begins before the actual (expected) death. Therefore, much research has to be done to determine early changes in both psychological and physiological functioning.
A further possibility is that disease processes may be initiated or aggravated when people change their "health" behavior in response to a stressful event. For example, a divorce may lead to an increase in smoking, a change in eating habits, and withdrawal from sport activities. All of these lead to a decrease in general fitness.
These questionnaires only contain items relating to life changes. This means that other important categories such as chronic stressors (*e.g.*, job stress, marital problems) and the "daily hassles" are not included. In addition, critics challenge the value of these instruments because the questionnaires do not take into account whether the life event is expected, appraised as desirable or undesirable. In short, the subjective evaluation of the event is not considered. This criticism stems from the stress theory of Lazarus (1966) which is discussed later. As stated before, in more recently developed life scales this criticism has been taken into account. It must be noted however, that such modifications represent a softening of the original assumptions of the life event approach to the study of stress.
Finally, it has to be noted that, gradually, investigators had incorporated other supplementary variables (except for coping and appraisal) such as personality and biomedical risk factors.

1.4.2. *A particular psychological state conducive to illness*

The Rochester group of investigators (Engel, Greene, and Schmale) stressed the importance of a special psychological state as determinant of physical illness (*cf.* Schmale, 1972). Their well documented investigations with patients suggested that many antecedent life experiences could be categorized as actual or threatening separation from highly valued persons, life goals, or places. Separation of this type is supposed to trigger a psychological state of anxiety, sadness, and depression. This state is believed to subsequently increase somatic vulnerability to disease. The recognition of this psychological state ultimately led to

the formulation of the "giving-up given-up" complex (Engel, 1968; Schmale, 1972). This reaction must be considered a complex, not only involving an unpleasant feeling, but also including a disruption in key relationships; a loss of motivation; feelings of helplessness or hopelessness, *i.e.*, the feeling of being unable to cope; a depreciated image of the self; a feeling of disruption of the sense of continuity between past, present and future; and a reactivation of memories of earlier periods of giving-up.

The physiological changes brought about by this complex (a predominance of parasympathetic activity and a relative sympathetic inactivity plus a dominance of hormonal, anabolic activity over catabolic activity) change the body economy in such a way that the capability of the organism to deal with pathogenic processes is strongly affected, permitting disease to develop. Genetic, constitutional and early experience predispositions will ultimately determine the choice of symptom formation.

With respect to this approach, Cohen (1981) remarked: "There has been much interest in their work; however, serious methodological problems exist with the research, including the lack of truly predictive studies, absence of control groups, possibility of observer bias, and other alternative explanations".

1.4.3. *Appraisal and coping*

1.4.3.1. *General introduction*

A marked change in the conception of stress occurred with the appearance of Lazarus 1966 book "Psychological stress and the coping process". Because of emphasis on concepts such as appraisal, initially put forward by Arnold (1960), and coping, Lazarus's approach can be characterized as transactional and cognitive-phenomenological. The term transactional refers to the importance of the relationship between environment and person. Here, attention is paid to the conditions for stress to occur, as well as to what constitutes a demanding stressor. Lazarus suggests that stress occurs when there are demands on the person which tax or exceed his adjustive resources. This means that "stress is not simply out there in the environment", but whether a state of stress develops depends both on external conditions as well as on the constitutional vulnerability of the person and on the adequacy of his cognitive defense mechanisms.

Another example of such an approach is the transactional model of stress by Cox and Mackay (*cf.* Cox, 1978). This model states stress to arise when there is an imbalance between the perceived demand and the person's perception of his capability to meet that demand. What is important is the cognitive appraisal both of the situation and of the capability to cope. This means that someone who does not realize his or her limitations will never be stressed until it becomes obvious to him/her that the demands exceed his/her powers to cope.

In the next section Lazarus's theory will be dealt with more extensively.

1.4.3.2. *Lazarus's stress theory*

As already stated above, Lazarus and his coworkers (*e.g.*, Lazarus, 1966; Lazarus *et al.*, 1970; Lazarus and Launier, 1978) emphasize the importance of cognitive appraisal and coping as mediators between the behavior of a person and the environment. These psychological processes determine the person's psychological reactions to the situation. Psychological reactions are considered to be the various emotional reactions and the person's ability to deal with the situation. From this standpoint, stress results from the way a person evaluates the present and future significance of such encounters for his (or her) well-being. Therefore, both quality and quantity of the emotional reactions are determined by the process of appraisal.
Negative appraisals such as threat, harm, and loss will lead to negative emotions such as anxiety or depression, whereas positive appraisals such as attention, appreciation and approval yield positive emotions such as joy and love.

The theory distinguishes between three types of appraisal: (1) primary appraisal; (2) secondary appraisal; and (3) reappraisal.
The process of primary appraisal is the evaluation of every transaction or encounter for its significance of well-being. Actually, three evaluations are possible. Besides the already mentioned benign-positive and negative-stressful evaluation, a third evaluation is possible: irrelevant. This means that the encounter has subjectively no relevance and hence can be ignored.
Lazarus *et al.* (1980a) also mention three forms of the negative encounter, namely, harm-loss, threat, and challenge. The distinction between harm-loss and threat must be considered on the time dimension. Harm-loss refers to the past; unpleasant events that already have happened. Threat, on the other hand, refers to the future, the anticipation of dismal occurrences. Challenge means that the situation has the potential for positive gain, mastery, or growth. Here one can recognize the influence of Lazarus's theory on later developments in life event research, when the subjective evaluation of the event is measured as well.

According to Lazarus, secondary appraisal concerns the evaluation of the person's coping resources and capacities that he has available to deal with a stressful encounter. Lazarus *et al.* (1980a) state that secondary appraisal is of greater importance in adaptation than orginally assumed. This statement is based on the insight that the person's evaluation of the adequacy of his or her resources, to a large extent, determines whether or not one feels threatened, challenged or hopeful.
As determinants of secondary appraisal in a given stressful period one may think of generalized beliefs about self and environment, previous experiences with similar events, and the availability of resources. The latter include the person's morale and assesment of health/energy, problem solving skills, social support, and material resources (Folkman *et al.*, 1979). Hence the term "coping resources" to refer to these background variables.

Reappraisal, finally, points to the feedback process from the process of interaction between subject and environment, which can bring about

changes in primary and secondary appraisals. For, as the person reacts, the environment counterreacts. The perception and evaluation of a continuously ongoing process of interaction repeatedly leads to a correction in the appraisal of the person-environment relationship.
This conception of stress thus clearly differs from the ones mentioned above where "stress" was used to denote either a response or a stimulus. According to this transactionistic approach, stress has to be considered dependent on the outcome of the appraisal processes. Stress will occur if the situation is appraised as relevant and (potentially) damaging, whereas, at the same time, one realizes that one has no adequate response available to meet the demands. Therefore, rather than being a *stimulus* or a *response*, stress is considered here (the outcome of) a *process*.

In the early sixties, Lazarus and his associates showed the relevance of the appraisal concept as a determinant of the psychological and physiological reactions by exposing subjects to gruesome films with different soundtracks (Speisman *et al.*, 1964). The films depicted a primitive ritual of cutting (with a stone knife) the penis and scrotum of adolescents entering manhood.
One soundtrack ("trauma") stressed the emotionally disturbing elements of the ritual, a second one ("denial") stated that, contrary to what one would expect, neither significant pain, harm, or distress resulted. The third soundtrack ("intellectualization") was meant to lead to a more detached and intellectualized way of looking at the films.
The results showed that during the trauma soundtrack both physiological and psychological reactivity was increased. The denial and intellectualization conditions, in contrast, gave evidence of reduced distress.
In later experiments, (*e.g.*, Lazarus and Alfert, 1964; Lazarus *et al.*, 1965) it was revealed that the specific sound tracks were even more effective in reducing stress reactions when they were presented before the films were shown. The authors interpret these findings by introducing the concept of "short circuiting". This means that the appraisal is altered in such a way that the events, depicted in the films, seem less threatening. This changed appraisal was assumed to result from the fact that the threat was "short-circuited" by the orientation.
These results clearly show that manipulation of appraisal and reappraisal results in different levels of (both psychological and physiological) distress, when one is confronted with a potential stressful stimulus.

In the seventies a shift in interest can be seen in the publications of Lazarus. The emphasis was placed more on the way people deal with their stressors. According to Lazarus, coping is very important with respect to health, well-being and social functioning (Lazarus and Launier, 1978; Roskies and Lazarus, 1980). Coyne and Holroyd (1982) distinguish at least four pathways through which coping might influence health. In the first place, this influence may exert itself because coping affects the frequency, intensity and possibly the character of the physiological stress responses of an individual.
Second, certain physiological symptoms may be learned or maintained because they serve coping functions. Here one has to think of individuals - unable to manage stress psychologically - who develop an elevated blood pressure in order to produce the sedative-like effects of

baroreceptor stimulation. Another example is that illness or illness behavior serves stabilizing functions in families in conflict, or is maintained by secondary gains and reinforcements.
Third, a very important contribution to the onset of disease may be made when, in response to stress, people assume a very unhealthy way of life (*e.g.*, increase of smoking, alcohol use, drugs abuse, little sleep).
Finally, Coyne and Holroyd (1983) mention that the way an individual copes with the threat of acute illness or with the demands of chronic illness can be an important determinant of the course of the illness and of the medical care that is received.

1.5. *Conclusion*

In summary, it has been shown that, after a flourishing period of more physiologically oriented stress research, investigators became aware of the fact that not only physical stimuli, but also the psychosocial situation can be a source of stress. This resulted in the life-event approaches. At the same time, the importance of broad psychosocial aspects was emphasized. This led to the attention on the psychological state of the subject and the subjective interpretation of the objective environment.
To put it another way, there was a remarkable shift in attention toward processes on the input side as well as appraisal and coping processes intervening between stressful stimuli and the stress responses. As an illustration of this, the "Michigan" model (Caplan, 1971; French and Caplan, 1972) may serve. In this model (actually restricting itself to the work situation), six groups of variables are distinguished: the objective environment; the subjective environment; the individual stress reactions; the ultimate consequences (health related variables); personality variables; and aspects of the direct social environment. For a more extensive discussion of the pros and cons of this model the reader is referred to Kleber (1982).

As Mikhail (1981) has pointed out, the next step has to be the integration of psychological and physiological theories. In the remainder of this book I will elaborate on Mikhail's attempt to integrate the theory of Lazarus and of Selye. Therefore, it is necessary to have a good understanding of the theory of Lazarus (especially his concepts of appraisal and coping), whereas the same holds for the theory of Selye and more recent developments in physiology. Before presenting our alternative, special attention will be paid to coping (as conceptualized by Lazarus), and to recent findings and developments in psychobiological stress research.

In the next chapter, attention is given to the concept of coping, its theoretical aspects and how it can be measured.

Chapter II

THE PSYCHOLOGY OF COPING

2.1. *Definitions of coping*

In many respects, trying to define "coping" leads to the same problems as trying to give a definition of "stress". Over the years, coping has acquired a variety of conceptual connotations, being commonly used interchangeably with concepts such as mastery, defense and adaptation (White, 1974).

Hamburg *et al.* (1953) used the concept to denote all the mechanisms utilized by an individual to meet a significant threat to his/her psychological stability and to enable him/her to function effectively. Coping refers to overt behavior as well as to intrapsychic processes that contribute to succesful adaptation to psychosocial stressors.

Pearlin and Schooler (1978) used the term coping to refer to any response to external life strains that serves to prevent, avoid, or control emotional distress. In their view coping can neither be distinguished from the distress experienced by the people nor from their inner state (*i.e.*, their emotions, thoughts).

Although Lazarus's theory with respect to coping will be dealt with more extensively later on, now I'd like to consider one aspect of it: his distinction between two main modes of coping, namely, (1) those coping activities that fundamentally entail direct action on the self or on the environment, and (2) those ones that function primarily through intrapsychic processes. The first is referred to as *Problem focused* (P) coping, the second as *Emotion focused*(E) coping.

Another approach to the concept is offered by Levine *et al.* (1978). Their definition is based on the reduction of the physiological arousal evoked by a stressful encounter. Or as Levine put it bluntly "coping is when my stomach does not hurt" (*cf.* Levine *et al.*, 1978).

In experimental psychophysiology, the term coping has been used as well, although often in a rather restricted sense, *e.g.*, to denote behavioral orientations towards laboratory stressors. Obrist and his co-

workers (*cf.* Obrist, 1981) use the term to denote the degree of control people have over an aversive stimulus in an experimental situation. Classical conditioning paradigms are referred to as inducing "passive" coping (because nothing can be done to avoid the aversive event), whereas in avoidance procedures the term "active" coping is used.
Henry (1976) and Henry and Stephens (1977) also made a distinction in coping patterns, where the dimension "active versus passive" plays an important role. These authors speak of "fight-flight" and "conservation-withdrawal", as two ways of dealing with stressors. Later on I will discuss the Henry and Stephens model more extensively.

Several authors emphasize the difference between coping and defense. Stagner (1981) states that the term coping should be restricted to actions directed at specific aspects of a certain stressor; the term defense, in contrast, has to be reserved for behaviors which relate to nonspecific ways of dealing with stressors.
Haan (1963) and Kroeber (1963) have developed a conceptual model of coping and defense. This model assumes coping and defense to occur in pairs; each represents aspects of ego functioning. Thus, coping and defense are distinguished on a qualitative basis. Coping refers to a rational evaluation of the situation. Characteristic are undistorted perceptions and a realistic approach of the problems encountered. In contrast, defense can be distinguished on the basis of distorted perceptions leading to irrational and often ineffective decisions.

Obviously, it seems mandatory to further conceptualize coping before studying it in concrete experiments.

2.2. *Psychological approaches of coping*

Folkman and Lazarus (1980) and Folkman (1982) present a discussion of three perspectives of coping, on which modi of measurement can be based.

The first conceptualizes coping in terms of *defensive* or *ego processes*. In this approach, coping is classified hierarchically with respect to maturity or pathology on the basis of clinical judgement. The problem, however, is that the evaluation can only be based on certain behavioral criteria. This necessarily leads to a confounding of outcome and process. Folkman and Lazarus give as an example the study by Wolff *et al.* (1964) on the relationship between psychological defenses and urinary cortisol excretion in parents of children with terminal illness. Wolff *et al.* examined the relationship between the quality of the defense mechanisms used and hormonal levels. Unfortunately, one way to define the quality of the defense was evidence of lack of distress. It seems well established, however, that psychological distress ranks high among the stimuli that evoke release of corticosteroids from the adrenals (*cf.* Mason, 1975b). Because lack of distress both correlated with predictor (quality of defense) and criterion (cortisol level) it could be expected that one would find a positive correlation.
Another problem is the lack of interrater reliability in assigning qualifications of defense to ego processes. It appears impossible to formulate a set of rules, with which most clinicians can agree.

This lack of objectivity makes it hard to use this approach in research. A third problem arises when it is realized that coping is more than just defense. Defense is restricted to tension reduction and restoring psychological equilibrium, palliation, etcetera. Coping, however, refers to problem solving behavior as well, *i.e.*, concretely dealing with situations and/or persons.

A second way to conceptualize coping is the *situation-oriented* approach. Proponents of this approach describe how people deal with specific stressful situations such as diseases (*e.g.*, cancer, polio, burns) or changes in their psychosocial context (*e.g.*, fired at work, divorce, death of a spouse). The situation-oriented approach is especially characterized by ordering coping strategies in fuctional categories. To mention a few: seeking information; maintaining social contacts; maintaining self esteem; anxiety reduction; and palliation.
This approach clearly shows how its virtues at the same time can be disadvantages. Obtaining insight into the specific coping strategies of a particular context, does not allow to generalize to other situations. This is clearly illustrated in the study by Pearlin and Schooler (1978) and, more recently, by Fleishman (1984). These investigators studied coping strategies not for specific situations, but for several social roles: marriage, parenting, household economics and occupation. Seventeen coping factors were identified, each made up of at least three specific strategies. It appeared that some coping responses were used in all four role areas, whereas others were restricted to only one area. This clearly shows that there is both consistency and variability across situations.

A third perspective views coping as a *trait*. In this approach, emphasis is on personality characteristics that influence coping responses. Often, the traits are derived from defense theory. For example, the Repression-Sensitization scale (Byrne, 1964) and the Goldstein (1959) Sentence-Completion test are frequently used to distinguish coping strategies of particular groups (for example, Type As and Type Bs as done by Vickers *et al.*, 1981) or to distinguish groups beforehand on the basis of test results. For example, Speisman *et al.* (1964), in their film experiment, contrasted the reactions of subjects who were disposed to employ repressive-denial forms of defense, and those who preferred intellectualizing defense. Their results indicated that deniers showed more stress reduction as a result of the denial sound track as compared to their responses to the intellectualization sound track. Intellectualizers, in contrast, showed more signs of stress reduction when hearing the intellectualization sound track. A second example is the experiment by the Lazarus group (*cf.* Weinstein *et al.*, 1968) in which it was found that repressors and sensitizers greatly differed in physiological reactivity to stressful films. Sensitizers (those who are more apt to express their feelings) showed less physiological arousal, as compared to repressors (*i.e.*, those who repress their feelings).
Similar studies within this tradition have been carried out by Roesler (1973) who differentiated between people with high and low scores on the Barron Ego Strength (ES) scale. It was found that the high ES group excreted significantly more catecholamines prior to exams. Furthermore, their results also showed that there was increased physiological reactivity to a stressor film for high ES subjects. Roessler (1973)

interpreted this result as indicating that high ES subjects can better discriminate between various situations and, therefore, respond more appropriately at the physiological level, *i.e.*, more arousal to strong threat, less arousal to weak threat.
It has to be noted, however, that one cannot equalize ES (and other stable personality characteristics) and coping. Rather, personality characteristics may refer to adaptability or coping ability. In my opinion, this is a very important distinction. I fully agree with Lazarus that traits are poor predictors of specific coping processes. This however does not rule out the possibility that "good" copers and "bad" copers, according to some criterion, each share particular traits. Lazarus *et al.* (1974) refer to these traits as *coping dispositions*. They come to the following classification:

1. response-oriented dispositions (*e.g.*, tendencies to respond with anxiety, depression, or agression);
2. stimulus-oriented dispositions (these dispositions refer to the tendency for diverse responses to be organized around some stimulus object or goal);
3. theoretically oriented dispositions (these are more basic and general dispositions of a genotypic nature, such as cognitive style).

The problem, however, is that when one restricts oneself to only one (or a few) aspects of disposition, this does not do justice to the complexity of the coping proces. This is the major reason for Folkman and Lazarus (1980) to reject this approach altogether.

Summarizing, it has been pointed out that the concept of coping can refer to several perspectives. The first approach (ego processes) is not a very attractive one, because it is difficult to disentangle process and outcome. The situation oriented perspective can be classified as thorough but restricted, *i.e.*, this approach is so situation specific that one cannot generalize to other situations. The trait approach has its limitations as well, although, within the context of a specific research topic, this conceptualization may be fruitful. This approach is more appropriate for measuring coping abilities than for identifying concrete coping behaviors.

What obviously is needed are theories on coping that distinguish clearly between process and outcome, that allow for situation specificity without attributing the coping process entirely to the situation, and that are primarily directed at coping behavior rather than coping ability. Theories answering this description do not exist as yet. However, some recent formulations are promising. I am referring here to the views held by those studying interactions and transactions between person and situation (*cf.* Hettema, 1979).

2.3. *Hettema's conceptions of short term and long term adaptation*

Conceptually closely related to the concept of coping is the notion of psychological adaptation put forward by Hettema (1979) to describe the processes occurring between an organism and his environment. In his theory the so called control assumption takes a central position. This

assumption states that internal and external activities in the person-environment interaction are governed by the leading principle of acquiring and maintaining control over the environment. The theory states that, when the equilibrium between organism and environment is disturbed, so called state-transition (ST) mechanisms are set in motion. These ST-mechanisms may be considered ways of dealing with a given situation. Their primary function is to regain control over the environment. These activities may take place either at the cognitive-symbolic level or at the sensomotor-operational level.
In the first case, the alternatives are "reflection" ("going over the significance of experiences, facts or events"), "uncoupling" ("generating a new transformation rule to replace a rule that was chosen earlier"), and "redirection" of previously intended goals.
At the sensomotor-operational level, the alternatives are "exploration" ("searching activities in the environment"), "substitution" ("the insertion of alternative operations within the context of an existing plan"), and "persistence" ("repetition accompanied by trial-and-error behavior and by an increase in executional vigor").

In case of failure of the ST-mechanisms for short term adaptation, a strong increase occurs in the emotional state of the organism, often resulting in a disorganization of behavior. In such circumstances, instead of maximizing control, efforts are invested to minimize non-control. States of "fear", "helplessness" or "frustration" may lead to long-term adaptation, while codetermining behavior in environments similar to the one in which the disturbance had occurred for the first time. In this way, Hettema, rather than pointing to the maladaptive elements of enhanced emotionality, stresses the adaptive aspects of what at first glance may appear maladjusted and totally disorganized behavior.

2.4. *Lazarus's view of coping*

The conceptualization of coping by Lazarus cannot be seen outside the framework of his cognitive phenomenological stress theory. As already stated, Lazarus's theory stresses the importance of the transactional relationship between person and environment. This ongoing relationship of reciprocal action between both elements is mediated by the processes of coping and appraisal. Whereas appraisal refers to the process of evaluation with respect to what is going on and wat can be done about it, coping is defined as "the behavioral and cognitive efforts made to master, tolerate, or reduce external and internal demands and conflicts among them" (Folkman and Lazarus, 1980; p.223).
The functions of coping are twofold: (1) modifying aspects of the situation or of the self to remove the source of stress; and (2) trying to reduce the emotional impact of the stress. Much the same as the person and the environment are in a dynamic interdependent relation linked to each other, so is the relationship between coping and appraisal. Coping and appraisal mutually influence each other throughout an encounter, because, related to the coping efforts, the person-environment transaction is changed resulting in a new evaluation.
In addition, Folkman and Lazarus (1980) use the terms "coping processes". This phrase refers to what people actually do and think in a confrontation with a particular stressor and to the changes that occur

in such efforts as a consequence of new developments. Although Lazarus's theory can be judged as elaborate, a point of great concern is how to test it. It is characteristic that after 1965 all publications of Lazarus and his group are theoretical until 1980 when Folkman and Lazarus published their study on the analysis of coping in a middle-aged community sample. In that article, they have to confess that this is not all they want, witness their statement that they do not yet have a description of how coping develops over time. It would be of interest to follow the progress in their efforts to undertake this very ambitious task.
In the following paragraph, I want to speculate on underlying dimensions of coping behavior, next the various ways of measuring coping are considered.

2.5. *Preliminary attempt toward a categorization of coping behaviors*

Reviewing the literature on coping and related concepts - both the more clinically oriented and the experimentally oriented - it can be concluded that, among others (*e.g.*, coping versus defense), four important dimensions may be distinguished. However, a more close look reveals that these dimensions appear to have much in common. The relevant dimensions are: (1) active versus passive coping (Obrist, 1981); (2) "fight-flight" versus "conservation-withdrawal" (Henry, 1976; Henry and Stephens, 1977); (3) E-coping versus P-coping (Folkman and Lazarus, 1980); and (4) short term versus long term adaptation (Hettema, 1979). These dimensions all share one important aspect: "passive confrontation" versus "active manipulation". In the former case, the advantages are in the "here and now", whereas, in the latter case, the benifits must be searched for in the future. Active coping involves actively dealing with a stressor, aiming at removal either the event or the subject-himself away from the situation. With respect to passive coping, one can discern two different points of view, although both agree that the same objective is served: learning to deal more effectively with similar situations in future. But, whereas Hettema (1979) considers learned helplessness to be adaptive because it extinguishes inefficient behavior patterns, Henry (1980) points to the adaptive value of inhibition of action and palliation of emotions in order to lessen interference with the learning process. To quote Henry (1980): ".....the individual may gain much by submission and by experiencing depression associated with the loss of control. The depressed animal with high ACTH no longer competes but accepts the unpleasantness of frustration. He learns new behavior more rapidly than normal, and the new patterns he acquires will permit him to avoid lethal consequences of defying the dominant. By submitting he can remain with the group and increase his effectiveness in it and thereby continue to gain access to desired goals.(...)It (*i.e.*, lowered activity) enables the individual to learn fresh patterns of behavior while not interfering by competing. He (*i.e.*, the depressed animal) remains useful to the group by abandoning individualism and by following the lead of others who are more succesful".

Although the dangers of generalizing such hypotheses over species and, consequently, over classes of behavior are realized, I believe it is a valuable starting point for further research.

2.6. *How to measure coping?*

As will be clear, the theoretical position one takes and the measuring techniques one uses are strongly interdependent. In addition, it has to be noted that the objectives of different investigators and theoreticians are not always similar. For example, some investigators, and especially clinicians, want to know about the quality of coping (is it "mature" or more "pathological"). Others show more interest in the outcome of the coping behaviors (illness, maladjustment, physiological reactivity). And, finally, there are investigators who want to know how people deal with particular stressful encounters.

To give some illustrations of these approaches:

1. As mentioned before, Vickers *et al.* (1981) compared Type As and Type Bs and tested the hypothesis that Type As show more defensive (*i.e.*, irrational, illogical) coping patterns, whereas the Type Bs follow a more realistic approach.
2. Ursin *et al.* (1978) emphasize the physiological responses and the changes in physiological reactivity when one has been subjected repeatedly to a threatening stimulus. They take the position that the subjects cope well with a situation, if physiological responses no longer occur (even though the behavior may be inappropriate).
3. Another way of evaluation is a judgment whether the behavior allows the individual to carry out certain personally or socially defined goals and tolerate the stressful situation without disruptive anxiety or depression (again regardless of whether the behavior is socially desirable).

In general, it can be said that coping and coping effectiveness can be measured by several variables such as physiological, health related, and behavioral criteria. General coping predispositions frequently are measured by means of subscales of personality questionaires, such as MMPI or TAT. Situation specific thoughts and behavior are measured using specific questionaires or interview procedures (*e.g.*, questionaires for specific diseases such as asthma or cardiovascular disorder; waiting for biopsy; preparing for exams).

Other approaches are the ones used by Pearlin and Schooler (1978) and Folkman and Lazarus (1980). As already said Pearlin and Schooler used interviews for measuring the specific coping of people in four social roles: (1) marriage, (2) parenting, (3) household economics, and (4) occupation. Therefore they took a midposition on the dimension "situation specific versus general" coping.
The objectives of Folkman and Lazarus, when they developed their questionnaire for the measurement of coping, were: (1) to obtain information about specific coping behaviors for specific stressful encounters; (2) to obtain a description of coping processes, that were not based on outcome information; (3) to word items in such a way that they can apply to a large variety of situations, providing the possibility to make cross-situational comparisons; and (4) to develop a measuring device that can be used for both ipsative and normative designs.
This resulted in their Ways of Coping Checklist (WCC). This response measure contains 68 items describing a broad range of behavioral and

cognitive acts that can be used by people in stressful conditions. Furthermore, this checklist consists of two subscales for measuring both P-coping and E-coping. Therefore, until now, this WCC seems to be one of the most appropriate instruments to measure coping.

2.7. *Conclusion*

In short, in this chapter it was shown how "coping" is conceptualized in different ways. This also has implications for the measurement of coping.
It is concluded that the approach of Folkman and Lazarus (1980) seems rather promising, because it does not have the shortcomings of other approaches. In addition, the theoretical foundations of this approach (Lazarus's transactional stress theory) are rather firm. This also seems to hold for the distinction between E-coping and P-coping.

As previously mentioned, the WCC may be used both in ipsative and normative designs. However, there is one major restriction. Because the WCC asks for a specific situation, it may only be used in normative designs if the subjects all have experienced a similar situation. This often meets with practical difficulties. Therefore, it is unfortunate that, until now, no "general" version of the WCC or similar scales is available. This problem also has been recognized by Schreurs *et al.* (1984). In my opinion, such a general version would have two main advantages.

1. General coping preferences can be measured and used in research on the relationship between personality variables or specific psychosomatic disorders and these coping preferences (*cf.* Vingerhoets and Flohr, 1984).
2. By letting subjects having experienced a particular life event, fill in both "general" and "specific" versions of this coping checklist, an estimate may be obtained of the relative contribution of personality characteristics and the situation as determinants of specific coping behavior.

As far as is known, until now, no such research has been carried out, although the work of Fleishman (1984) approaches it. In the present study, I will address this topic by presenting some preliminary results concerning this problem.

Chapter III

PHYSIOLOGICAL APPROACHES IN STRESS RESEARCH

3.1. *Historical perspective*

As may be concluded from Chapter I, a review on developments in the psychophysiology and psychoneuroendocrinology of stress necessarily starts with the experiments of Selye and Cannon. The theoretical position of Selye has been discussed already. Therefore, this discussion is limited to the work of Cannon.

It has to be noted that Cannon was much more aware of the cognitive aspects of stress and emotions than Selye. Cannon was one of the most ardent critics of the emotion theory of James (1884). In short, the theory of James states that bodily and physiological changes directly follow the perception of an exciting stimulus, and that emotion is the mere perception of these changes. Thus, the cognitive qualities of emotions are *secondary* to the physiological reactions.
Cannon (1927, 1929, 1931) criticized this position on several grounds and formulated an alternative. His alternative differed in two important ways from James's theory. In the first place, Cannon suggested that the physiological state of arousal follows rather than precedes the cognitive aspects of emotions. Second, he was of the opinion that the physiological changes were independent of the quality of the emotion. This means that qualitatively different emotions such as anger, anxiety, and elation all should be accompanied by the same physiological changes. In addition, he pointed to the importance of the thalamus as the coordinating center in the brain for the visceral aspects of emotion.
Whereas Selye stressed the importance of the adrenal cortex releasing corticosteroids, Cannon especially paid attention to the adrenal medulla secreting the catecholamines (adrenaline and noradrenaline). Cannon suggested that the increased activity of the SNS and the accompanying enhanced release of catecholamines could be interpreted as an "emergency" reaction. The organism would then be prepared for overt action, "fight-or-flight". This hypothesis was inferred from the specific chang-

es that resulted from the increased sympathetic activity, all leading to a mobilization of energy and a redistribution of the blood flow from the intestines to the muscles.

No wonder that physiologically oriented researchers later on concentrated especially on just these two reaction systems: the adrenal medulla (Cannon) and the adrenal cortex (Selye). However, more recently, other response systems have been paid attention to as well. In the next section a review of the physiological systems involved in stress responses will be examined.

3.2. *The structure of the autonomic nervous system (ANS)*

Physiological changes related to confrontation with stressful stimuli involve both neural responses and hormonal responses. The neural responses are mediated via the ANS. The ANS generally is a peripheral, viscerally involved system. This, however, does not mean that these functions are not under control of the cerebral cortex. For example, the frontal lobe has an influence on the cardiovascular system and the intestinal tract by virtue of its connections with the hypothalamus. The hypothalamus, nevertheless, may be considered the main coordination center regulating ANS activity. In addition, important reflex centres (*e.g.*, the vagal centres) are located in the brain stem, where much autonomic activity is initiated under the controlling influences of the hypothalamus and higher structures.
The main function of the ANS is to regulate the internal milieu of the body to maintain optimal conditions despite the disruptions, caused by the continuous interaction with the environment. The ANS involves centers in the brainstem and spinal cord and the fibers to the organs that are innervated by the ANS such as internal organs, smooth muscles, heart and lungs.

The ANS has two divisions: the sympathetic branch (SNS) and the parasympathetic branch (PNS). These two parts of the ANS function for the most part antagonistically. This means that the effects of both divisions of the ANS on the organs they innervate oppose each other. For example, increased activity of the SNS results in a faster heart rate (HR) whereas enhanced vagal (= parasympathetic) activity leads to a decrease in HR. Initially, it was difficult to make a clear distinction between neural SNS effects and adrenal medullary hormonal activity, because the adrenal medulla, actually, is a collection of SNS cells. However, since the discovery of different receptor types within the ANS, insight into the specific actions of neural sympathetic activity, as well as of adrenaline and noradrenaline, has increased enormously. The main function of the catecholamines is to support and prolong the neural effects of SNS stimulation. Ever since Cannon, attention of psychophysiologists has primarily been directed to manifestations of increased activity of the SNS. For this reason, HR and galvanic skin level (GSL) (both under the influence of the SNS) have long been used as indicators of increased SNS activity, presumably reflecting a state of stress within the body.
More recently, however, in psychophysiology one has become aware of the following (related) facts: (1) As shown by Lacey (1959, 1967), not

all stressors uniformly lead to an increase in HR (and in some cases even a substantial decrease was found). (2) One overlooked the role of the PNS; for example, an increase in HR was nearly always considered to reflect enhanced SNS activity. However, this diminished HR rather could reflect a decrease in PNS activity.

The consequences were far reaching. In the first place, the results of Lacey could be considered evidence against the notions of both Selye and Cannon that stressors always trigger a nonspecific physiological reaction pattern. Second, a competition was started among psychophysiologists to discover noninvasive cardiovascular parameters that purely reflect adrenergic (= SNS) activity, or alternatively, parameters that could serve as an estimate of PNS activity.

Since it will take too long to discuss all the parameters extensively, I shall restrict myself to a short enumeration:

- Katona and Jih (1976) stated that the contribution of the PNS activity could be estimated from respiratory sinus arrhythmia.
- Obrist *et al.* (1972, 1974, 1978) proposed to measure contractile force of the heart as an index for beta-adrenergic influences on the myocardium. According to them this could be done by recording dP/dt at the carotid sinus. At the moment, this index in not used any longer as such.
- Simonov *et al.* (1975), Punch *et al.* (1976), and especially Heslegrave and Furedy (1979), and Furedy and Heslegrave (1983) promoted the use of the amplitude of the ECG T-wave as a valid indicator of SNS activity.
- Newlin and Levenson (1979) introduced (in psychophysiology) the use of "systolic time intervals", especially pre-ejection period to represent sympathetic tone of the heart.
- Steptoe *et al.* (1976), and Gribbin *et al.* (1976) were among the first to measure Pulse Wave Velocity (PWV), or its inverse Pulse Transit Time (PTT) as a beat-by-beat estimate of blood pressure changes. Obrist *et al.* (1979) also found an appreciable covariation with systolic blood pressure (SBP) changes. Their point of view is that this covariation is related to the influence of myocardial-inotropic activity on both variables. They therefore concluded that PTT provides a noninvasive continuous beat-by-beat measure of sympathetic influences on myocardial performance. Allen *et al.* (1981) found a substantial relationship between PTT and SBP with hypertensive patients.
  Other investigators, however, doubt the value of registrating PTT alone. For example, Weiss *et al.* (1980) used both changes in HR and PTT. Depending on the direction of the changes in both variables and their amplitudes, they inferred changed ANS influences on the cardiovascular system.
- Ever since the early work of Kalsbeek and Ettema (1963), there has been a growing interest in indices of heart rate variability (HRV). Recent research (*cf.* Mulder, 1980) suggests that only two time domain indices of HRV can be considered useful and valid. These are: (1) the number of fluctuations in the tachogram (N); and (2) the sum of the absolute differences between successive RR-intervals (S). Recently, ECG frequency domain measures attracted the attention of psychophysiologists (Mulder, 1980; Mulder and Mulder, 1981). Until now, however, the method has rarely been applied and interpretation of the results is controversial (*cf.* Settels *et al.*, 1982).

Several investigators, however, claim that the variations in power in a particular frequency band (the .10 Hz band, representing HRV due to blood pressure variations) may be used as a valid estimate of PNS influences on the cardiovascular system.

These are the cardiovascular variables most frequently used in psychophysiological stress research. In addition, recording palmar sweat activity (= GSL) is still popular. This variable in some sense is particular because the transmitter substance at the termination of the postganglionic sympathetic fibres regulating the activity of the sweat glands is acethylcholine instead of noradrenaline, which is the normal transmitter substance for postganglionic fibres within the SNS.
Other, less frequently used measures are respiration rate (RR), gastric motility, electromyogram (EMG) recordings, and there are some studies in which electroencephalographic (EEG) recordings have been made.
At the moment, however, there is a growing interest in endocrine indices. One possible reason is related to the rather generally accepted (but not yet proven) hypothesis that disturbances at the neuroendocrine level lay at the basis of somatic, and probably also psychological, disturbances caused by psychosocial stressors.
In the next sections a review on the findings of stress and endocrine variables is provided.

3.3. *The neuroendocrine system*

The integration center in the brain that controls the humoral system is the hypothalamus. However, the hypothalamus does not function autonomically. As pointed out by Bohus (1984), the hypothalamus is under the direct and indirect influence of many other brain structures and is also sensitive to feedback of several hormones.

If something stressful happens, the hypothalamus receives input from the cerebral cortex. This message can trigger a whole series of reactions. In the first place, as already said, sympathetic neural activity and release of catecholamines by the adrenal medulla is stimulated. Second, by a network of portal blood vessels via which blood flows from the hypothalamus to the pituitary, the hypothalamus also controls pituitary functioning by secreting "releasing factors" and "inhibiting factors" that regulate the secretion of the various pituitary hormones especially in the anterior part of this structure. Corticotropin releasing factor (CRF), for example, produced by various hypothalamic nuclei, acts on cells in the anterior pituitary to release adrenocorticotropic hormone (ACTH).

The pituitary gland consists of three lobes: an *anterior lobe* or *adenohypophysis*; an *intermediate lobe* or *pars intermedia*; and a *posterior lobe* or *neurohypophysis*. Although all three lobes mutually influence each other, each may be viewed as a separate gland.

3.3.1. *Adenohypophysis*

The anterior lobe of the pituitary is considered to be most productive, because it secretes at least six hormones. These all are peptides or glycoproteins. In this section, a short review is given on these hormones and their primary (physiological) functions. Later, the findings in stress research are considered.

The best known substance secreted by the adenohypophysis is ACTH. The major effect of ACTH is the regulation of the release of the glucocorticosteroids by the adrenal cortex. In addition, ACTH possibly exerts several primary effects on carbohydrate and fat metabolism (Schwandt, 1981).

Human growth hormone (hGH) has as its major action the stimulation of protein synthesis. Moreover, it decreases the rate of carbohydrate utilization, and increases mobilization of fatty acids and their use for energy. These actions also promote enlargement of the cells and increased mitosis with development of increased numbers of cells, leading to an augmented growth rate. Release of hGH is under the control of both releasing and inhibiting hypothalamic factors.

The third hormone is thyroid stimulating hormone (TSH) or thyrotropic hormone. It's primary action is to stimulate the release of the thyroid hormones (*e.g.*, thyroxine (T4) and triiodo thyronine (T3)) from the thyroid gland. As an extra thyroid effect, TSH stimulates lipolysis in adipose tissue, which is similar to the effects of growth hormone.

Furthermore, there are two gonadotropic hormones, luteinizing hormone (LH) and follicle stimulating hormone (FSH). These hormones regulate the secretion of sex-steroids. In males, LH controls the production and release of testosterone by the testes and FSH stimulates spermatogenesis. In females, LH and FSH stimulate the production and release of progesterone and estrogens (estriol, estradiol) by the ovary.
Estrogens predominate just prior to ovulation; progesterone prevails after ovulation and during pregnancy.

The last hormone to be considered is prolactin (PRL). This hormone promotes mammary gland development and milk production. PRL inhibitory factor until now appears to be the most important inhibitory hypothalamic factor controlling hormonal release by the pituitary.

3.3.2. *Pars intermedia*

The major hormone secreted by this part of the pituitary is melanocyte stimulating hormone (MSH). This hormone stimulates the melanocytes, which are cells that contain the black pigment melanin. In addition, MSH has well-defined extra-pigmentary actions on peripheral organs (Thody, 1980). Until now, however, little is known about the extent to which generalization of these findings in animal research is warranted to other species including man. For, although the pars intermedia is a well defined part of the pituitary gland in lower animals, it can hardly be recognized as a distinct entity in the normal human pituitary gland.

Recent evidence shows that, in the rat, this intermediate lobe, together with the anterior lobe, is involved in the release of endorphins evoked by stressful stimuli (*cf.* Berkenbosch, 1983). However, little is known about the relevance of this hormone for human (physiological) functioning.

3.3.3. *Neurohypophysis*

Unlike the other parts of the pituitary, this lobe has direct neural connections with the hypothalamus. At least two hormones are released in the neurohypophysis: anti-diuretic hormone (ADH) (also called vasopressin), and oxytocin. These hormones actually are produced within the hypothalamus, hence the name neurohormones.

ADH controls the rate of water excretion into the urine and in this way helps to control the concentration of water in the body fluids. Of minor importance are the effects on uterine contractions during the delivery and on milk ejection from the nipples. These last two functions, however, are the main functions of oxytocin.

3.3.4. *The target gland hormones*

For conciseness, consideration is limited to the best known hormones of the target glands, with special emphasis on those of interest for stress research.

The steroids released by the adrenal cortex are divided into two important categories: the mineralocorticoids and the glucocorticoids. The name "mineralocorticoids" points to their influence on the electrolytes of the extra cellular fluids, *e.g.*, potassium and sodium. The glucocorticoids have gained this name because of their effect on the regulation of blood glucose concentration. Aldosterone and desoxycorticosterone are the major representatives of the mineralocorticoids, whereas cortisol is the principal glucocorticoid.

The direct and indirect actions of aldosterone are too various and broad to encompass. Of major importance is its effect on renal reabsorption of sodium. Dysfunctioning of this process leads to a great variety of disturbances such as muscle paralysis, polydipsia and cardiovascular malfunctioning. The main effects of the glucocorticoids, in addition to their primary influence on carbohydrate metabolism, include: mobilization of amino acids from tissues; mobilization of fatty acids from adipose tissue; and anti-inflammatory effects.

The most important effects of the thyroid hormones are the stimulation of metabolic rate, growth, and heat production. They also appear to catalyze effects on the nervous system.

Apart from the relevance of testosterone for the development of primary and secondary sex characteristics (*e.g.*, distribution of body hair, baldness, voice), this hormone also influences the thickness of the

skin; the development of the muscles; basal metabolism; amount of red blood cells; and electrolyte and water balance.

3.3.5. *The catecholamines*

Release of the catecholamines is regulated by the hypothalamus and also independently by some parts of the cerebral cortex. The amount of adrenaline secreted by the adrenal medulla is about three to four times the amount of noradrenaline. That the results of plasma assays always show a larger quantity of noradrenaline is related to the fact that the major part of the plasma noradrenaline originates from the nerve terminals, where noradrenaline functions as a neurotransmitter.
Although both catecholamines have sympathicomimetic effects, there are some important differences between adrenaline and noradrenaline. Adrenaline clearly has a greater effect on cardiac functions (increased heart rate, greater contractility), whereas noradrenaline causes stronger constriction especially in the muscle vessels. In addition, adrenaline causes a greater increase in the metabolic rate of the body. This results in a general enhanced activity and excitability of most physiological systems. These differential effects of adrenaline and noradrenaline can be attributed to the already mentioned different receptor types within the ANS.

3.4. *Stress and endocrine variables*

The literature on stress and endocrine activity shows much variation in the use of hormones as dependent variables. Apart from purely technical and economical reasons, this difference may be explained by theoretical considerations.
Traditionally, most research concentrated on the adrenals using several derived variables for estimating both adreno-cortical and adrenal-medullary activity. For example, to obtain estimates of adreno-cortical activity one examined metabolites such as 17-ketosteroids or cortisol in urine and eosinophil counts in plasma.
As indices of adrenal medullary activity metabolites, the urinary samples of metanephrine and normetanephrine or 3-methoxy-4-hydroxy mandelic acid (VMA) were examined.

More recently, interest has been shown for other hormones such as hGH, PRL and testosterone. Because the studies using indices of pituitary-adreno-cortical or sympathetic adrenomedullary activity are too numerous to mention, and because some excellent reviews exist (*e.g.*, Kagan and Levi, 1974; Mason, 1972; Rose, 1980) for these variables, consideration is mainly on the most important findings.

3.4.1. *The pituitary-adrenocortical axis*

As previously mentioned, the first important discovery for psychoneuroendocrinology was the finding that non-physical stimuli could stimulate pituitary-adrenocortical and adrenal-medullary activity. Among the earliest studies were the effects of aircraft flights, the preparation for

surgical operation, examinations, and, in the late sixties, combat in Vietnam (*cf.* Mason, 1972; Rose, 1980).
An interesting finding is that even admission to a hospital or being brought into an unfamiliar laboratory for experimental study may cause significant cortisol elevations. Studies also showed that reassurance and briefing aimed at reducing feelings of ambiguity and uncertainty lessened adrenal cortical response to a novel situation.

The second finding of great importance was that, despite the fact that psychosocial stimuli are very potent in activating the adrenal cortex, great individual differences exist. These differences appear to be largely determined by the individual coping style and the appraisal of the situation.
For example, Poe *et al.* (1970) found that what was most important in predicting urine cortisol levels in young men during their first combat training in the army, was the degree to which those people were able to protect or insulate themselves (by whatever means) from the demands of the training and the threat and humiliation.
Katz *et al.* (1970) also showed the strong impact of defense mechanisms on psychoendocrine functioning. They found that women, who underwent breast tumor biopsy for determination of potential malignancy, succesfully employed defense mechanisms such as denial or isolation to suppress cortisol production. Knight *et al.* (1979) also succeeded in predicting adreno-cortical activity in children during the first day after admission to the hospital. These investigators used interview and Rorschach data as the basis of information about coping strategies.

Rose (1980) concludes that individuals adapt or accomodate to most stressful situations, upon being re-exposed to them.
An example is the study by Bourne *et al.* (1967). It involved the measurement of urinary cortisol in helicopter medics who took care of medical evacuation flights. The results revealed that when those people were flying and facing the danger of being shot down, they did not excrete more cortisol as compared to when they remained at their base.
Another study by the same group (Bourne *et al.*, 1968) also yielded interesting results. In this instance, the study involved a group of soldiers who had intercepted a message that their camp was to be attacked by the Vietcong. Twenty-four hour urine samples were collected both before and during the period the attack was expected, and for several days afterwards. Although the attack did not occur, significant changes in urinary cortisol levels were found. The captain and the radio operator who both spent a lot of time passively waiting and communicating with the headquarters, showed enhanced cortisol levels on the day of the expected attack.
The enlisted men, on the contrary, being engaged in several task-oriented and problem solving activities showed a significant *decrease* compared to control values before and afterwards.
Vaernes *et al.* (1982) applying multivariate methods on endocrine reactions to an acute stress situation, found three factors: (1) a Cortisol factor, (2) a Testosterone factor, and (3) a Catecholamine factor. Significant correlations were found between the Cortisol factor and defensive mechanisms, as measured by several psychological tests.

It is surprising that Rose (1980) did not mention the concept "controllability". In my opinion, this concept may be useful to explain much of the findings with respect to adrenocortical activity. In Sweden, Lundberg and Frankenhaeuser (1978) and Frankenhaeuser *et al.* (1980) provided evidence that the pituitary-adrenal axis is especially sensitive to controllability. This means that (the feeling of) having control over the environment determines to a large extent whether the release of corticosteroids will be stimulated.
Therefore, in addition to the phrases quoted by Rose (1980) to demonstrate the internal dialogue of people who fail to show enhanced corticosteroid secretion in stressful situations such as "I've seen this before" or "The consequences of this are not very important to me" there should be mentioned statements as "This does not bother me, because I know exactly what to do" or "Everything is under control, so there are no problems at all".
Evidence in support of this is also provided by data of animal experiments (the "learned-helplesness" paradigm, Seligman, 1975) and clinical data (*e.g.*, Sachar, 1976) that show cortisol levels to be enhanced in the state of depression.
This point of view is further elaborated by Henry (1980) and Henry and Stephens (1977). These authors as well as Engel and Schmale (1972) call such a reaction pattern "conservation-withdrawal". According to them, in a social situation in which escape is not possible, an animal may gain much by submission. At that moment, the organism no longer tries to fight or flight, but surrenders to the situation, thereby developing a depressed emotional state. This passive state in which feelings of helplesness prevail is a potent trigger of adrenocortical activity.

3.4.2. *The sympatho-adrenal system*

Much the same as with the adrenocortical hormones, the earliest investigations focusing on adrenal medullary activity were aimed at establishing which (psychosocial) conditions affected catecholamine release (*cf.* Mason, 1972).
Then, the knowledge that two hormones were involved in sympathetic adrenal medullary activation raised the question whether these two hormones responded in a unitary way or were specifically responsive to stimuli of different quality. These studies, in general, confirmed Funkenstein's (1955) concepts that noradrenaline relates to active, aggressive emotional states, whereas increased adrenaline levels relate to passive, anxious states.
These results, however, have been challenged by the findings of Levi (1972) and others, who found, in agreement with the theory of Cannon, that *every* emotion is accompanied by enhanced sympathoadrenal activity. This controversy has not been resolved as yet although recently arguments in favor of a specificity conception have been put forward by several investigators (*e.g.*, Dimsdale and Moss, 1980 Henry, 1980, 1982; Kemper, 1978; Vingerhoets, 1984(b)).

Henry (1980, 1982) suggests that noradrenaline is increased when one is challenged by the environment and one is trying to make active efforts to achieve certain goals. This is in line with the conception of Mandler (1967), who proposes noradrenaline to be associated with cir-

cumstances in which relevant behavior is available to the organism. In contrast, excessive adrenaline responses can be obtained in situations which evoke feelings of anxiety and in which the uncertainty about what could be done predominates.

Whereas these results seem to illustrate a negative relationship between catecholamine levels and psychological functioning, the results of several other studies indicate moderately elevated catecholamines (especially adrenaline) to be a necessary condition for optimal performance. Several studies by the Frankenhaeuser group (for reviews, see Frankenhaeuser, 1971, 1975, 1976, 1980a,b) provide evidence that for performance to remain intact under difficult (stressful) conditions it is needed to "raise the body's thermostat of defense", resulting in enhanced adrenaline levels. In addition, their findings showed that, among normal healthy persons, those who secrete relatively more catecholamines, generally, perform better in terms of speed, accuracy, and endurance than those who secrete less. Furthermore, it appeared that the positive relationship between adrenaline levels and psychological efficiency is not confined to acute situations but also applies to general cognitive functioning.
The studies by Lambert *et al.* (1969), Johansson *et al.* (1973), and Bergman and Magnusson (1979) reveal a positive relationship between catecholamine excretion and school achievement and/or intelligence.
Other researchers dealt with the relationship between catecholamine output and personality variables. Among them are Roesler *et al.* (1967) who found, as already stated, that subjects high in Ego Strength excreted more catecholamines while anticipating exams.
Fine and Sweeney (1968) provide evidence supporting the hypothesis relating trait aggression to noradrenaline excretion. In accordance with the results of Silverman and associates (Silverman and Cohen, 1960; Silverman *et al.*, 1961), their data showed that individuals, high in trait aggression, excreted more noradrenaline than individuals relatively low in trait aggression.

More recently, several investigators paid attention to the relationship between the "Type A" behavior pattern and psychophysiological responding. The Type A behavior pattern can be described as a complex of behaviors, shown by persons "who are in chronic excessive struggle to achieve an unlimited number of things in the shortest possible time". Further characteristics are hostility, excessive and competitive drive, and an enhanced sense of time urgency. Moreover, it has been shown that this pattern is linked to the occurrence of clinical coronary heart disease (Rosenman *et al.*, 1975).
Differences were found between Type As and their behavioral antipodes (Type Bs) in catecholamine (especially noradrenaline) excretion, above all if the situation did appeal to their specific characteristics. During rest conditions often no differences had been found (*cf.* Vingerhoets, 1983).
Finally, the study by Ursin *et al.* (1978) is considered. These investigators applied factor analysis on hormonal data and found a Cortisol factor, a Testosterone-Free Fatty Acid factor and a Catecholamine factor, which all had different relationships to psychological variables. Individuals with high scores on the Catecholamine factor appeared to have much in common with the Type A personality. Characteristic traits of

this personality are activity, need, and impatience. These people appraise and cope with their problems well, untill the situation becomes uncontrollable. Then maladaptive and rigid behaviors predominate.

Taken together, the results of the above mentioned studies reveal that the catecholamines not only are important for adaptation at the physiological level, but also at the psychological level. For, performance in terms of (mental) speed, endurance and vigilance partly seems to be related to catecholamine (especially adrenaline) levels.
However, in stress states, levels increase so much that coordinated and controlled actions are no longer possible. Action proneness, aggression and irritation are accompanied by noradrenaline elevations, whereas excessive adrenaline responses are related to anxiety and unsurety.

3.4.3. *hGH*

Although it appears to be established that hGH is also responsive to a wide variety of stressful stimuli, the secretion of it is less specific than for cortisol or the catecholamines (*cf.* Rose, 1980). Rose suggests the dissociation between cortisol and hGH to be dependent on stimulus intensity. As an argument in favor of this statement he refers to evidence that hGH only responds if there are significant cortisol elevations, while the converse is not true.
It also has to be noted that the measurement of hGH is complicated because of the fact that the secretion occurs episodically in bursts, and hGH levels rapidly fall toward baseline (Brown and Reichlin, 1972; Brown *et al.*, 1978).

As it is impossible to make a general comment on the relationship between hGH and psychological variables, some recent studies are summarized.
Greene *et al.* (1970) studied patients during hospital admission for cardiac catheterization. On the basis of observation and interviews, patients were classified into the groups: (1) anxious-engaged; (2) anxious-not engaged; and (3) depressed and calm. Calm and depressed showed no increases in plasma levels of either hGH or cortisol, whereas anxious-not engaged persons showed increases for both substances. Anxious-engaged patients showed elevations of cortisol but no enhancement of hGH.
Although these authors suggest that their findings reflect different types of coping behavior, they unfortunately do not further elaborate on this suggestion.

Friedman *et al.* (1971) compared hGH concentrations in Type As and Type Bs, both in resting conditions and after a physiological challenge (arginine infusion). Their results showed that Type As excreted significantly less hGH under normal conditions. Moreover, after arginine infusion, their hGH responses were less than one half that observed in Type Bs.
Most interesting, however, was that these patterns appeared to be situation dependent. When Type As were retested under circumstances in which their intense behavior was minimized, their responses to arginine were similar to that observed in Type Bs. Conversely, when a Type B

subject was retested while being subjected to intense psychosocial pressures and challenges, no response of hGH was observed after arginine infusion.
These results led the authors to the conclusion that emotional stressors probably inhibit hGH release. These results complicate matters, because it has generally been found that hGH reacts to anxiety and distress with an increase, as is seen in the next examples.

Carruthers and Taggart (1973) exposed volunteers to extremely violent films and determined several biochemical and cardiovascular reactions. Their results showed that, in addition to an increase in parasympathetic activity, hGH levels were elevated. However, there were also indications of enhanced sympathetic activity, although these appeared to be overridden by the parasympathetic activity.

Another study using films as stimuli was carried out by Brown and Heninger (1975). All subjects viewed selected control, suspense and erotic films. An important conclusion was that growth hormone elevations occurred independently of cortisol elevations and no clear relationship to films or affect was found.

In 1976, Brown and Heninger inquired into the psychological characteristics, the subjective states, and the physiological variables that differentiate subjects who do and who do not release hGH during a stressful encounter. Their findings suggested that hGH release was not dependent on a particular psychological state at the time of the stressor, but rather they found a relationship with a trait measure, namely, field independence. In addition, they found higher "egotism" (self-involvement) scores in hGH responders.
This last result seems to corroborate the earlier findings of Greene *et al.* (1970) who found, as already indicated, that especially anxious-non engaged subjects were responsive.

Theorell *et al.* (1979) subjected twins to psychological and psychophysiological evaluation by means of a stressful interview. In addition, relationships between personality traits and psychophysiological variables were investigated. One of the most interesting findings was that the more aggressive subjects exhibited a significantly less hGH response to a stressful interview as compared to the less aggressive healthy subjects.

Considering the previously mentioned results, I will put forth a preliminary hypothesis with regard to hGH secretion.
Gellhorn (1965, 1970) elaborated on the work by Hess (1957) and also makes a distinction within the ANS between a trophotropic and an ergotropic division. Activation of the trophotropic system is accompanied by: (1) enhanced parasympathetic activity; (2) increased hormonal activity of the so called "anabolic" (Mason, 1972) hormones (*e.g.*, insulin, hGH, and glucagon); (3) a low frequency/high amplitude EEG; and (4) a decreased muscle tone and decreased activity.
Activation of the ergotropic systems, in contrast, leads to: (1) increased sympathetic activity; (2) a high frequency/low amplitude EEG; (3) release of "catabolic" hormones (*e.g.*, the catecholamines); and (4) enhanced muscle tone and increased activity.

It is interesting that many studies were carried out in medical settings: cardiac catheterization (Greene *et al.*, 1970), venipuncture (Vingerhoets, 1984) and injection (Greenwood and Landon, 1966). These medical settings preeminently evoke trophotropic responses, in some cases resulting in syncope (Engel, 1962, 1978; Sledge, 1978; Vingerhoets and Schomaker, 1984, 1985). A similar reaction pattern was found by Carruthers and Taggart (1973) in subjects while viewing violent films.
Careful analysis of the psychosocial aspects of fainting learns that this reaction pattern frequently occurs in men with a particular disposition, when they want to escape from or avoid a particular situation but then realize that there is no real escape possibility. This induces a state of hopelessness and helplessness, or as Engel (1962, 1978) called it psychological "giving up", at the biological level being accompanied by the "conservation-withdrawal" reaction which is characterized by a strong trophotropic excitation (Engel, 1978; Vingerhoets 1984; Vingerhoets and Schomaker, 1984).
Gellhorn (1970) states that the trophotropic and ergotropic system are more or less in a balanced reciprocal relation so that when one becomes more active, the other becomes correspondingly inhibited. This seems to fit in with the findings that Type As (Friedman *et al.*, 1971) and more aggressive people (Theorell *et al.*, 1979) show dominance of the ergotropic system and therefore also secrete less hGH.
Moreover, Vingerhoets (1984) showed that people who faint secrete a large amount of hGH, whereas Babcock and Powell (1982) provide evidence that aggressive imagery is effective to offset syncope. This leads me to suggest that hGH is especially sensitive to feelings of hopelessness and helplessness (as indicated by Rose (1980) very similar to cortisol), whereas, on the other hand, aggressiveness or, more broadly, action-proneness inhibits the secretion of this hormonal substance.

3.4.4. *Testosterone*

Lay people often believe testosterone to be related to virility or other indices of sexual interest or functioning. In addition, a relationship between testosterone and aggression is often suggested.
In this section, an investigation is given into the scientific research with respect to the association between testosterone and psychological variables. Similarly to hGH, the picture emerges as a a blurred one. Unlike most other hormones, testosterone levels usually fall following exposure to stressful stimuli. However, in the literature other studies are reported indicating that the first response of testosterone is an increase rather than a decrease (*cf.* Davidson *et al.*, 1978).

Rose *et al.* (1969) and Rose (1969) published the earliest reports dealing with androgen responses to psychological stressors. The subjects were servicemen during their first month of training in the army, and again, the servicemen in Vietnam under threat of attack. In both cases, relatively low levels of urinary metabolites of testosterone were found.
Kreuz *et al.* (1972) and Aakvaag *et al.* (1978) compared plasma testosterone levels of servicemen during the first days of combat training and during a control period. Again, evidence was provided that psychological distress can suppress plasma testosterone levels.

Interesting experiments with testosterone levels as dependent variables were carried out by Mazur and Lamb (1980) and Elias (1981). Mazur and Lamb (1980) tested whether human males' plasma testosterone levels change when their status changes. Their operational definition of change in status was winning or losing a tennis match. As control condition, they arranged a lottery also yielding winners and losers.
Their results showed that most decisive winners of matches showed subsequent rises in testosterone levels relative to the losers of those matches. Contrary, winners in close matches, in which there was no clear cut triumph, did not show increases in testosterone. In the control condition (the lottery), no significant differences were found between "losers" and "winners".
In addition, measurements in a natural setting were obtained. Enhanced testosterone levels were found among new recipients of the MD degree 1 and 2 days after the ceremony. These results also emphasized the importance of the subjects' mood. Mazur and Lamb (1980) concluded that when males achieve a rise in status through their own efforts, and they have an elation of mood over the achievement, then often an increase in testosterone can be observed.
Similar results were obtained by Elias (1981), who studied the activity of the pituitary-gonadal axis in wrestlers. Their findings indicate that, generally, losers had lower post-match levels of testosterone than winners.

Most research, however, has concentrated on exploring the relationship between testosterone production and indices of aggression and hostility. Persky *et al.* (1971) demonstrated a striking correlation between testosterone and hostility as measured by the Buss-Duskee Hostility Inventory. However, in later studies their findings could not be replicated (Meyer-Bahlburg *et al.*, 1974; Monti *et al.*, 1977; Persky *et al.*, 1977).
On the contrary, other measures of aggressiveness have been reported to correlate with testosterone. To mention a few, Kreuz and Rose (1972) studied a young criminal population and found a significant correlation between conviction for violent and aggressive crimes and testosterone production.
Ehrenkranz *et al.* (1974) showed that prisoners qualified as aggressive or as socially dominant had significantly higher testosterone levels than those categorized as non-aggressive.
More recently, both Olweus *et al.* (1980) and Scaramella and Brown (1978) found a relationship between plasma testosterone levels and self-reports of responses to threat. In addition, in the study of Olweus *et al.* (1980) lack of frustration also appears to be related to testosterone levels.
Kedenburg (1979) tried to explain these conflicting results by referring to stress as a moderator variable. He simply states that sometimes positive correlations will be found, not because these variables are causally linked, but because there is a negative association between, on the one hand, stress and testosterone production, and, on the other hand, between stress and aggressiveness.

Bosak Houser (1979) examined the relationship between plasma testosterone and various measures of behavior, affect and physical discomfort. A remarkable finding was that central nervous system motor functioning was observed to deteriorate with increases in testosterone,

as illustrated by an increase in hand unsteadiness and reaction time. Moreover, positive affect appeared to be *negatively* correlated with testosterone. This author concluded that both affect-endocrine and behavior-endocrine relationships may exist across individuals but not (or to a lesser degree) within individuals.

The study by Daitzman and Zuckerman (1980) indicated that normal males, who scored high at the disinhibition subscale of the sensation seeking scale had elevated testosterone levels. The results also showed testosterone to correlate positively with measures of sensation seeking, impulsivity and heterosexual experience. Persons low on testosterone and estradiol were characterized by a high degree of self control and social conformity.

The above review clearly illustrates that it is impossible to draw any valid conclusions concerning the relationship between testosterone and psychological variables. Most evidence is in favor of lowered levels in periods of stress, whereas production is increased during a (positive) change in status. Finally, there is some evidence supporting the hypothesis of enhanced levels during aggression. It has to be noted, however, that only studies have been reported in which aggression was defined as a *trait* measure. As far as is known, no data (for humans) are available with aggression as a *state* measure.
A parsimonious, and therefore attractive, hypothesis is the one put forth by Vingerhoets (1984b). This formulation states that the association between testosterone and aggression only holds in case that aggression succesfully has been applied to attain a higher status.

3.4.5. *PRL*

Only since 1970 have radioimmuno assay methods of sufficient sensitivity been available to determine PRL in human plasma. Therefore, it is a variable without tradition in stress research. This may explain why, until now, rather few studies on psychological stressors have been carried out using PRL as a dependent variable. Among the first ones are the studies by Frantz and associates (Frantz, 1978; Frantz *et al.*, 1972; Noel *et al.*, 1972).
Their most interesting results concern the finding that during surgery, especially for women, PRL levels showed significant elevations. The same held for gastroscopy, whereas during proctoscopy less marked rises were found. In addition, significant elevations did occur during exercise, and, for some female subjects, during sexual intercourse.
Although the authors conclude that PRL is sensitive to psychological stressors, caution is needed because in the conditions in which the highest values were found, medication was administered. Moreover, recent studies (Nesse *et al.*, 1980; Johansson *et al.*, 1983) fail to find increases in PRL during and after the exposure to psychological stressors such as a flooding therapy and an examination for medical students.
In contrast, women also may respond to gyneacological examination with an increase in PRL (Koninckx, 1978). Most provocative for PRL release, however, seems to be the stimulation of the nipple both following child-

birth and during sexual activity (unrelated to the psychological characteristics of the setting) (Boyd and Reichlin, 1978).
A last finding of importance is that serum PRL levels also are raised after the administration of chlorpromazine and other antipsychotic and tranquilizing drugs. Therefore, it is difficult to conclude that PRL is a stress hormone, comparable to cortisol or the catecholamines.

These findings argue for the preliminary hypothesis that PRL is released when the body is involved (both in a positive and a negative sense) rather than when one is confronted with purely psychological stressors.

4.5. *Concluding remarks*

The fact that restriction has been to the hormones discussed above does not imply that other endocrine systems do not react to psychological stressors. On the contrary, animal research has shown the importance of the thyroid hormones, insulin, aldosterone, MSH, and also of the newly found peptides such as endorphins, enkephalins, and substance P.
However, until now, studies on the effects of psychological stressors on these endocrine systems in "normal" individuals are not numerous enough to allow clear conclusions.
Given the fact that the brain regulates activity of most, if not all, endocrine systems, either directly or indirectly, there is little doubt that the release of other hormones will be influenced by stimulation of a psychological nature. Most interesting, then, is to study multihormonal patterns as suggested by Mason (1975b,c).

Until now, maybe because of economical reasons, there are few such studies with (groups of) humans as subjects. Therefore, much experimentation is needed to disclose the riddles of psychoneuroendocrinology.

Chapter IV

THE PRESENT EXPERIMENT.

4.1. *Toward a general stress model*

In the preceeding chapters, I have attempted to give a review on the developments in stress research. It was shown that in the early stages of stress research, physiological and psychological traditions developed as separate branches.
The psychological approach stressing the broad psychosocial context, the subjective elements, and the relevance of cognitive processes restricted itself mainly to the input side. On the output side, interest was shown for psychological responses such as anxiety, depression, rage, as well as behaviors such as addiction, alcohol abuse, suicide, and diminished cognitive functioning.
The physiological approach, in contrast, explored the physiological changes in response to stressors such as hunger, cold adaptation, in short, physical stressors. Gradually, however, it became obvious that psychological stressors also were able to elicit physiological responses, and, in contrast, that a given physical stressor not always leads to the same physiological reactions, depending on the relationship between stimulus and subject.
One of the best illustrations of the last statement is provided by the "yoked control" experiments in which the physical qualities of the stressor (*e.g.*, in case of shocks, frequency and intensity) are identical while the psychological characteristics differ. In such experiments, the physiological consequences for pairs of animals to shocks or aversive stimulation of a different nature are investigated. In a prototypical experiment one animal of each pair can avoid the aversive stimulation by making an operant response, whereas the partner has no control over the aversive event.
Weiss (1972) found that the passive rats (*i.e.*, those without control) had more gastric lesions and higher levels of plasma corticosterone, despite the fact that the shock frequency and intensity for both groups of animals were identical. Corley and associates (Corley *et al.*, 1975, 1977)

also found most pathophysiological disturbances (even cardiac arrest) in the passive animals (squirrel monkeys in this case).

This kind of experiments clearly stress the importance of psychological factors for the onset of pathophysiological reactions. However, it remains to be established whether such findings can be generalized to humans, and, if this is the case, to what degree and under which circumstances. Which conditions the stressors and the individual have to fulfill for pathophysiology to occur?
In an excellent review, Natelson (1983) showed that mammals respond to acute stressors in a species-specific manner. In addition, Natelson presented evidence for the hypothesis that exposure to stressors never is a sufficient explanation for the onset of illness in healthy organisms. According to his view, potentially lethal symptoms only occur when overt or covert disease exists or when a predisposition for disease exists. This point of view is in line with Engel's position (Engel, 1978). Engel proposed that cardiac arrest and vasovagal syncope are manifestations of the same underlying (vagally-induced) physiological processes. The outcome, however, will be determined by the health status of the myocardium.

Therefore, physiologists and psychologists have come to realize that in order to study psychosomatic phenomena cooperation is needed. At that moment, they were forced to merge. Yuwiler (1976) notes that this fusion, given their conceptual divergences, was not easy and is still far from complete. This position is still reflected in research orientation and in interpretation of data. Whereas psychologists were mainly interested in the structure of coping and it's determinants, without paying attention to the implications for and relationships with physiological functioning, physiologists mainly concentrated on the physiological changes that occur during states of stress and restricted themselves to the well-known laboratory stressors which are able to provoke physiological stress reactions. Only in exceptional cases, investigators showed interest in the mediating effects of coping, or, more generally, psychological processes.

A similar distinction can be seen in the life stress-illness research. Considerable epidemiologically-oriented research has been done using questionnaires for measuring life stress and health related variables. In contrast, (psycho)physiological research is mainly restricted to the well known laboratory stressors with students as subjects, whereas there are hardly physiological data available of people who are at high risk for disease because they experienced many stressful life events, or because they had experienced a particular stressful life event. Such data would be a valuable contribution to human stress research, especially because then the problems with the criterion variables (as mentioned in Chapter I) may be circumvented.
As far as is known, the only exception is the study by Pardine and Napoli (1983). These investigators administered a life-stress measure to students. High and low stress respondents were selected for taking part in an experimental study involving a laboratory stressor. Their results showed a differential reaction pattern for heart rate and blood pressure during the recovery period.

High life-stress respondents maintained elevated levels throughout recovery, whereas the low stress group rapidly returned to pre-stressor baseline levels. The authors showed their data to be consistent with evidence suggesting that the confrontation with stressors creates wear and tear of the organism by interfering with mechanisms that normally operate to effectively demobilize resources in post-stress periods (*cf.* Frankenheauser, 1975).

A major reason for this lack of research may be the absence of stress models dealing in detail with both the psychological and physiological aspects. Mikhail (1981) is one of those who realize that an integration of "old" (psychological and physiological) theories to a new one is important for scientific progress.
Henry and Stephens (1977) present an overview of the developments until 1977. To mention the best known models: Rahe (*cf.* Rahe and Arthur, 1978) presents a model that uses optical lenses and filters to illustrate the various steps along the pathway from nervous excitation to pathophysiology. This model shows that past experience and psychosocial defenses may filter or change the impact of life changes (some increasing others diminishing). It, however, does not elaborate on the coping process. Unfortunately, Rahe restricts the term coping to conscious response management practices designed to reduce bodily symptoms. In contrast, in their model, the definition of defense is limited to unconscious, almost reflexive protective shielding from the environment. Only those defense mechanisms such as denial, displacement, repression are seen as efficacious in protecting the individual from physiological arousal. In addition, the model lacks an elaboration with respect to the specific physiological changes that may occur, and that eventually may result in bodily complaints.

Another popular model is the one presented by Kagan and Levi (1974). This model recognizes the combined effect of psychosocial stimuli and the psychobiological program as determinants of the stress response. In addition, "interacting variables" (intrinsic or extrinsic, mental or physical factors) are responsible whether or not stress will ultimately lead to disease. A psychobiological program is defined as "a propensity to react in accordance with a certain pattern *e.g.*, when solving a problem or adapting to an environment." As determinants of this program, one must think of genetic factors and earlier environmental influences. It is remarkable that the term coping is not used in this model. Presumably, "coping" is included in the psychobiological program as well as in the interacting variables. Kagan and Levi also do not specify the relationships between psychology and physiology. It looks as if these authors adhere a strict "nonspecificity" view, witness their statement that "it is generally agreed that adrenal cortical stimulation occurs in response to a variety of psychosocial stimuli, but that the hypophyseo-adrenocortical system reacts more slowly and requires somewhat higher stimulus intensities before reacting than does the hypothalamo-adrenomedullary system" (p. 228).

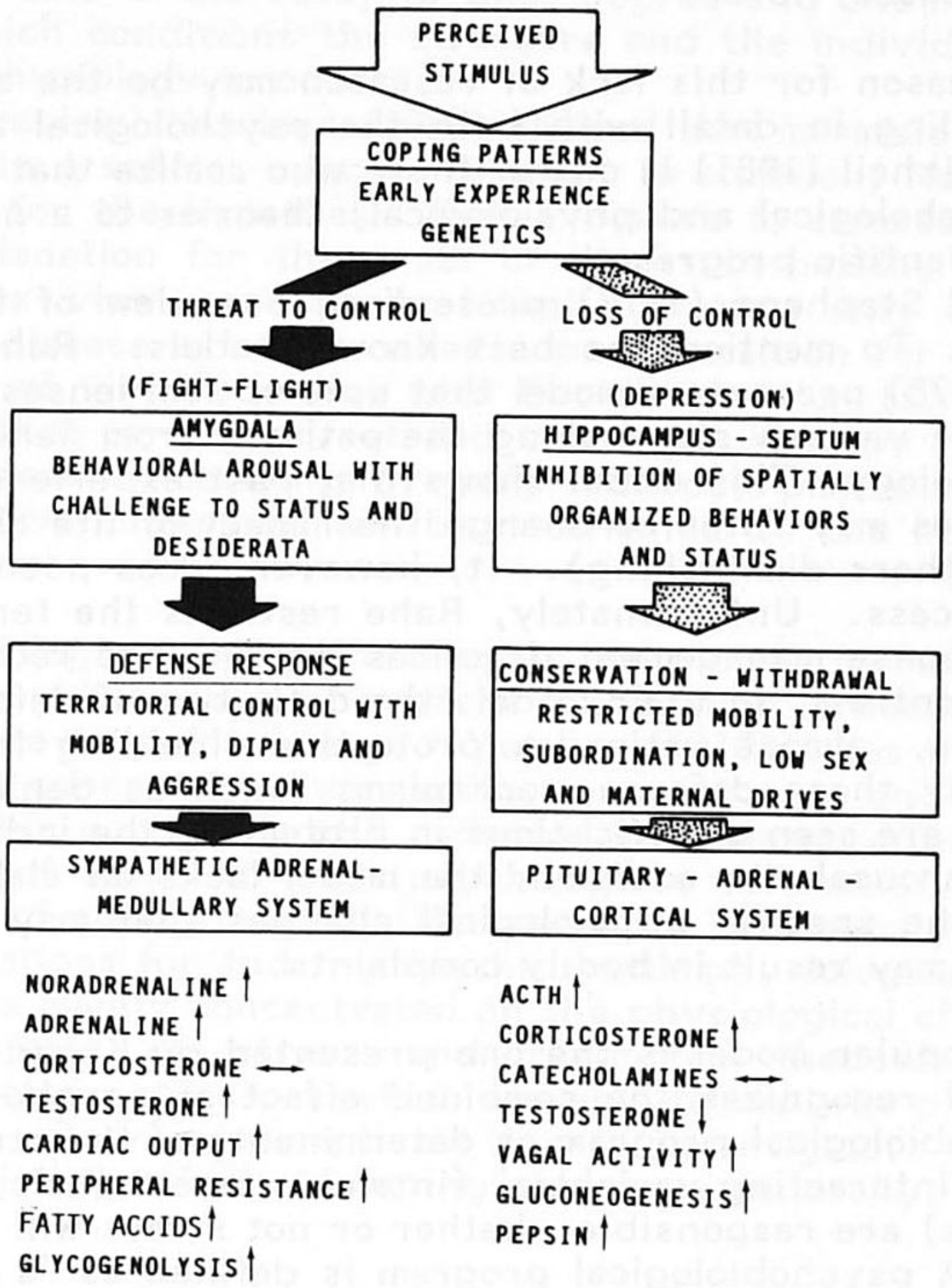


Fig. 4.1: Schematic representation of the model of Henry (1967, 1980) and Henry and Stephens (1977). Dependent on the outcome of the 'appraisal' processes, two possible responses may ensue. When the organism is challenged in its control of the environment, the amygdala and the sympathetic adrenal-medullary system are activated. On the other hand, when there is loss of control because the organism has no adequate (active) coping response available, the hippocampal pituitary-adrenal cortical system becomes more involved and the conservation-withdrawal response is triggered. Each response has its own characteristic biological pattern as shown. (Reproduced with the permission of Geriatrics).

Henry and Stephens (1977) (*cf.* Fig. 4.1) consider this same model, resulting in a more definite variant. More precisely, they specify the relationship between "coping" and physiological functioning. As can be seen in Fig. 4.1, they make a distinction between two coping responses: "fight-or-flight" and "conservation-withdrawal", each with a specific physiological reaction pattern. This makes the model attractive. However, it has to be noted that this model is much more elaborate on the physiological (output) side than on the psychological (input) side, although their concepts of "threat to control" and "loss of control" seem to be related to Lazarus's concepts of threat and challenge.

I am of the opinion that this model is the most concrete comprehensive to date. Integration of this model with Lazarus's stress theory may yield a more valuable starting point for the exploration of physiological responses as a function of coping style in humans than the integration of the theories of Selye and Lazarus, as suggested by Mikhail (1981). Obviously, it then will be necessary to undertake an attempt to make a shaded subdivision of human behavior into categories having similarities with the distinction in coping strategies, as made by Henry and Stephens. In Chapter II I already have mentioned some parallels between several categorizations of coping styles.
Human evidence in support of this model can be inferred from the research findings described in Chapter III. Henry (1980, 1982) also attaches great value to the findings in research with Type A subjects. These people frequently have been found to differ in the responsivity of their sympathetic adrenal-medullary and pituitary-adrenocortical systems in the same way that dominant animals differ from subordinates. Looking at differences in physiological responses between Type As and Type Bs as caused by differences in coping reveals much about the relationship between psychological and physiological responses to psychosocial stimuli.

However, it must be realized that such (laboratory) research also has several disadvantages. Since laboratory stressors differ qualitatively from stressful life events, it is doubtful whether this kind of experiments can contribute to a good understanding of pathophysiological processes, brought about by psychosocial stress.
In the present study, I want to provide an alternative which possesses the advantages of both field research and laboratory research. Within this approach four aspects are of particular relevance: (1) the nature of the stimulation; (2) the subjects; (3) the measurement of coping style; and (4) the measurement of the physiological responses.
According to Lazarus's theory, for a stimulus to be a stressor, in the first place, the stimulus has to be appraised as "relevant", or, more precisely, as "negatively stressful" with respect to one's well-being. It may be assumed that those life events, which rank high on life event scales such as the SRE, belong to this category. I further assume that this not only holds for a direct, real life confrontation, but also for a confrontation with a symbolic representation of it, as shown by Theorell (1980) and Wolff and associates (*cf.* Holmes, 1978).
Lazarus's theory, however, states that not only the stimuli are of relevance. Of major importance is the relationship between the person and the stimuli. This leads us to choose for particular subjects, namely those ones, who really did experience a similar life event, as depicted

by the stimuli. If these conditions have been satisfied, Lazarus's theory predicts a state of stress to occur.
Adequate measurements of coping style and physiological reactions then allow for the study of the relationships between stress, coping, and biological functioning.

In the next sections, I will address and warrant the choice of the stimuli, the subjects, the measurement of coping style, and the biological variables, in more detail.

4.2. *Studying psychosocial stress: The stimuli*

Since I attach great value to controlling conditions and the possibility to create adequate control conditions, I looked for an adequate medium for the symbolic representation of psychosocial stimuli. The early studies by Wolff (*cf.* Wolf and Goodell, 1968) and the studies by Theorell and associates (*cf.* Theorell, 1980) show that, when being symbolically confronted with psychosocial stressors, patients may show pathophysiological reactions. Because it is often assumed that disturbances in the neuroendocrine system lay at the basis of such pathophysiological manifestations, it could be hypothesized that also with people, who are still in good health, physiological (and especially endocrine) changes will occur when being exposed to symbolic stressors.

However, the use of interviews appears to have several disadvantages. For example, the subject's overt behavior is not under control and there are other methodological problems of stimulus equivalence. In addition, several social psychological processes may exert their influence on psychological and physiological processes. A major problem also is that the subject has to talk. Recently, Friedman *et al.* (1982) showed that speaking greatly affects cardiovascular functioning.
An alternative could be the use of films as stimuli. The literature shows that films are rather frequently used in psychological and psychophysiological research to evoke emotions. Beside the already cited studies by Lazarus and his associates, several other investigators made use of this medium. Well known examples of studies using films as stimuli are those by Levi (*cf.* Levi. 1972). He exposed his subjects to films inducing different emotions such as fear, anger and euphoria. It was shown that, regardless of the quality of the emotions, urinary catecholamine output generally increased, while during a natural scenery film, decreases in catecholamines were found.
Similar studies were done by Handlon and his coworkers (Handlon *et al.*, 1962; Wadeson *et al.*, 1963). These investigators concentrated on the pituitary-adrenocortical axis, using cortisol secretion as a dependent variable. Significant elevations in plasma cortisol levels were observed during a war movie, whereas the viewing of Disney nature films, similarly to the Levi (1972) study, resulted in a marked decrease in adreno-cortical activity.
Other investigators also used films or television programs as stimuli. Wroblewski and Markiewicz (1973) measured urinary catecholamines after viewing a film containing emotional scenes. A marked increase in catecholamine excretion in the urine of the subjects was found (thus corroborating the results of Levi (1972)).

In contrast, Starlinger *et al.* (1969) found no significant change in the excretion of catecholamines after exposure of their subjects to a stressful film.
Carruthers and Taggart (1973) showed extremely violent films to their subjects, and made continuous ECG recordings during the exposure. In addition, they analyzed urine samples for catecholamines, and plasma samples for free fatty acids, triglycerides, cholesterol and glucose. Their results showed that both adrenaline and noradrenaline increased after the film, as did free fatty acids. Triglycerides decreased, whereas glucose levels and cholesterol remained unchanged. Remarkable was the finding that their index of parasympathetic activity, the "sinus arrhythmia" gap showed increased vagal activity during the violent films. To elucidate the factors underlying the biochemical changes, for a subgroup of the subjects, further hormonal estimations were made. Increases in hGH and decreases in glucagon were detected, whereas gastrin and insulin levels showed no changes.

That films can have a strong impact on psychological and physiological functioning is further shown by studies in which films are used as clinical tools. For example, Clemens and Selesnick (1967) used repeated exposure to a stressor film as a psychological method for evaluating medication.
Furthermore, Henderson *et al.* (1972) introduced the technique of psychological immunization by films for "systematic automated desensitization" of anxiety-prone groups. In this context, also the work of Folkins *et al.* (1968) and Davidson and Hiebert (1971) may be mentioned. Their results showed that repeated exposure to films could lessen the subsequent subjective and physiological responses to similar stressors. In both articles, it was emphasized that the effectiveness of such a treatment particularly lies in the repeated exposure or, in psychological terms, "cognitive rehearsal". This more clinical concept seems closely related to the aforementioned concept of "short circuiting" introduced by Lazarus and Alfert (1964).

A further example is the work by Hulleman *et al.* (1971), although there is one major difference with all studies mentioned above: things were really happening. These investigators made continuous telemetrical recordings during TV broadcasting of the world football championship (soccer) in Mexico, 1970. Heart rates and diastolic blood pressure increased during the game. Pulse pressure was narrowed and, during certain events, a decreased pulse amplitude was observed. Moreover, two subjects who had suffered from myocardial infarction had more arrhythmic episodes during exciting periods of a game.
These studies clearly show that films can be an adequate medium for the induction of emotions. This led me to decide in favor of films as stimuli.

Until now, however, this medium has never been used as a means for evoking rather person-specific emotions, by exposing subjects to films that have a special meaning for them. By doing so and measuring the coping strategies of the subjects as well as the biological reactions, it will be possible to study stress, coping and psychobiological functioning as related processes.
In the next section, I will concentrate on the subjects used in the present study.

4.3. *Studying psychosocial stress: The subjects*

In a transactional stress model, neither stimuli, nor subjects may be considered isolated entities. Consequently, special care must be taken in the selection of the subjects. For this reason, subjects were selected who recently had experienced a particular life event. Whereas in the foregoing section, I stated an opposition to the use of laboratory stressors in favor of a symbolic representation of real life situations, here I state my opposition to the use of students as subjects. Below I give short reviews of evidence that the experience of particular life events may lead to both psychological and physiological malfunctioning. Therefore, it seems appropriate to let such persons serve as subjects in investigations aimed at the study of the consequences of psychosocial stress. More precisely, I will concentrate on four life events, three of which rank high on the SRE (job loss, divorce, and bereavement), whereas the last one (hospitalization and surgical operation) also is recognized as an important source of stress, directly influencing the recovery process.

4.3.1. *Job loss and unemployment*

Although much research has been carried out showing negative features of employment including excessive responsibility, overload, bad working conditions, role ambiguity (*e.g.*, Kasl, 1982; Fletcher and Payne, 1980a, 1980b), this surely does not mean that unemployment by most people is considered not to be aversive.

In an Editorial in Psychological Medicine on the psychological aspects of employment and unemployment, Warr (1982) identifies six benefits of having a job: (1) financial gain, (2) outlet for physical and mental energy, (3) variety, (4) temporal structure, (5) social contacts, and (6) personal identity and status within social institutions.

Probably related to withdrawal of the positive features described earlier, the psychological impact of unemployment should not be underestimated. This seems to hold especially for people with high "work involvement", *i.e.*, the degree to which having paid employment is salient within a person's system of values (Warr, 1978; Stafford *et al.*, 1980).

A second important moderator seems to be "employment commitment", which is conceptually distinguished from involvement in one particular job. Employment commitment may be considered a component of the work ethic of the social environment (*cf.* Jackson *et al.*, 1983). In addition, just like in other stressful circumstances, social support has been reported to modify the relationship between unemployment stress and health variables (Gore, 1978).

Recently, Hagen (1983) has provided a review of studies concerning the relationship between job loss and physical and mental illness. A number of studies are cited showing a strong association between unemployment and several indices of psychological malfunctioning, *e.g.*, loss of self esteem, increased suicide rates, state prison admissions, state mental hospital admissions and increased incidence of physical illness.

In spite of the criticism of some investigators that caution is needed in interpreting such relationships, because the job loss could be the effect rather then the cause of the psychological disturbances (*cf.* Zimmerman, 1983), the conclusion that job loss and unemployment are associated with reduced psychological wellbeing and increased physical malfunctioning still seems warranted.

The only study relating job loss to several indices of physiological functioning has been carried out by Kasl and associates (*cf.* Kasl, 1982; Kasl and Cobb, 1980). Changes in serum cholesterol, blood pressure, body weight, cigarette smoking and pulse rate were examined in relationship to the stages (anticipation, closing of the plant, unemployment and reemployment) of job loss experience.
The results revealed that these cardiovascular risk factors did not at any moment show a level of risk exceeding the risk among controls. Cigarette smoking proved to be a stable habit, in no sense affected by employment status. The other risk factors (especially cholesterol) did show some evidence of being sensitive to the employment status changes. However, this was related to the low levels after reemployment rather than elevated levels during unemployment.
Another important finding was that indices of arousal in men continuing to remain unemployed tended to return to baseline levels parallel to those who were being reemployed at that time. This result suggests that the effects of job loss, on this level, were short lasting, and that a process of adaptation occurs such that those finding a new job could not be distinguished from the ones which remain unemployed.

Summarizing then, although there appears to be a host of evidence suggesting subversive effects for psychological functioning, until now no data are available, indicating changes in physiological functioning when being confronted with this particular stressor.

4.3.2. *Divorce and marital separation*

Divorce also appears to become a major mental health problem. Not only both partners but also the children do experience much distress. Almost irrespective of the quality of the marriage or of desire for its dissolutions, the disruption of marriage, in most cases, leads to emotional distress (Weiss, 1976).

Bloom *et al.* (1978) reviewed studies linking divorce to several indices of emotional and physical malfunctioning. Divorce and job loss, in this respect, seemed to share many features. Although also in this case, the possibility cannot be ruled out that divorce is the consequence, rather than the cause of psychological disturbances, this criticism cannot refute the result of many studies supporting the latter possibility.
Separated people are found to be overrepresented among the psychiatric patient population. In addition, these people are more likely to be involved in automobile accidents. Divorce and marital separation also is associated with higher rates of illness and disability, as well as higher death rates due to suicide, homicide, and disease mortality (Bloom *et al.*, 1978).

The stress symptoms most often reported by a divorced population are depression, weight loss, insomnia, nervousness, anxiety, anger, loneliness, and fear. Furthermore, confusion, guilt, indecision, panic, helplessness and disorganization were reported in the study by Dasteel (1982).

While many articles deal with the difficulties encountered by the children of divorced parents and their custodial mothers, some research especially focuses on the problems of divorced fathers (Jacobs, 1982). The most compelling problem for these fathers appears to be the sense of loss of their children.

While in some cases (*e.g.*, Greif, 1979) attention has been focused on physical symptoms following marital separation, such as weight loss, dental problems, hypertension, rheumatoid arthritis, and headaches, until now no research has been carried out with respect to the physiological and endocrine functioning of this group of people.

4.3.3. *Bereavement and grief*

Contrary to job loss and divorce, grief and bereavement have been the subject of study ever since the early publication of Freud, entitled: "Mourning and melancholia" (Freud, 1925). However, ethical considerations lay restrictions on this kind of research. In addition, the various theoretical frameworks within which studies on grief have been carried out do not allow generalization. This seems especially of relevance when trying to make a distinction between "normal" and "morbid" or "pathological" grief.

McFarland Solomon (1977) presented a survey of studies aimed at studying the normal grief process. Despite the differences between these studies (in part related to the different theoretical position) both psychological, somatic and behavioral aspects of the grief process undoubtedly give evidence of great emotional distress. Among the characteristic symptoms are digestive disorders, exhaustion, guilt, irritability, self-blame, difficulty in accepting loss, restless movement, loss of interest in personal appearance, and other symptoms manifesting psychological dysfunctioning.

Another indication of the enduring character of effects of grief is the finding that illness susceptibility among the bereaved has been found to be elevated. The same holds for mortality rate and mental health status (*cf.* Gallagher *et al.*, 1982; Jacobs and Ostfeld, 1977).

Much the same as for the life events mentioned already, for bereavement few data are available with respect to physiological and endocrine functioning. A major exception are the studies by Hofer and associates (Hofer *et al.*, 1972a,b). Restricted reviews are given by Fredrick (1971, 1977, 1983). In the studies by Hofer *et al.* (1972a,b), it was shown that parents of leukemic children showed changes in their urinary excretion of cortisol following the death of their children. Of major importance was the finding that overall group mean rates remained unchanged. Careful analysis, however, revealed this to be the result of

an interaction of people with low pre-loss values who increased their rates, and those with high rates during the illness who showed a significant decrease after the death of their children.
In addition, it was found that those parents who were more involved in the process of mourning and who gave evidence of more intense feelings of grief had excretion rates in the highest quartile.

Fredrick (1977, 1983) linked the increased activity of the pituitary-adrenal axis and the subsequent hypersecretion of corticosteroids to the suppression of the immune response in the bereaved as an explanation for the increased susceptibility for both physical and psychological disturbances. Given this restricted number of studies, it appears that much research has to be done to enlighten the specific (?) physiological changes, accompanying grief.

4.3.4. *Surgery and hospitalization*

Numerous studies and the relevant clinical literature document the stressful character of both hospitalization and surgery (*cf.* Mathews and Ridgeway, 1981; Johnston, 1980). Hospital-induced stressors include: unfamilarity of surroundings; lack of information; medication; and loss of independence. Differences in anxiety about hospitalization have been reported to be related to the personality of the patient and the hospital environment, rather then to be a function of the diagnosis or the physical status of the patient (Lucente and Fleck, 1972).

Volicier and Burns (1977) conducted a study to identify predictors of the hospital stressors that patients experience. Among the variables they studied were demographic characteristics, prior hospitalization experience, seriousness of current illness, and life stress preceding hospitalization. Their data reveal some interesting relationships.
Younger patients reported higher levels of hospital-induced stress than older patients. Also women reported higher stress levels than men. In addition, their data suggested that life stress prior to hospitalization might be an important factor determining the level of stress experienced related to hospitalization. Moreover, it was found that number of years since the last hospitalization was a significant predictor of hospital-induced stress. The same holds for seriousness of illness. In both cases, however, the results only hold for either medical or surgical patients. Only medical patients with recent hospitalizations reported more hospital-induced stress. In contrast, seriousness of illness was a hospital stress factor for surgical patients only, not for medical patients.

The practical aspects of this specific emotional state concern the hypothesis that there is a relationship between pre-operative anxiety and post-operative recovery. In addition, there is some evidence that, related to the disrupted physiological status of the patient, higher doses of pentothal for narcotic purposes are required (*cf.* Johnston, 1980).

Also with respect to this topic, some investigations have been carried out in which biochemical measurements are available. Among the first of those was the study by Price *et al.* (1957). These investigators collected both psychological data and measured plasma cortisol levels. The

major finding in this study was that nearly all patients showed elevated cortisol levels. However, complex relationships were detected between these levels and several indices of psychological functioning.
A similar study was done by Mason *et al.* (1965). These investigators also focused on corticosteroid responses to hospital admission. Their subjects were normal young adult volunteers. Nevertheless, their results showed, for most subjects, a peak in adrenal cortical activity on the initial day, followed by a consistent downward trend evident in successive, serial samples. Also significant associations were reported between cortisol levels on the admission day and several psychosocial factors such as confidence and experience of the ward staff, and previous experience away from home.
More recently, Czeisler *et al.* (1976) measured plasma cortisol every twenty minutes over 24 hours in patients on the day prior to coronary bypass surgery. Even during the evening and early night when cortisol levels normally are rather low, substantial increases were found when patients were prepared preoperatively. Similar results indicating that anticipation of a surgical event is a strong, provocative stimulus for activation of the pituitary-adrenal axis have been reported by Weitzman *et al.* (1971).

To summarize, hospitalization clearly may be considered a stressfull event although the degree it will be rated as distressing as well as the endocrine reactions appear to be influenced by many psychosocial factors.

4.4. *The measurement of coping*

Taken into account the considerations put forward in Chapter II, I chose for the measurement of coping by using a modified version of the WCC. The main reasons for this option are: (1) that the distinction between E-coping and P-coping seems to be theoretically well founded; and (2) that this distinction allows for testing hypotheses with respect to the relationship between coping and biological functioning. In the following sections, these topics will be dealt with in more detail.

4.5. *The biological variables*[1]

The choice of the biological variables was determined by the intention to have both variables reflecting activity of the sympathetic system and of the parasympathetic system, and to include both "catabolic" and "anabolic" hormones. In that way I hope to have the opportunity to form a notion of the complex interrelationships between the several biological response-systems. As can be seen in Fig. 4.1 such distinctions are use-

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[1]In the remainder of this text, the term "biological variables" will be used to denote both endocrine and (electro)physiological variables (*e.g.*, PTT, GSL, IBI, etcetera); the term "physiological variables" will be used to refer only to the last mentioned non-hormonal (electro)physiological variables.

ful to make predictions with respect to the relationship between coping and biological functioning.

4.6. *An experimental study of psychosocial stress*

The purpose of the present study is to investigate psychophysiological and endocrine activity during psychosocial stimulation as a function of experience and coping style.
Taking into account the considerations noticed above, the following experiment was designed. Subjects were selected having experienced a particular stressful life event (death of a family member, divorce, job loss, surgical operation) and a control group. The experimental subjects filled in the WCC and were exposed to films depicting similar episodes. During each film, (electro)physiological, endocrine and psychological data were collected. In addition, the subjects completed the Maastricht Questionnaire (MQ) (Appels, 1980, 1983) to measure their feelings of "vital exhaustion and depression".
With respect to coping, it is hypothesized that the bipartition made by Henry (1976) and Henry and Stephens (1977) also fits in with the present categorization of coping. This leads to the formulation that P-copers and E-copers differ along the same biological continua as suggested by Henry and Stephens for "fight-or-flight" and "conservation-withdrawal", respectively.
More precisely, as may be inferred from Fig. 4.1, I expect E-copers to show more evidence of enhanced parasympathetic tone as well as higher levels of ACTH, cortisol, and hGH. In contrast, P-copers are hypothesized to have a higher sympathetic tone and higher levels of catecholamines and testosterone.

Experience will be dealt with in the following way. It is supposed that having experienced a particular situation will effect especially appraisal and coping strategies in a new confrontation. As it is assumed that both physiological and endocrine processes are dependent on appraisal and coping, I hypothesize that each group when being exposed to the particular film relating to their own problems will show deviant physiological reaction patterns, resulting in a "Group (= life event) X Film" interaction in an ANOVA design. It is, however, difficult to speculate about the specific biological changes that will occur. For, there are no reasons to suppose that having had experience with a particular life event will predispose to one special kind of coping reaction, and, hence, to a particular biological reaction pattern. The studies with patients by Theorell (1980) and Wolff (*cf.* Holmes, 1978) also do not yield a definite answer because the underlying mechanisms of the pathophysiological manifestations are not clear.
Premature ventricular contractions, as reported by Theorell (1980) may be related to enhanced catecholamines (*cf.* Kones, 1979), but rhythm disturbances also are reported to be symptoms of increased vagal activity (Engel, 1978; Corley *et al.*, 1975, 1977). Therefore, it is hard to speculate about the exact nature of the "Group X Film" interaction, for both the "fight-flight" and the "conservation-withdrawal" reaction may occur.

Based on what was stated above, it could be expected that the triple interaction "Group X Coping X Film" will reveal the relationship between coping and physiology for a particular film. Over films, this relationship can be investigated by concentrating on the main factor "Coping". How the factor "Coping" will manifest itself of course depends on the generality of our coping measure.
In addition, an Adjective Checklist (ACL) will be used to measure dimensions as psychological distress, interest and involvedness, and activation-deactivation which may be considered an operationalization of psychological reactions and behavioral tendencies.

The present study allows for the consideration of subsidiary questions relating stress, coping, and illness. In addition, in two further experiments the psychological (ACL) and (electro-)physiological results will be evaluated. More precisely, it will be investigated what extent blood sampling influences these reactions, and what will happen when the order of presentation and the context of the films are changed. The nature of each of these questions is outlined in more detail below:

1. I will investigate the degree that coping depends on stable personality characteristics and the specific qualities of the situation. This will be done by letting the subjects complete two versions of the WCC; one in which they are asked how they "in general" react to stressful episodes, and a second one in which the subjects have to indicate how they had dealt with the specific stressful encounter that they were selected for. By calculating the correlation between the scores (both for the E-scale and the P-scale) on both versions, an estimate of the variance these two versions have in common will be obtained. It is assumed that the variance shared gives an indication to what degree coping depends on more stable personality characteristics and on features of the specific situation.
2. Apart from the physiological and endocrine variables, I also will use as a dependent variable a questionnaire measuring symptoms of vital exhaustion and depression (MQ; Appels, 1980, 1983). This allows for studying the relationship between, on the one hand, coping and these vague complaints, and, on the other hand, between these psychosomatic complaints and psychobiological functioning.
3. Furthermore, in a second experiment, I will concentrate on the effects of taking bloodsamples on (electro)physiological variables. Venipunction is one of the best known stressors to evoke syncope (*cf.* Engel, 1978; Sledge, 1978). Engel and Romano (1947) report a case study showing that the mere sight of a syringe lead to the development of a sharp fall in blood pressure and heart rate (HR). In contrast, a study by Ruetz *et al.* (1967) provides evidence that fainters have higher HRs. However, as far as is known, no systematic study has been carried out focusing directly on the effects of blood sampling on physiological functioning.
4. In the same (second) experiment, I will reverse the order of presentation of the films. In this way the effects of adaptation to the experimental procedure will be studied. In other words, will a particular film evoke the same physiological reaction pattern, independent of the specific position in the order of presentation?
5. Finally, the question of the stability of the physiological reaction patterns will be dealt with. This will be done with a preliminary analysis of data obtained in a study by Hettema and Willems (in pre-

paration). In that study, the subjects of the second study were exposed to the same films for a second time. In that way, it will be established what changes occur in the behavior of the different physiological variables after repeated exposure. Three experimental conditions can be distinguished. In the first condition, the subjects received the same treatment as in Experiment II. In a second condition, the specific positions of the films in the order of presentation were systematically varied. Finally, in the third condition the context of the films was manipulated, by replacing, systematically, two "old" films by two "new" ones. More precisely, in the last manipulation the position of all films was kept constant, but two films, not yet seen before, took the place of two "old" films. Since the results of this study will be reported elsewhere in full detail (Hettema and Willems, in preparation), restriction will be to the results as far as relevant for the present study.

4.7. *Concluding remarks*

I believe that the approach outlined may be an example of what Payne *et al.* (1982) meant when they spoke about combining methods frequently used in stress research to maximize both "causal/predictive" and "descriptive/purposive" explanations. Second, the present experiment can be seen as a highly standardized situation both with respect to dependent and independent variables. Third, as proposed by Payne *et al.* (1982), the present study primarily concentrates on patterns of physiological response systems and also on coping behavior. In summary, by applying the present approach, I hope to meet much of the criticism put forward by Payne *et al.* (1982) and to give valuable solutions to the problems stress research has been confronted with in the last few years.

Chapter V

METHODS

5.1. *Experiment I*

5.1.1. *Subjects*

Eighty-nine male subjects (aged 25-40) took part in the present study. Aside from the Control group (N= 16) all subjects had in common that recently (*i.e.*, less than six months ago) they had experienced a particular stressful life event. The following life events were chosen: (1) Divorce (N= 18); (2) Job Loss (N= 19); (3) Surgical Operation (N= 17); and (4) Death (of a family member) (N= 19).
Recruitment of the subjects was different for each group and occurred according to the description given below. Once the names of potential subjects were obtained, they were written a letter containing general information. A few days later these people were called or were visited at home. At that occasion, they received specific information about why they were asked to participate and the aim and procedures of the study.
It was ascertained that all subjects were free from medication. They received the instruction to use no alcoholic beverages on the night before, to go to bed at their normal time, and to use a normal breakfast on the morning the experiment took place. During the experimental session the subjects were not allowed to take any food or coffee.
The recruitment of the subjects occurred as follows:

A) Divorce
The Registrar's Office of the Town of Tilburg gave listings with the names of couples whose divorce officially was pronounced by justice. From these listings, those men were selected whose age fell within our limits and who were still registrated as inhabitants of the town of Tilburg. However, it appeared that many had moved in be-

tween. This together with refusals led me to notify 55 men, untill there were 18 who consented to participate in the present study.

B) Surgical Operation
Thanks to the cooperation of the Maria Hospital in Tilburg, it was allowed to make the study public among the patients of the surgical wards. If they showed interest, they could contact us. In addition, I actively approached friends and acquaintances of other subjects and assistants who were known to fulfill the requirements. These requirements were: 1) that it was a purely surgical problem; 2) that they used no medication; and 3) that they had been hospitalized (*i.e.*, no out-patients).

C) Job Loss
Recruitment of this group occurred thanks to the cooperation of the Labour Exchange in Tilburg, and the Christian Federation of Trade Unions for Building and Wood Workers (CNV). In addition, an advertisement was placed in a regional daily newspaper calling for participants for the present study.

D) Death (of a family member)
The procedure used to recruit subjects in this category actually was similar to the one used for the Divorce group. For this category, I also received the names of the relatives of the deaths from the Registrars Office of the town of Tilburg. In this case, especially care was exercised that the candidates were not aproached within six weeks after the death. I also restricted the study to those people whose father or mother had died. In this group, 64 people were approached. Nineteen of them agreed to participate.

E) Controls
The control group consisted of male volunteers within the same age range. None of these men recently had experienced a stressful life event of the kind under investigation.

Care was taken that subjects already had visited the laboratory before, or, if this was not possible, that extensive information was given to them, including photographs of the situation and an example of the blood sample set. At that occasion, if the subjects consented to participate, they completed some questionnaires and signed an informed consent agreement. The questionnaires included the MQ (Appels, 1980, 1983), our revised (general) version of the WCC (Folkman and Lazarus, 1980) and a short general questionnaire to get informed about use of medication, health and stressful episodes experienced during the last year. All subjects were paid Dfl 75.-.

5.1.2. *Experimental procedures*

An experimental session always started at 9.00 AM, to minimize disturbing between-subjects effects of circadian rhythms in the secretion of certain hormones. Before the experiment started, at first a catheter for taking blood samples was inserted. Then the electrodes and other transducers were applied. This included Siemens Ag-AgCl electrodes

for measuring the electrocardiogram (ECG), lead electrodes to measure GSL, a transducer for measuring finger tip temperature and a Hewlett Packard photoelectric earpiece for making plethysmographic recordings.
The catheter was a chronical Longdwel catheter needle that was inserted into an antecubital vein of the right arm, except for some cases in which there were special (*e.g.*, anatomical) reasons to use the left arm. When blood samples were drawn, the obturator was removed and a Venoject vacuum collecting tube was applied. Next, a new obturator was inserted into the catheter to prevent coagulation and blockage. None of the subjects ever mentioned feeling discomfort or pain during this procedure.
Each blood sample was immediately placed into a centrifuge (5 min, 3000 rpm). Plasma subsequently was rapidly stored at -20° C and next at -70° C until analysis.

ECG electrodes were fixed at the left lower rib and just beneath the right collar bone. The subjects were grounded at the left wrist. GSL electrodes were applied to the index and middle finger of the left hand. In addition, a transducer for measuring finger tip temperature differences was applied to the thumb of this hand. The plethysmograph always was attached to the uppermost portion of the right ear (pinna).

After being connected, the participants received written instructions. When the subjects declared that everything was clear, an adaptation period of 10 minutes was begun. Then the first film was shown. Each subject saw seven films in the same order. The first two films were used as buffer films to get the subjects acquainted with the procedures. Blood samples taken during these films were discarded. Intervals between films were spaced so, dependent on the length of the films, that the blood sampling occurred at constant intervals of 15 minutes. After each film, an ACL was completed, measuring dimensions such as psychological distress, activation, attention and involvedness.
In between the films, the subjects listened to popular music until the next film. An experimental session ended with a 10 minutes lasting Rest condition, during which the subjects also were exposed to "easy listening" music. A session lasted about two and one half hours.

5.1.3. *Independent variables*

5.1.3.1. *The measurement of coping*

A Dutch translation was used of the WCC of Folkman and Lazarus (1980). The WCC consists of 68 items describing a broad range of behavioral and cognitive coping strategies, that might be used in the confrontation with stressful episodes. Items stem from several domains such as: defensive coping (*e.g.*, avoidance, denial, repression); problem solving; information seeking; magical thinking; palliation; action; and inhibition of action. As described previously, the WCC is composed of two subscales: the Emotion-focused coping scale (E-scale) and the Problem-focused coping scale (P-scale). The former consists of 40 items whereas the latter includes 24 items. In contrast to the original version

in which subjects were asked how they behaved in a specific situation, it was asked whether the subjects "generally" behaved in the way stated in the item, when confronted with a stressful situation. This version, therefore, is indicated as WCC(gen). The response alternatives were "yes" and "no".
In addition to the experimental groups, the WCC(gen) was also completed by a Reference group (N= 214) of males within the same age range to provide norm data.

Moreover, the subjects of the experimental groups (apart for the Control group), filled in a more original version of the WCC, in which they had to state how they dealt with their particular life event. This version will be referred to as WCC(spe).

5.1.3.2. *The stimuli*

As described above, seven films were presented in the same order. The first two served as buffer films, whereas the other five were considered to be the experimental films. Their length varied between five and ten minutes.
These films fulfilled not only certain technical requirements (35 mm, full colour), but also the content satisfied strict criteria. Except for the two buffer films, the scripts of the (experimental) films were based on the results of a situation taxonomy study (Van Heck, 1984). Each film represented a specific situation and contained only situational cues which in the Van Heck study were shown to be essential and characteristic for the definition of that particular situation. The films were designed and produced by Brandt *et al.* (1985), in the context of a research program on psychological adaptation (cf. Hettema, in preparation).

The buffer films dealt with the following topics:

1. Gossip: a humoristic film in which a teacher is suspected to have an affair with a pupil. At the end, however, the girl appears to be his daughter.

2. Advances: this film is about a young man ingratiating himself with a girl, who is studying to be a cellist with the conservatoire. He therefore undertakes several attempts to learn to play the cello by himself and ultimately succeeds in making a date.

The experimental films depicted the following situations:

3. Driving Test: a woman goes up for a driving-test. At first she has to do the theoretical part, next the practical part. The film mainly shows the ride through the city and the special excercises she has to do. She performs succesfully.

4. Job Loss: a man working in a factory has to come to the personnel department. There he has been told that because of reorganisation, his division will be closed and he will be discharged. Then he goes home to tell it to his wife.

5. Divorce: a couple comes to the conclusion that there would be no sense in staying together and decide on divorce. They then call for the help of lawyers to divide the property. The film also shows reflections on how the rupture developed.

6. Death Bed: this film shows a middle-aged woman in the ultimate phase of a disease. The last sacraments are administered to her and then she dies. Some pictures of the funeral are shown.

7. Surgical Operation: the film starts with a traffic accident. The victim is transported to the hospital by ambulance. Then he is prepared for an operation. The last part of the film shows the operation itself.

8. Rest Condition: no films were shown in this condition. The subjects were asked to relax, while listening to popular music.

5.1.4. *Dependent variables*

5.1.4.1. *Psychological variables*

A. MQ
This questionnaire is developed by Appels (1980, 1983) to measure feelings of "fatigue - general malaise", reflecting a status of physical and mental overexcertion. A study on persons with elevated scores on this questionnaire indicated that the construct which is measured can be described as a syndrome of vital exhaustion and depression. Preliminary results (Appels, 1980, 1983) show that (1) there is a significant association between the syndrome of vital exhaustion and the prevalence of imminent myocardial infarction (in men older than 40); and (2) subjects scoring in the higher range have more chance to get a new coronary event within a period of 10 months.

B. ACL
This ACL was based on the one originally developed by Kjellberg and Bohlin (1974). It consists of 30 adjectives such as tense, nervous, sleepy, tired, and curious. The subjects had to indicate on a 4-point scale (not at all / a little / rather / very) the degree in which the item applied to him while he was viewing the film just finished.

C. WCC(gen) and WCC(spe).
Although coping preference actually is used as an independent variable, it will be checked whether there are reliable differences between scores on both versions of the WCC between experimental groups. As such, coping was considered a dependent variable as well as an independent variable.

5.1.4.2. *Physiological variables*

(Electro-)physiological variables were analysed during the second minute of each film as well as during another 1 min period, in which the

most salient scenes took place. This second measuring period was established in advance by a panel of judges.

Cardiovascular parameters were calculated using the first 50 cardiac cycles during these periods.
The following variables were computed:

1. Inter-Beat Interval (IBI): the time between successive ventricular contractions.
2. Pulse Transit Time (PTT): the time between the R-wave of the ECG and the arrival of the pressure pulse in the right ear.
3. ECG T-wave amplitude (TWA): amplitude of the T-wave in the ECG reflecting the repolarisation phase of the cardiac cycle.
4. The sum of the absolute differences between successive IBIs (S). This parameter reflects the variability in the tachogram. In formula form:

$$S = \sum_{i=2}^{n} |X_i - X_{i-1}|$$

where n is the total number of intervals, while X_i is the i^{th} IBI in msec.

5. Galvanic Skin Level (GSL). This variable reflects the degree in which a current, that passes through the skin from an external source, is conducted. Every measuring period 15 samples were printed out. The ultimate score was the average of these 15 samples.
6. Finger Tip Temperature (FTT). Sympathetically induced vasoconstriction in the skin brings about a reduced bloodflow in the fingers, leading to a decrease in temperature. Scoring occurred from paper by determining the mean value for each measuring period.

5.1.4.3. *Endocrinological variables*

During each condition (films and rest), after the second measuring period 10 cc blood samples were taken for determination of the following hormones:

1. adrenaline (A)
2. noradrenaline (NA)
3. adreno-corticotropic hormone (ACTH)
4. cortisol
5. growth hormone (hGH)
6. testosterone

Because the catheter always was applied first and the samples of the two buffer films were discarded, there was an interval of at least about 45 minutes between the venipunction and the sample of the first experimental film.

5.1.5. *Analysis of hormonal data*

Catecholamines (A and NA) were assayed using a radioenzymatic assay (Upjohn). This kit can be used for the quantitative differential, radioenzymatic assay of NA, A, and dopamine in plasma. The sensitivity ranges from 2 - 5 pg for NA and A per 50 µl sample.

Determination of ACTH occurred by radioimmuno assay (CEA: Sorin). The lower sensitivity is about 10 pg/nl and normal levels are between 10 - 80 ng/L. Plasma cortisol was determined with a radioimmuno assay (Becton Dickinson). This method measures total circulating cortisol, since the bound cortisol is separated from endogenous transcortin. hGH also was measured by means of a radioimmuno assay kit (RIA-gnost-hGH; Behring-Hoechst), while testosterone was measured with a competitive protein binding assay as reported by Pratt *et al.* (1975).

5.1.6. *Experimental set-up, apparatus and measurements*

The experimental sessions took place in a space especially fitted up as a cinema. Except for the screen, walls, ceiling and floor covering within the visual field of the subject were black coloured. The subject was seated in a comfortable chair, about 4.50 m before the screen (3.4 x 1.8 m).
Films were projected by means of a Ernemann VIII projector. All analogous physiological signals were amplified and written on paper by a Beckman R 611 Dynograph recorder. Registration equipment was housed in an adjacent room. This also held for the projector.

IBIs were measured by feeding the analogous signal into a locally made timer circuitry measuring the time between successive R-waves. For preamplification of the plethysmographic signal, a specially deviced amplifier was employed. The output of both the ECG and the earpulse was led into a pulse maximum detector. This device measured the time between the apex of the R-wave and the peripheral pulse. Via a so called serdex-line both IBI and PTT for each cardiac cycle were transmitted to the VAX computer and stored in files.
GSL was measured by means of a Conductron (Vrolijk and Enting, 1979). This device both has an analogous and a digital output. During the measuring periods, GSL values were printed out every four seconds, yielding 15 measurements for each measuring period.
FTT changes were measured by means of a locally developed Wheatstone bridge in connection with a Beckman voltage/pulse/pressure coupler. Unfortunately absolute values could not be measured reliably. I therefore had to settle for relative changes rather than absolute values.

ECG, plethysmographic signal and marking signal together with codes for the subjects and films were stored on magnetic tape (Hewlett Packard, 3968A). These signals were used in case of breakdown of the connection with the VAX computer and for off-line analysis of TWA.

For TWA analysis analogous signals were digitized with a frequency of 512 Hz. The R-wave was used to trigger the AD-conversion for 500 msec. TWA was nominally defined as the difference between the highest and lowest value occurring between 200 and 400 msec after the R-wave. The exact limits were set for each subject individually.

Timing and marking during the experiment was done by locally developed timers and digital logic circuitry.

During the experiment, each subject wore headphones to guarantee the quality of the sound and to protect against noise from outside.

5.2. *Experiment II*

As subjects 66 men, comparable to the members of the Control group of Experiment I, took part. The main differences with Experiment I were:

1. no blood sampling occurred;
2. prior to every condition; for each variable rest values were obtained (multiple baseline), and
3. to 22 subjects, the films were shown in the orginal order, whereas the remaining 44 men saw the experimental films in a revers order. More precisely, films were presented in this order: (1) Gossip; (2) Advances (buffers); (3) Surgical Operation; (4) Death Bed; (5) Divorce; (6) Job Loss; and (7) Driving Test. In the last condition ((8) Rest), the subjects again listened to music.

5.3. *Experiment III*

Sixty men, also having participated in Experiment II, served as subjects. Three treatments (N= 20 each) can be distinguished, which differed in the following aspects:

- Group A ("Stability"). These subjects underwent exactly the same procedures as in Experiment II. This means a classical psychometric reliability study.
- Group B ("Latin Square"). During the reexposure, this group saw the films in a different order. This occurred according to a classical latin square design (cf. d'Amato, 1970).
- Group C ("Context"). In this condition, for every subject, two experimental films were replaced by other films in order to vary the context of the films. These new films were "Pregnancy" and "Application".

Because the technical quality of the second bufferfilm (Advances) no longer was adequate, this film also was replaced by a new one, entitled "Officialdom".

Chapter VI

RESULTS

6.1. *Experiment I*

6.1.1. *Life events and coping*

As described above, all subjects completed two versions of the WCC: (1) a general version, in which it was asked how they "generally" react when being confronted with stressful situations (WCC(gen)); and (2) a specific version, in which the subjects had to report how they coped with the specific event they were selected for (WCC(spe)) (this, of course, did not hold for the Control group).
The general version also was filled in by a sample of 214 men within the same age range. This sample is used as a Reference group.
The WCC consists of two subscales *viz.* the E-scale and the P-scale. Mean and SD were calculated for the Reference group, and for the five experimental groups. In the latter case, this was done both for the WCC(gen) and the WCC(spe).

Table 6.1: Means of the scores on the P-scale and the E-scale of the WCC(gen) for the experimental groups and the Reference group.

	Controls	Divorce	Operation	Job Loss	Death	Reference
P-scale	12.25	12.23	13.29	11.59	11.29	11.62
E-scale	24.00	21.59	22.65	21.71	19.94	21.17

Table 6.2: Means of the scores on the P-scale and the E-scale of the WCC(spe) for the experimental groups, having experienced a particular life change.

	Divorce	Operation	Job Loss	Death
P-scale	11.00	10.24	9.00	7.12
E-scale	19.12	16.71	16.47	14.47

Tables 6.1 and 6.2 show the mean values. The results of ANOVA show that for WCC(gen) no significant differences exist, neither between experimental groups nor between experimental groups and the Reference group. This holds both for the E-scale and the P-scale (E-scale: $F(5,292)= 1.63$; n.s.; P-scale: $F(5,292)= 1.18$; n.s.).
In contrast, the results for WCC(spe) do show significant differences between experimental groups for the P-scale ($F(3,64)= 4.53$; $p < .01$). This, however, does not apply for the E-scale ($F(3,64)= 1.59$; n.s.). Inspection of Table 6.2 reveals that this finding is especially related to the low scores of the Death group on the P-scale.

To get an impression of the extent to which coping is determined by situational versus personality factors, correlations were computed between WCC(spe) and WCC(gen) scores. For the P-scale, this yielded a value of $r= .54$ and for the E-scale $r= .53$.
On the basis of these coefficients, coping styles can be considered sufficiently "general" to treat them as more stable personality variables.

In order to qualify people as to their general coping style either as E-copers or as P-copers, the following procedure was applied. For both the E-scale and the P-scale, mean and SD in the Reference group were calculated. Next, these parameters were used for converting the raw scores of the experimental groups into standardized (Z) scores in order to obtain comparable scores for both scales.
Subtracting the individual Z-score of the E-scale from those of the P-scale resulted in an index of the degree to which, in a particular subject, his E-coping or P-coping dominated, relative to the Reference group. Large positive values point to a strong preference for P-coping, whereas large negative values reveal a tendency for E-coping.

These scores (Coping Dominance Index: CDI), subsequently, were correlated with the endocrine variables measured in the Rest condition. Table 6.3 presents the results of this computation.
The results reveal a positive association between both catecholamines and CDI, whereas the anterior pituitary hormones (ACTH and hGH) are negatively correlated with this index. In other words, high values

*Table 6.3: Correlations between CDI and endocrine variables during Rest (df = 81, *: p <.05).*

	A	NA	ACTH	Cortisol	hGH	Testosterone
CDI	.21*	.22*	-.24*	.03	-.20*	.16

(preference for P-coping) appear to be associated with high catecholamine levels, whereas low values (indicating E-coping) seem to be attented with elevated ACTH and hGH levels.
In addition, there is a trend towards a positive correlation between testosterone and the CDI, whereas for cortisol no relationship with the CDI was found.

6.1.2. *Life events, coping, and MQ*

An ANOVA on the MQ results was carried out with factors "Group"(= life event) and "Coping". For this analysis (just as for those that will follow), it is needed to make a bipartition in coping preferences.
Since a zero value of the CDI indicates a balance between E and P coping, this value was taken as a cut off point. This means that all people having positive values are considered to be P-copers, whereas negative values determine E-copers. This bipartition yielded the following results (number of men classified within each of both groups): Controls: 12 E and 4 P; Divorce: 8 E and 9 P; Surgical Operation: 4 E and 13 P; Job Loss: 9 E and 8 P; and, at last, Death: 9 E and 8 P. Table 6.4 shows the mean scores on the MQ for all subgroups.

Table 6.4: MQ results of both E and P coping within groups.

	Control	Divorce	Operation	Job Loss	Death
E-copers	94.25	96.62	91.25	117.89	83.89
P-copers	70.75	94.56	84.23	89.62	71.62

The results of the ANOVA are represented in Table 6.5. It can be seen that both main factors ("Group" and "Coping") are significant. Inspection of Table 6.4 shows that E-copers have higher scores than P-copers. The greatest difference in scores between groups can be attributed to the Job Loss group (high scores) and the Death group (low scores).

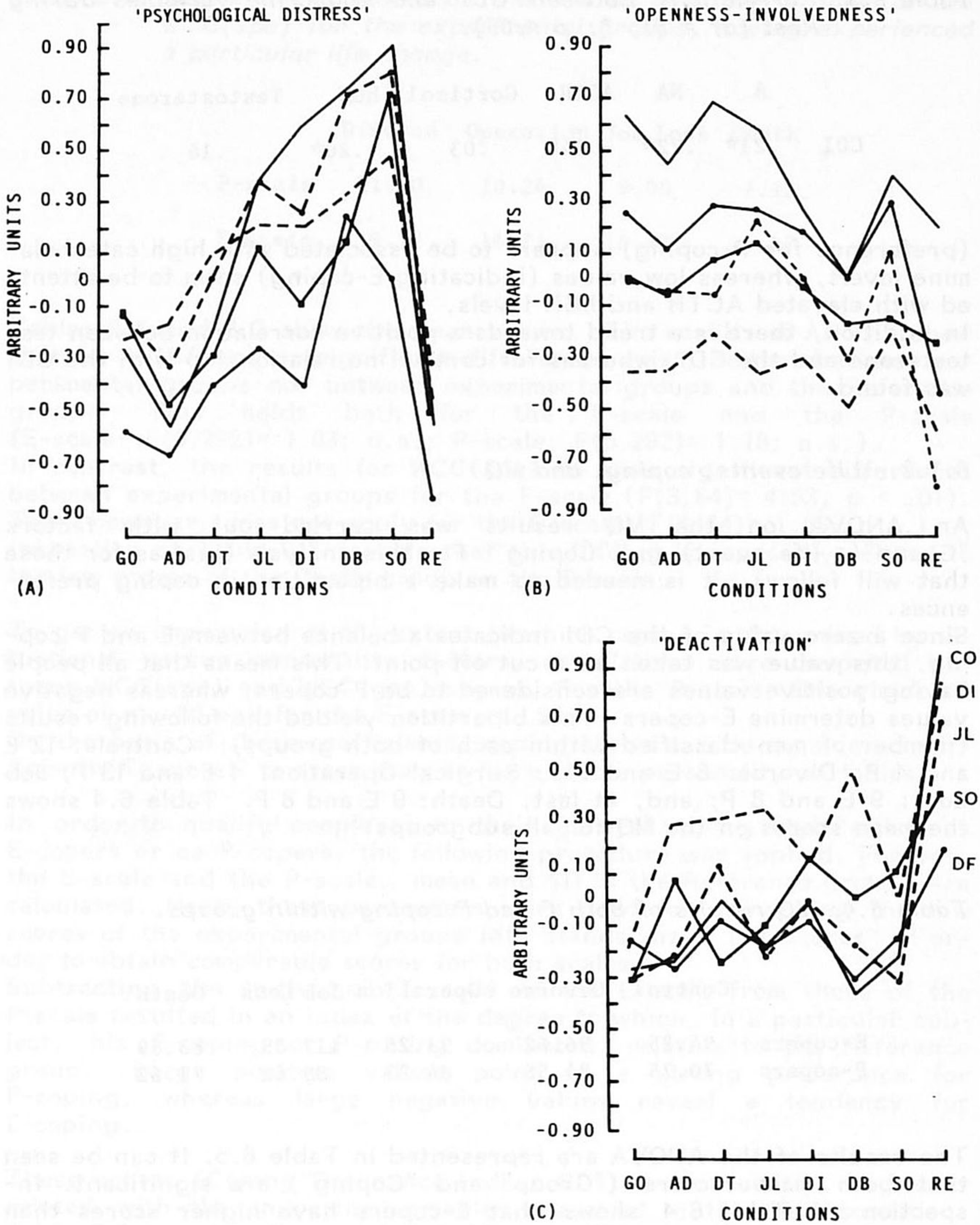


Fig. 6.1: Averaged factor scores for each ACL factor, represented per group (= life event), for each condition (Experiment I).

Table 6.5: Results of the ANOVA carried out on the MQ scores.

	df	MS	F
A: Group	4	1753.08	2.77 *
B: Coping	1	3906.22	6.18 *
A x B	4	473.03	0.75
Error	74	632.18	

6.1.3. *Life events, coping, and ACL*

Each ACL item received a score from 1 ("not at all") to 4 ("very"). These raw scores (for each subject, per item eight data points) were subjected to a principal component analysis (PCA) with Varimax rotation. This yielded 3 factors with eigenvalues above 2.0. Table 6.6 shows the items with factor loading greater than .40 on these ACL factors. The three factors appear well interpretable, and together they explain 48 per cent of the variance. The labeling of these ACL factors is as follows: (1) "Psychological Distress"; (2) "Openness/Involvedness"; and (3) "Deactivation".

Table 6.6: ACL items with (absolute) factor loadings above .40 on the factors (Experiment I).

FACTOR I		FACTOR II		FACTOR III	
Restless	.78	Interested	.76	Drowsy	.81
Jittery	.76	Alert	.73	Lethargic	.79
Tense	.73	Attentive	.71	Dreamy	.79
Anxious	.72	Lively	.65	Sleepy	.75
Worried	.69	Energetic	.63	Tired	.72
Confused	.58	Clear	.59	Unenterprising	.55
Hesitating	.49	Sure	.50	Bored	.41
Sure	-.40	Exhilarated	.50		
Exhilarated	-.56	Curious	.45		
Fine	-.59	Fine	.44		
Relaxed	-.62	Relaxed	.41		
Calm	-.63				
Comfortable	-.67				

Next, for each of these ACL factors, factor scores were calculated per subject for every condition. Subsequently, ANOVA was carried out on these factor scores with "Group" and "Coping" (E *vs.* P) as between subject factors and "Condition" (Films and Rest) as within subject factor.

*Table 6.7: Results of the ANOVAs on the ACL factor scores of Experiment I (T: .10 < p < .05; ***: p < .001).*

		'PSYCHOLOGICAL DISTRESS'		'OPENNESS/INVOLVEDNESS'		'DEACTIVATION'	
	DF	MS	F	MS	F	MS	F
A: Group	4	7.02	1.99	12.53	2.40 T	3.16	0.68
B: Coping	1	0.54	0.15	6.20	1.19	6.51	1.40
A x B	4	1.33	0.38	7.91	1.51	6.89	1.48
Error	74	3.53		5.23		4.65	
C: Condition	7	13.16	27.85 ***	2.51	8.09 ***	5.10	11.98 ***
A x C	28	0.55	1.16	0.26	0.84	0.58	1.36
B x C	7	0.44	0.94	0.12	0.40	0.46	1.07
A x B x C	28	0.46	0.97	0.19	0.63	0.50	1.18
Error	518	0.47		0.31		0.43	

Table 6.7 summarizes the results of this ANOVA, whereas Fig. 6.1(a-c) shows a graphical representation of the averages per group. For every ACL factor, the main effect "Condition" proves to be highly significant ($p < .001$ in all cases). In addition, for ACL factor 2 ("Openness/Involvedness"), there is a main effect for "Group". Fig. 6.1(b) shows the largest difference for ACL factor 2 between the Control group, which is most open and involved, and the Divorce group, whose scores are lowest on this ACL factor, all over the experiment.
No significant interactions were found for either of these ACL factors. The Job Loss, Death Bed and Sugical Operation conditions were uniformly rated as most distressing. The most remarkable finding for ACL factor 2 is that not only during the Rest condition, but also during the Death Bed film, there is a decrease in average factor scores. Fig 6.1(c) shows that, except for the Rest condition, no large variations in activation-deactivation were reported by the subjects.

6.1.4. *Life events, coping, and endocrine reactions*

Raw data of all hormonal variables are plotted in Fig. 6.2(a-f). Table 6.8 presents the mean, standard errors of measurement (SEM), ranges and normal range for all endocrine variables.
Because the distributions of the hormonal variables appear to be rather skewed, log transformations were carried out to attain more appropriate distributions to allow for a similar ANOVA design as used for the ACL data. However, because the blood samples of the first two (buffer) films were discarded, the ANOVA main factor "Condition" here has only six levels.

Table 6.8: Means, standard errors of mean (SEM), and ranges of the hormonal variables, represented for each group (= life event).

	ACTH			CORTISOL		
	MEAN	SEM	RANGE	MEAN	SEM	RANGE
CO	36.93	2.03	3)-91	35.91	1.46	11-82
DI	35.48	2.10	3)-112	48.25	1.37	20-90
SO	35.31	2.42	3)-125	35.59	1.43	3-82
JL	55.18	3.39	3)-150	40.11	1.55	17-102
DF	32.34	2.32	3)-91	40.76	1.50	17-86
Normal range 10-80 (ng/l)				Normal range 30-55 (mumol/		

3) Stands for <5

	ADRENALINE			NORADRENALINE		
	MEAN	SEM	RANGE	MEAN	SEM	RANGE
CO	43.45	2.79	1-133	381.48	18.17	66-1028
DI	47.26	4.25	1-377	460.40	24.19	16-1872
SO	55.04	9.15	1-688	473.00	30.03	38-2039
JL	45.72	4.06	1-403	500.23	22.60	16-1126
DF	51.25	1.98	14-142	450.73	15.95	149-956
Normal range 20-105 (ng/l)				Normal range 200-600 (ng/l)		

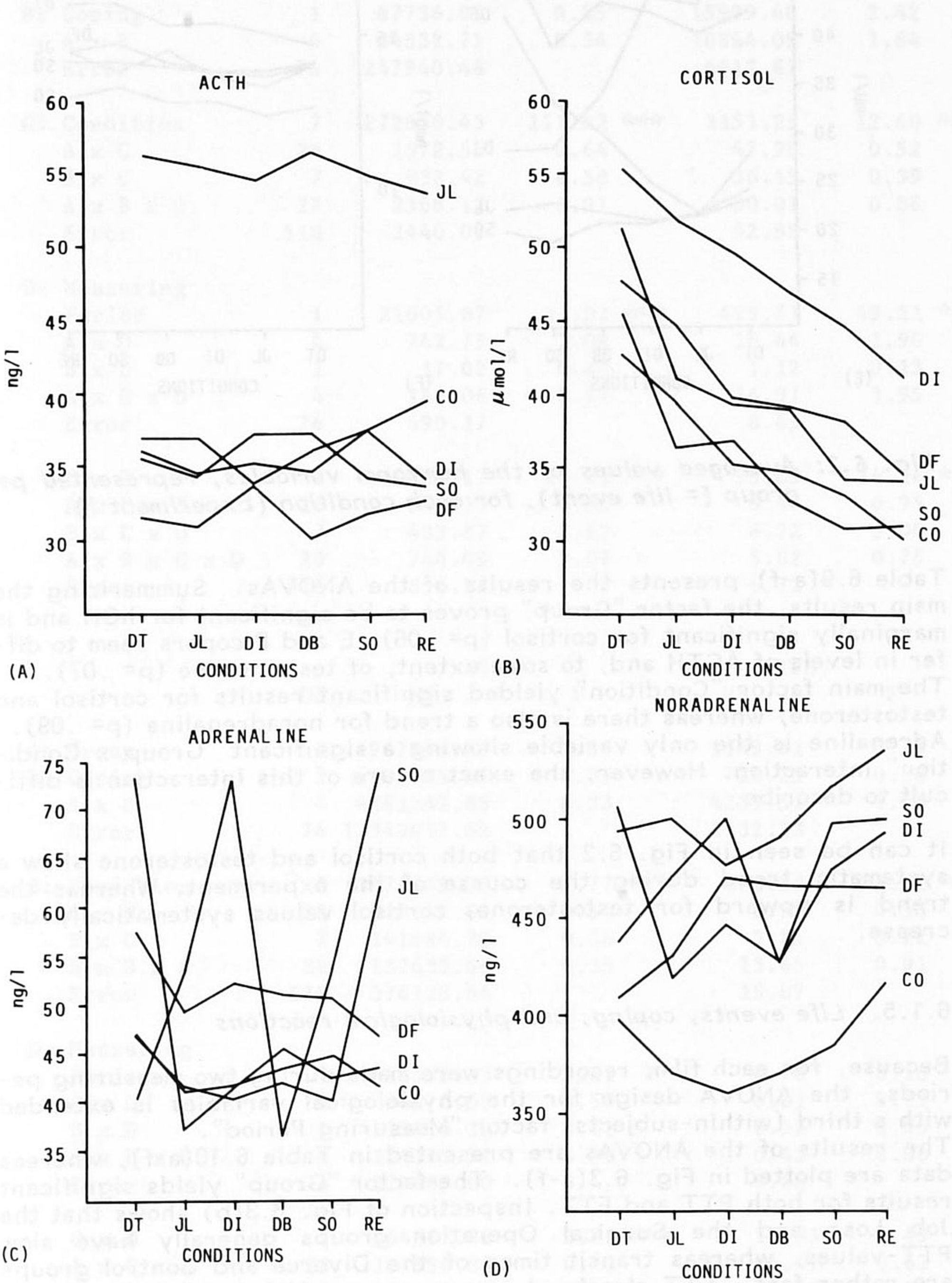
	hGH			TESTOSTERONE		
	MEAN	SEM	RANGE	MEAN	SEM	RANGE
CO	42.79	3.56	11-220	12.74	0.45	5.7-22.8
DI	38.31	5.45	9-430	15.52	0.61	4.4-31.2
SO	20.98	0.97	6-64	13.91	0.56	4.5-31.3
JL	22.17	0.98	7-81	14.09	0.38	6.8-23.1
DF	29.49	4.05	1-340	14.21	0.46	7.2-26.6
Normal range 0-15 (mU/l)				Normal range 14-30 (nmol/l)		

*Table 6.9: Results of the ANOVAs on the hormonal variables (after log transformation) (T: .10 < p < .05; *: p < .05; ***: p < .001).*

		ACTH			CORTISOL		
	DF	MS	F		MS	F	
A: Group	4	0.92	1.37		0.33	2.36	T
B: Coping	1	3.41	5.05	*	0.00	0.00	
A x B	4	1.02	1.52		0.06	0.44	
Error	74	0.67			0.13		
C: Condition	5	0.01	0.33		0.21	30.83	***
A x C	20	0.03	1.15		0.00	0.51	
B x C	5	0.02	0.91		0.01	0.77	
A x B x C	20	0.01	0.44		0.01	0.79	
Error	370	0.02			0.01		

		ADRENALINE			NORADRENALINE		
	DF	MS	F		MS	F	
A: Group	4	0.41	0.73		0.21	0.71	
B: Coping	1	0.34	0.60		0.05	0.18	
A x B	4	0.81	1.42		0.20	0.66	
Error	74	0.57			0.30		
C: Condition	5	0.07	1.39		0.03	1.90	T
A x C	20	0.08	1.60	*	0.02	1.07	
B x C	5	0.08	1.67		0.02	1.28	
A x B x C	20	0.03	0.64		0.01	0.96	
Error	370	0.05			0.02		

		hGH			TESTOSTERONE		
	DF	MS	F		MS	F	
A: Group	4	1.05	2.64	*	0.13	0.91	
B: Coping	1	0.71	1.77		0.46	3.16	T
A x B	4	0.45	1.14		0.23	1.60	
Error	74	0.40			0.15		
C: Condition	5	0.01	0.95		0.01	6.97	***
A x C	20	0.02	0.99		0.00	0.82	
B x C	5	0.02	1.39		0.00	0.22	
A x B x C	20	0.01	0.67		0.00	0.64	
Error	370	0.02			0.00		



-Fig. 6.2 to be continued-

Fig. 6.2 cont.

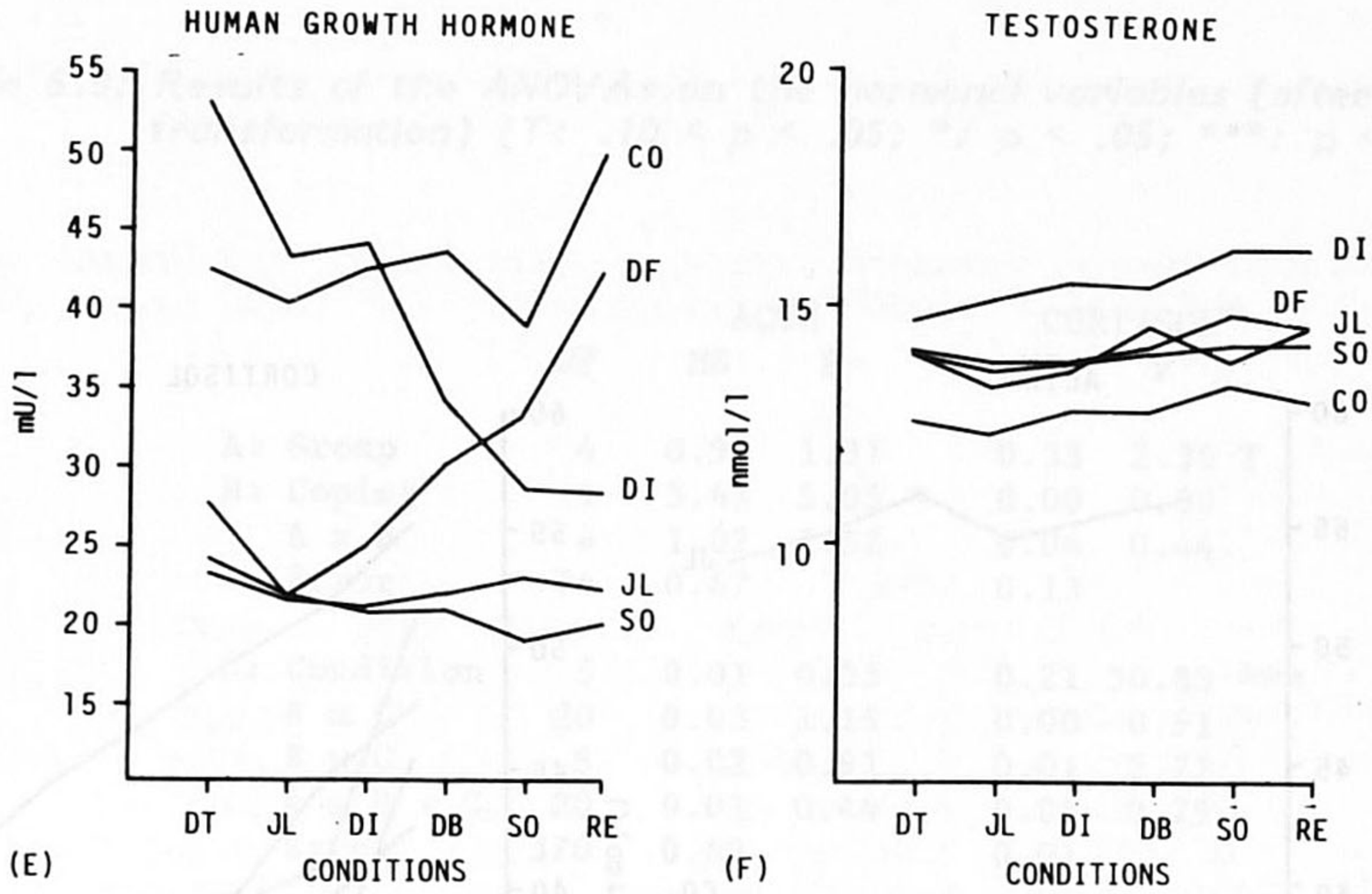


Fig. 6.2: Averaged values of the hormonal variables, represented per group (= life event), for each condition (Experiment I).

Table 6.9(a-f) presents the results of the ANOVAs. Summarizing the main results, the factor "Group" proves to be significant for hGH and is marginally significant for cortisol (p= .06). E and P copers seem to differ in levels of ACTH and, to some extent, of testosterone (p= .07).
The main factor "Condition" yielded significant results for cortisol and testosterone, whereas there is also a trend for noradrenaline (p= .09).
Adrenaline is the only variable showing a significant "Group x Condition" interaction. However, the exact nature of this interaction is difficult to describe.

It can be seen in Fig. 6.2 that both cortisol and testosterone show a systematic trend during the course of the experiment. Whereas the trend is upward for testosterone, cortisol values systematically decrease.

6.1.5. *Life events, coping, and physiological reactions*

Because, for each film, recordings were made during two measuring periods, the ANOVA design for the physiological variables is extended with a third (within-subjects) factor "Measuring Period".
The results of the ANOVAs are presented in Table 6.10(a-f), whereas data are plotted in Fig. 6.3(a-f). The factor "Group" yields significant results for both PTT and FTT. Inspection of Fig. 6.3(b) shows that the Job Loss and the Surgical Operation groups generally have slow PTT-values, whereas transit times of the Divorce and Control groups are rather fast. FTT clearly shows one group (Job Loss) being divergent, as compared to the other ones.

*Table 6.10: Results of the ANOVAs on the (electro)physiological data of Experiment I (T: .10 < p < .05; *: p < .05; **: p < .01; ***: p < .001).*

		IBI			PTT	
	DF	MS	F		MS	F
A: Group	4	190326.46	0.77		33126.72	5.01 **
B: Coping	1	87736.05	0.35		15999.48	2.42
A x B	4	84332.71	0.34		10864.09	1.64
Error	74	247940.48			6612.67	
C: Condition	7	272840.43	111.82	***	1151.25	12.40 ***
A x C	28	1572.55	0.64		47.90	0.52
B x C	7	938.42	0.38		36.49	0.39
A x B x C	28	2368.12	0.97		80.01	0.86
Error	518	2440.05			92.88	
D: Measuring Period	1	21605.87	31.31	***	425.61	49.21 ***
A x D	4	742.79	1.08		16.44	1.90
B x D	1	17.02	0.02		1.12	0.13
A x B x D	4	151.06	0.22		16.91	1.95
Error	74	690.17			8.65	
C x D	7	10464.17	15.03	***	95.05	14.14 ***
A x C x D	28	555.10	0.80		6.40	0.95
B x C x D	7	433.87	0.62		6.72	1.00
A x B x C x D	28	744.09	1.07		5.02	0.75
Error	518	696.38			6.72	

		S			TWA	
	DF	MS	F		MS	F
A: Group	4	6967591.66	0.56		1659.61	0.78
B: Coping	1	4107075.46	0.33		728.25	0.34
A x B	4	4041358.88	0.33		4231.51	1.98
Error	74	12343017.82			2132.33	
C: Condition	7	3674639.35	9.77	***	476.39	31.61 ***
A x C	28	203045.81	0.54		8.79	0.58
B x C	7	141884.30	0.38		3.25	0.22
A x B x C	28	132633.80	0.35		13.65	0.91
Error	518	376120.54			15.07	
D: Measuring Period	1	416332.13	3.21	T	0.70	0.10
A x D	4	64876.63	0.50		0.81	0.11
B x D	1	15416.12	0.12		0.32	0.05
A x B x D	4	124385.91	0.96		0.45	0.06
Error	74	129689.00			7.06	
C x D	7	564337.46	3.71	***	11.01	1.49
A x C x D	28	107590.80	0.71		4.47	0.61
B x C x D	7	156881.47	1.03		5.95	0.81
A x B x C x D	28	64615.12	0.42		4.63	0.63
Error	518	152282.05			7.37	

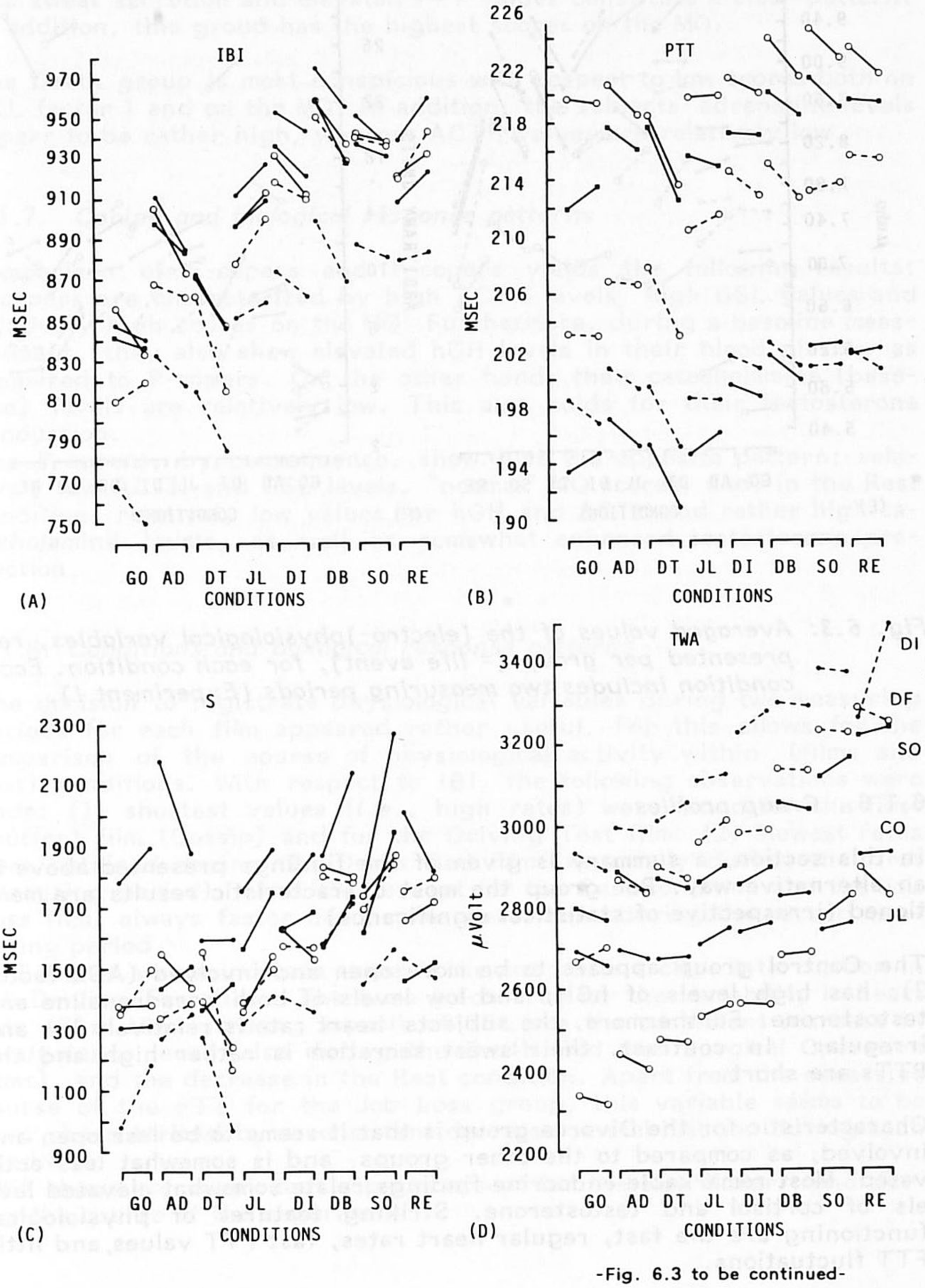
-Table 6.10 to be continued -

Table 6.10 cont.

			GSL			FTT	
		DF	MS	F		MS	F
A:	Group	4	16063.68	0.45		14126.39	2.73 *
B:	Coping	1	164126.96	4.63 *		6842.48	1.32
	A x B	4	27151.66	0.77		1356.93	0.26
	Error	74	35433.13			5176.09	
C:	Condition	7	3634.03	9.37 ***		3254.75	16.72 ***
	A x C	28	246.47	0.64		424.08	2.18 ***
	B x C	7	437.90	1.13		239.95	1.23
	A x B x C	28	541.74	1.40 T		162.12	0.83
	Error	518	388.04			194.62	
D:	Measuring Period	1	104.26	1.64		711.96	37.53 **
	A x D	4	57.65	0.94		101.11	5.33 **
	B x D	1	169.79	2.67		29.57	1.56
	A x B x D	4	49.99	0.79		41.22	2.17 T
	Error	74	63.56			18.97	
	C x D	7	458.62	13.39 ***		182.51	19.97 ***
	A x C x D	28	23.13	0.68		7.17	0.78
	B x C x D	7	67.51	1.97 T		15.94	1.74 T
	A x B x C x D	28	35.04	1.02		9.05	0.99
	Error	518	34.25			9.14	

GSL appear to differentiate between coping styles. P-copers give less prove of sweat gland activity than E-copers.
The factor "Condition" appears to be highly significant for each variable. "Measuring Period" is significant for IBI, PTT and FTT, and just failed to reach the 5 percent level of significance for S (p= .07).

The interaction most frequently found to be significant is "Condition x Measuring Period". This holds for all variables, except for TWA. In addition, some marginally significant interactions are found for TWA ("Group x Coping"; p= .10) and GSL ("Condition x Group x Coping"; p= .08, and "Condition x Measuring Point x Coping"; p= .06).
FTT has the largest number of significant interactions. "Condition x Group" and "Group x Measuring Period" are highly significant (p= .001 each), and the triple interactions "Group x Coping x Measuring Period" and "Coping x Condition x Measuring Period" both show a trend towards significance (p= .08 and p= .09, respectively).



-Fig. 6.3 to be continued-

Fig. 6.3 cont.

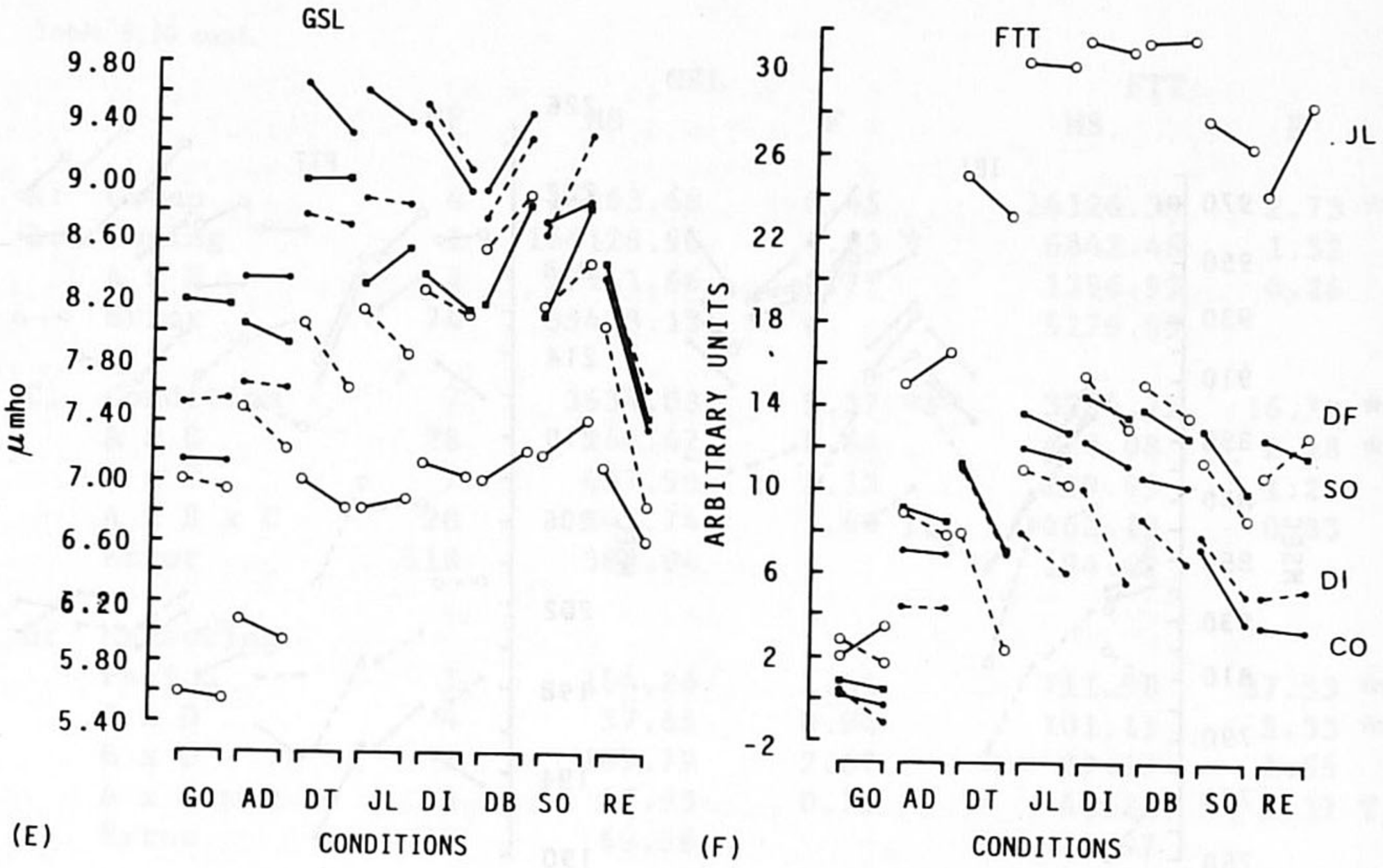


Fig. 6.3: Averaged values of the (electro-)physiological variables, represented per group (= life event), for each condition. Each condition includes two measuring periods (Experiment I).

6.1.6. *Group profiles*

In this section, a summary is given of the findings presented above in an alternative way. Per group the most characteristic results are mentioned (irrespective of statistical significance).

The Control group appears to be more open and involved (ACL factor 2); has high levels of hGH; and low levels of both noradrenaline and testosterone. Furthermore, the subjects' heart rate is relatively low and irregular. In contrast, their sweat secretion is rather high and the PTTs are short.

Characteristic for the Divorce group is that it seems to be less open and involved, as compared to the other groups, and is somewhat less activated. Most remarkable endocrine findings relate somewhat elevated levels of cortisol and testosterone. Striking features of physiological functioning are the fast, regular heart rates, fast PTT values, and little FTT fluctuations.

The Surgical Operation group, except for the relatively long PTT values, and low hGH levels, for all other variables seems to take an intermediate position.

The Job Loss group, on the contrary, probably shows the most clearcut differences. High ACTH levels, together with long transit times (PTT), less sweat secretion and elevated FTT values constitute a clear pattern. In addition, this group has the highest scores on the MQ.

The Death group is most conspicious with respect to low scores both on ACL factor 1 and on the MQ. In addition, the subjects' adrenaline levels appear to be rather high, whereas ACTH values are relatively low.

6.1.7. *Coping and biological response patterns*

Comparison of E-copers and P-copers yields the following results: E-copers are characterized by high ACTH levels, high GSL values and relatively high scores on the MQ. Furthermore, during a baseline measurement, they also show elevated hGH levels in their blood plasma, as compared to P-copers. On the other hand, their catecholamine (baseline) levels are relatively low. This also holds for their testosterone production.
The P-copers, by consequence, show just the opposite pattern: relatively low ACTH and GSL levels, "normal" MQ scores, and, in the Rest condition, relatively low values for hGH and ACTH and rather high catecholamine levels, as well as somewhat enhanced testosterone production.

6.1.8. *Conditions and biological response patterns*

The decision to registrate physiological variables during two measuring periods for each film appeared rather useful. For this allows for the comparison of the course of physiological activity within (films and rest) conditions. With respect to IBI, the following observations were made: (1) shortest values (*i.e.*, high rates) were found for the first (buffer) film (Gossip) and for the Driving Test film. (2) Slowest rates were obtained during the Death Bed film (especially during the first measuring period). And (3), except for the Rest condition and the Job Loss film, always faster heart rates were found during the second measuring period.
PTT shows a slow increase towards the end; with a clear interruption in the Driving Test film. The same holds true for the variability in heart rate (S). Most striking aspects of GSL are the consistent increase in conductance level (also during the Death Bed and Surgical Operation films), and the decrease in the Rest condition. Apart from the excessive course of the FTT for the Job Loss group, this variable seems to be most characterized by a consistent decrease or stabilisation during each condition.
TWA shows no conspicuous aspects except for the slow linear trend during the course of the experiment.

6.2. *Experiment II*

6.2.1. *ACL*

As in Experiment I, raw scores of the ACL were subjected to a PCA with Varimax rotation. Again, three factors were extracted with eigenvalues above 2.0. The amount of variance explained was 52 per cent. Table 6.11 shows the items with loadings greater than .40. The labeling of the factors is identical to the one in Experiment I: (1) "Psychological Distress", (2) "Deactivation", and (3) "Openness/Involvedness". The major difference concerns the reversal of Factor 2 and Factor 3.

Calculation of the coefficient of congruence (Phi) to measure the degree of factorial similarity (*cf.* Harman, 1976) yielded the following results: factor 1-1: phi= .99; factor 2-3: phi= .95; and factor 3-2: phi= .97.

The following two comparisons were made for the factor scores on these ACL factors: 1) It was tested whether taking bloodsamples does affect ACL self reports. Therefore, I compared the findings of the 22 subjects who saw the films in the same order as in Experiment I, to the results obtained during Experiment I. 2) I investigated whether the order in which the films were presented influences the psychological reactions (*i.e.*, the ACL self reports). This leads to the comparison of the two groups of Experiment II which saw the films in a different order.
Table 6.12 shows the results of the ANOVAs relating to the former issue. The most important result is the absence of significant interactions with the main factor "Blood Sampling". This holds true for all three ACL factors. An ANOVA summary for the comparison of the different orders of film presentation is presented in Table 6.13. Here also, no significant interactions were found with the factor "Order of Presentation". These results are depicted in Fig. 6.4(a-c).

Table 6.11: ACL items with (absolute) factor loadings above .40 on the factors (Experiment II).

FACTOR I		FACTOR II		FACTOR III	
Restless	.79	Drowsy	.86	Interested	.71
Tense	.77	Lethargic	.85	Attentive	.70
Jittery	.76	Sleepy	.83	Alert	.68
Anxious	.76	Dreamy	.76	Lively	.65
Worried	.68	Unenterprising	.75	Energetic	.58
Confused	.57	Tired	.67	Exhilarated	.53
Hesitating	.54	Bored	.52	Curious	.52
Sure	-.49	Apathetic	.50	Clear	.44
Exhilarated	-.54	Attentive	-.41		
Fine	-.64	Clear	-.42		
Calm	-.70	Alert	-.46		
Relaxed	-.76				
Comfortable	-.76				

Fig. 6.4: Grand averages of the (ACL) factor scores of Experiment I and II. Experiment II includes two treatments: original film order (ABC) and reversed film order (CBA). A correction is made for the reversed order of presentation.

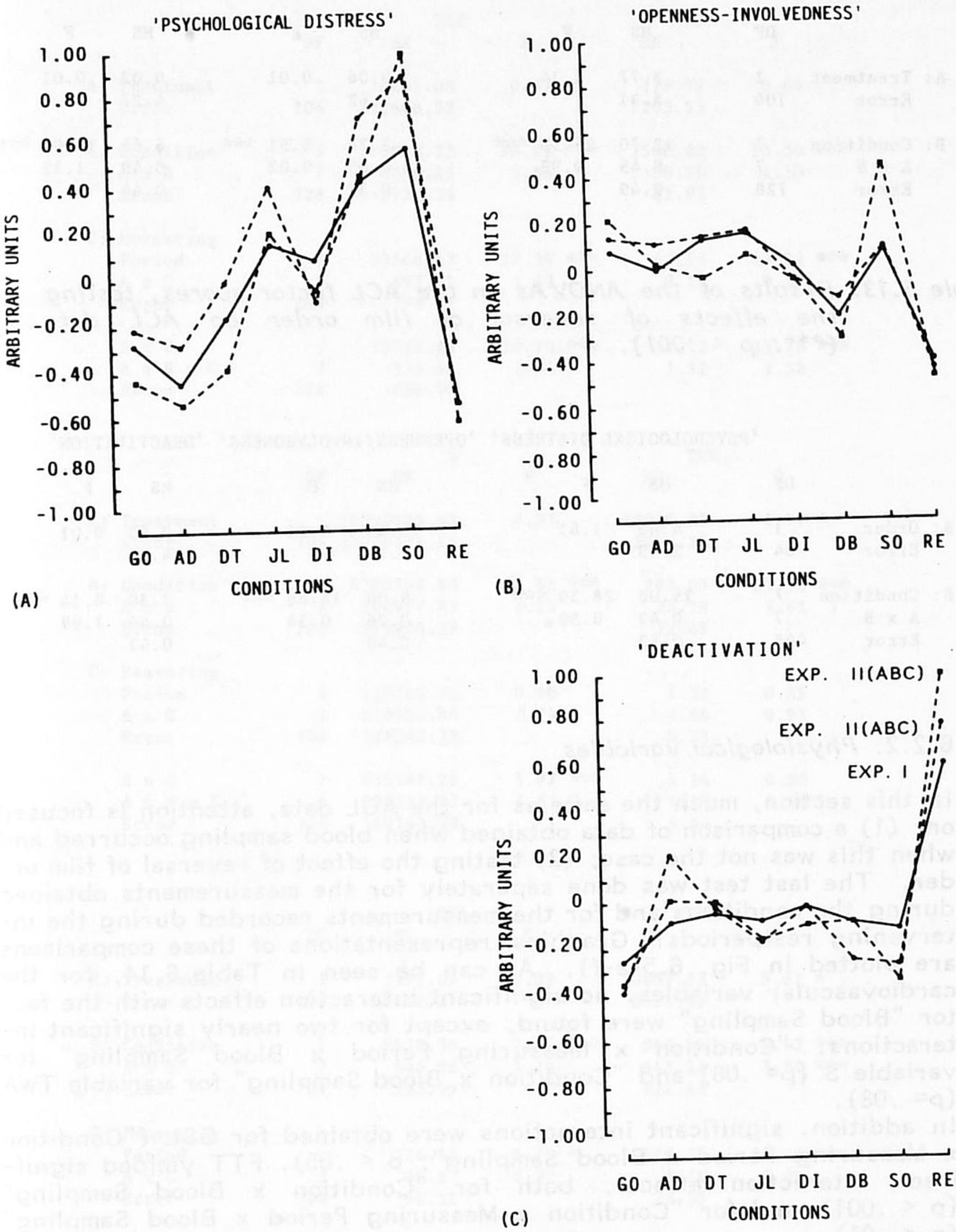


*Table 6.12: Results of the ANOVAs on the ACL factor scores, testing the effects of blood sampling on ACL data (***: p < .001).*

		'PSYCHOLOGICAL DISTRESS'			'OPENNESS/INVOLVEDNESS'			'DEACTIVATION'		
	DF	MS	F		MS	F		MS	F	
A: Treatment	1	3.77	1.14		0.06	0.01		0.02	0.01	
Error	104	3.31			5.62			4.27		
B: Condition	7	12.70	25.90	***	2.76	8.51	***	6.65	15.09	***
A x B	7	0.45	0.93		0.05	0.02		0.49	1.12	
Error	728	0.49			0.32			0.44		

*Table 6.13: Results of the ANOVAs on the ACL factor scores, testing the effects of reversal of film order on ACL data (***: p < .001).*

		'PSYCHOLOGICAL DISTRESS'			'OPENNESS/INVOLVEDNESS'			'DEACTIVATION'		
	DF	MS	F		MS	F		MS	F	
A: Order	1	4.40	1.81		0.04	0.01		0.03	0.01	
Error	64	2.43			3.73			4.98		
B: Condition	7	15.06	28.30	***	9.08	18.88	***	3.30	8.14	***
A x B	7	0.43	0.80		0.26	0.54		0.44	1.09	
Error	448	0.53			0.48			0.41		

6.2.2. *Physiological variables*

In this section, much the same as for the ACL data, attention is focused on: (1) a comparison of data obtained when blood sampling occurred and when this was not the case; (2) testing the effect of reversal of film order. The last test was done separately for the measurements obtained during the conditions and for the measurements recorded during the intervening restperiods. Graphical representations of these comparisons are plotted in Fig. 6.5(a-f). As can be seen in Table 6.14, for the cardiovascular variables, no significant interaction effects with the factor "Blood Sampling" were found, except for two nearly significant interactions: "Condition x Measuring Period x Blood Sampling" for variable S ($p = .08$) and "Condition x Blood Sampling" for variable TWA ($p = .08$).
In addition, significant interactions were obtained for GSL ("Condition x Measuring Period x Blood Sampling"; $p < .05$). FTT yielded significant interaction effects, both for "Condition x Blood Sampling" ($p < .001$) and for "Condition x Measuring Period x Blood Sampling" ($p < .01$).

*Table 6.14: Results of the ANOVAs on the (electro-)physiological data of Experiment I and II, testing the effects of blood sampling (T: .10 < p < .05; *: p < .05; **: p < .01; ***: p < .001).*

		IBI		PTT	
	DF	MS	F	MS	F
A: Treatment	1	78881.08	0.37	279.89	0.04
Error	104	213668.52		7203.53	
B: Condition	7	264930.33	96.93 ***	1500.82	18.30 ***
A x B	7	4250.85	1.56	90.20	1.10
Error	728	2733.30		82.01	
C: Measuring					
Period	1	30268.47	37.99 ***	43.54	43.54 ***
A x C	1	897.12	1.13	0.17	0.17
Error	104	796.75			
B x C	7	13022.11	18.70 ***	11.73	11.73 ***
A x B x C	7	933.54	1.34	1.32	1.32
Error	728	696.32			

		S		TWA	
	DF	MS	F	MS	F
A: Treatment	1	10590589.48	0.81	10020.22	4.77 *
Error	104	13076879.97		2098.97	
B: Condition	7	4700706.40	11.41 ***	282.03	21.95 ***
A x B	7	504977.43	1.23	23.19	1.81 T
Error	728	411878.29		12.85	
C: Measuring					
Period	1	110785.72	0.90	1.32	0.25
A x C	1	210035.84	1.71	4.84	0.91
Error	104	123042.10		5.31	
B x C	7	955545.28	5.97 ***	5.14	0.88
A x B x C	7	290249.27	1.81 T	3.17	0.54
Error	728	160168.79		5.84	

		GSL		FTT	
	DF	MS	F	MS	F
A: Treatment	1	3195.59	0.09	30837.57	5.61 *
Error	104	35632.87		5495.59	
B: Condition	7	2872.36	7.31 ***	940.11	4.42 ***
A x B	7	446.98	1.14	845.12	3.98 ***
Error	728	393.09		212.48	
C: Measuring					
Period	1	326.51	4.79 *	469.30	20.10 ***
A x C	1	62.91	0.92	2.10	0.09
Error	104	68.12		23.35	
B x C	7	237.35	6.32 ***	251.15	28.96 **
A x B x C	7	81.34	2.17 *	23.66	2.73
Error	728	37.55		8.67	

Table 6.15 reveals no significant interactions with "Order of Presentation" for the in between rest values of any of the physiological variables. Only PTT yields a trend towards significance for the "Order of Presentation x Condition" interaction (p= .10).
The main findings of the ANOVAs comparing measurements during conditions (Table 6.16) can be summarized as follows. For all variables, it holds that the interaction "Condition x Order of Presentation" is significant, while the triple interaction "Condition x Measuring Period x Order of Presentation" fails to reach the statistical level of significance.

*Table 6.15: Results of the ANOVAs on the (electro-)physiological data of the baseline measurements, testing the effects of reversal of film order (***: p < .001).*

		IBI			PTT	
	DF	MS	F		MS	F
A: Order	1	248820.92	1.69		380.12	0.11
Error	64	147131.76			3505.10	
B: Condition	8	61487.48	28.94	***	216.08	4.71 ***
A x B	8	1551.12	0.73		76.55	1.67 T
Error	512	2124.84			45.86	

		S			TWA	
	DF	MS	F		MS	F
A: Order	1	743900.66	0.05		23486836.36	2.47
Error	64	16269413.19			9496518.79	
B: Condition	8	1214202.48	4.27	***	438469.13	10.27 ***
A x B	8	268878.70	0.95		24276.03	0.57
Error	512	284292.55			42714.59	

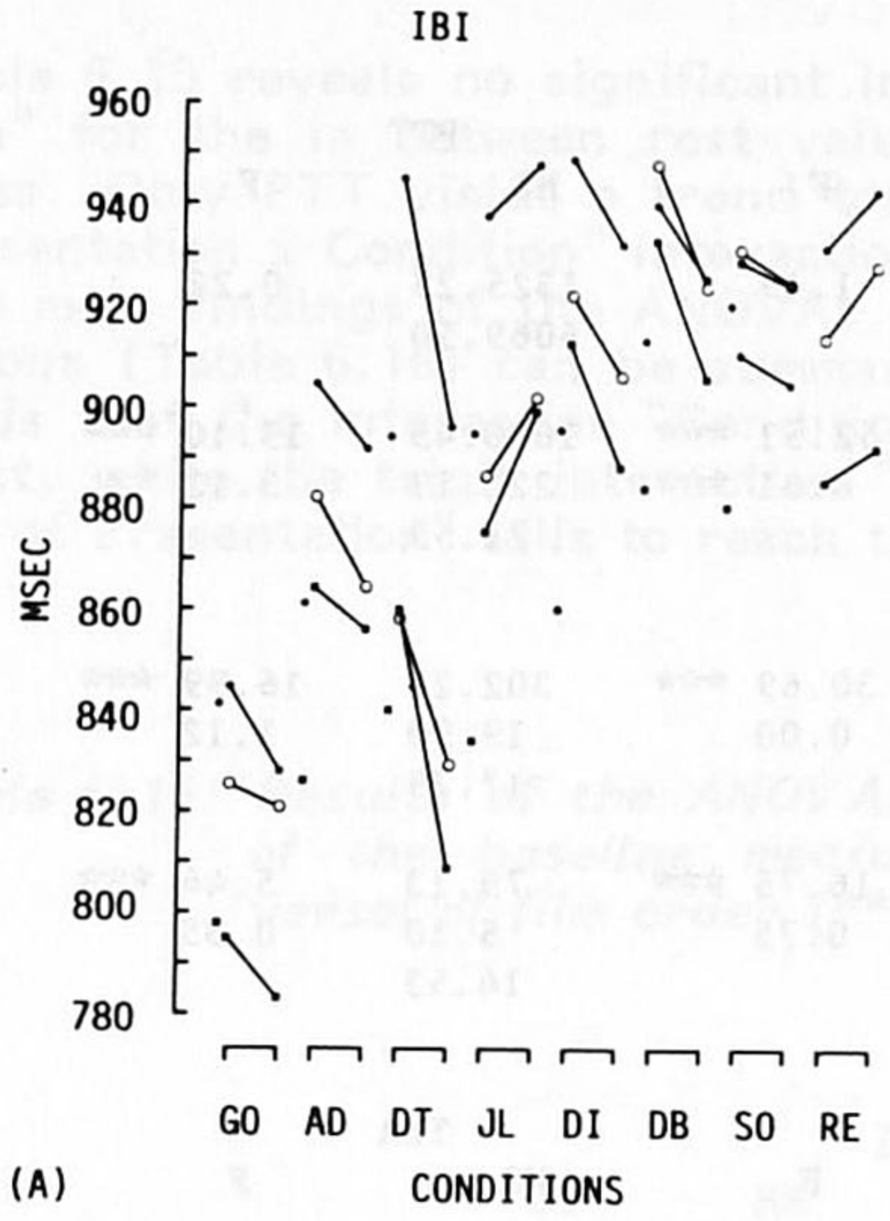
		GSL			FTT	
	DF	MS	F		MS	F
A: Order	1	141685.25	0.95		580.86	0.26
Error	64	148932.06			2242.90	
B: Condition	8	2895.70	11.60	***	728.02	6.84 ***
A x B	8	311.13	1.25		68.54	0.64
Error	512	249.68			106.41	

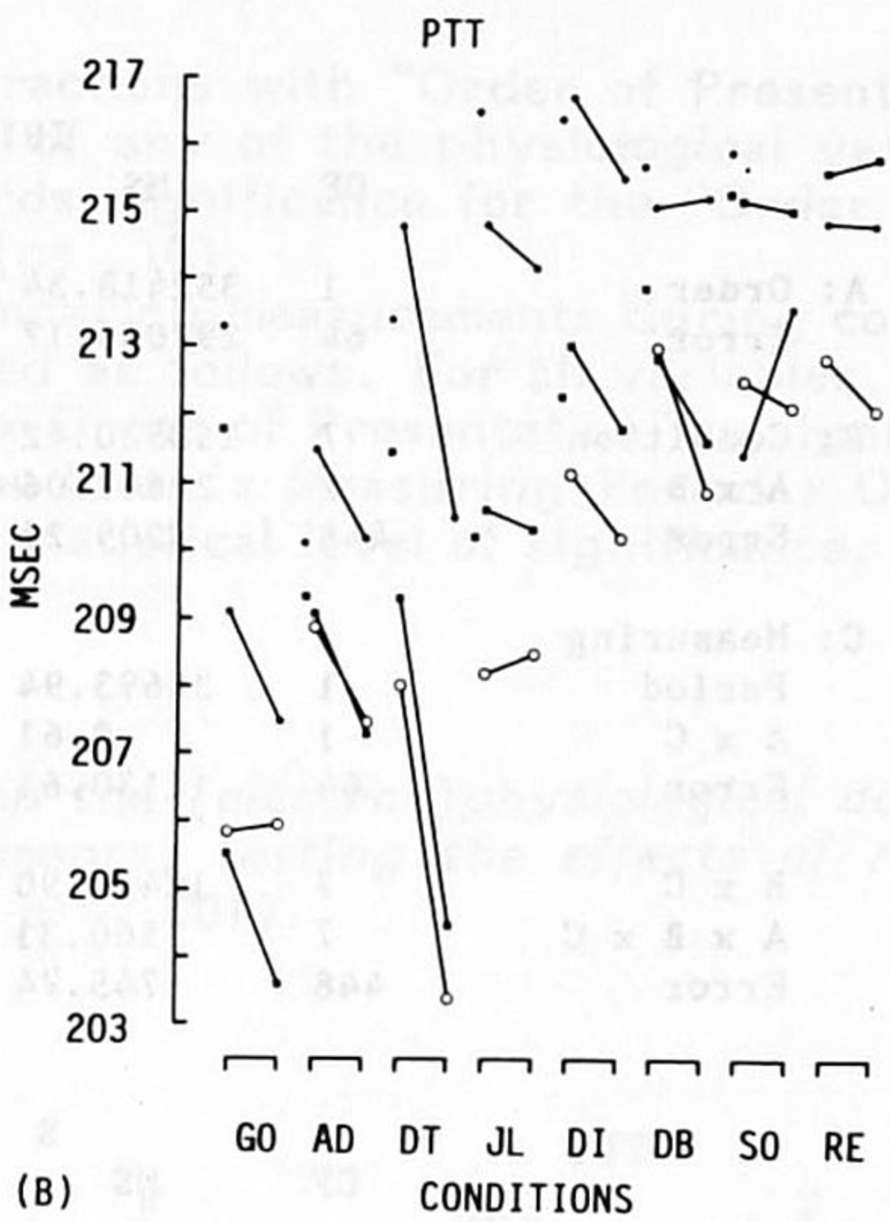
*Table 6.16: Results of the ANOVAs on the (electro-)physiological data, testing the effects of reversal of film order (T: .10 < p < .05; *: p < .05; **: p < .01; ***: p < .001).*

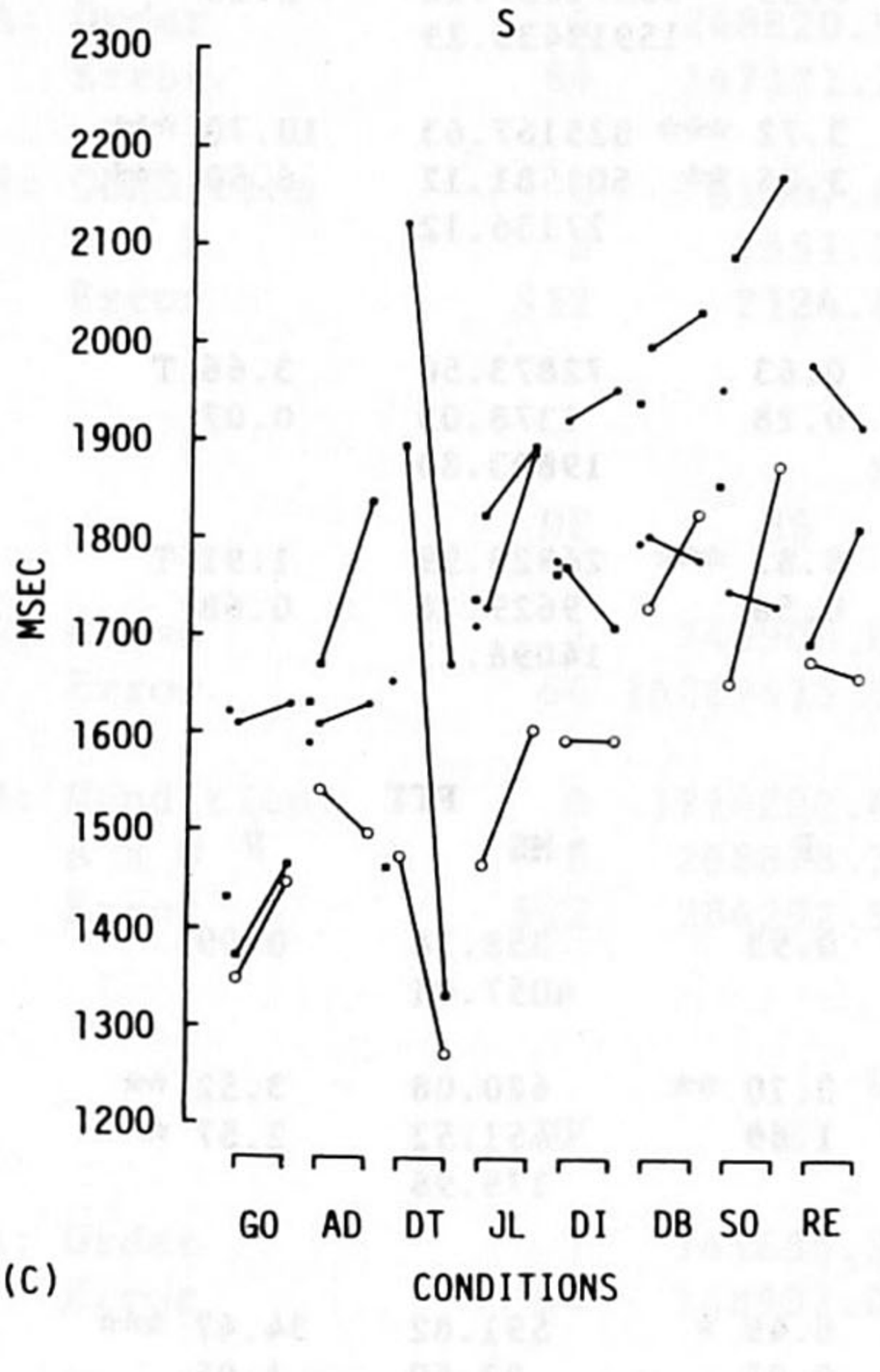
		IBI		PTT	
	DF	MS	F	MS	F
A: Order	1	352418.34	1.19	1325.25	0.22
Error	64	297036.17		6069.50	
B: Condition	7	168520.42	52.51 ***	1080.45	15.10 ***
A x B	7	27641.06	8.61 ***	223.19	3.12 **
Error	448	3209.21		71.53	
C: Measuring Period	1	34693.94	30.69 ***	302.27	16.99 ***
A x C	1	0.61	0.00	19.90	1.12
Error	64	1130.61		17.79	
B x C	7	12489.90	16.75 ***	79.13	5.44 ***
A x B x C	7	560.31	0.75	5.10	0.35
Error	448	745.74		14.53	

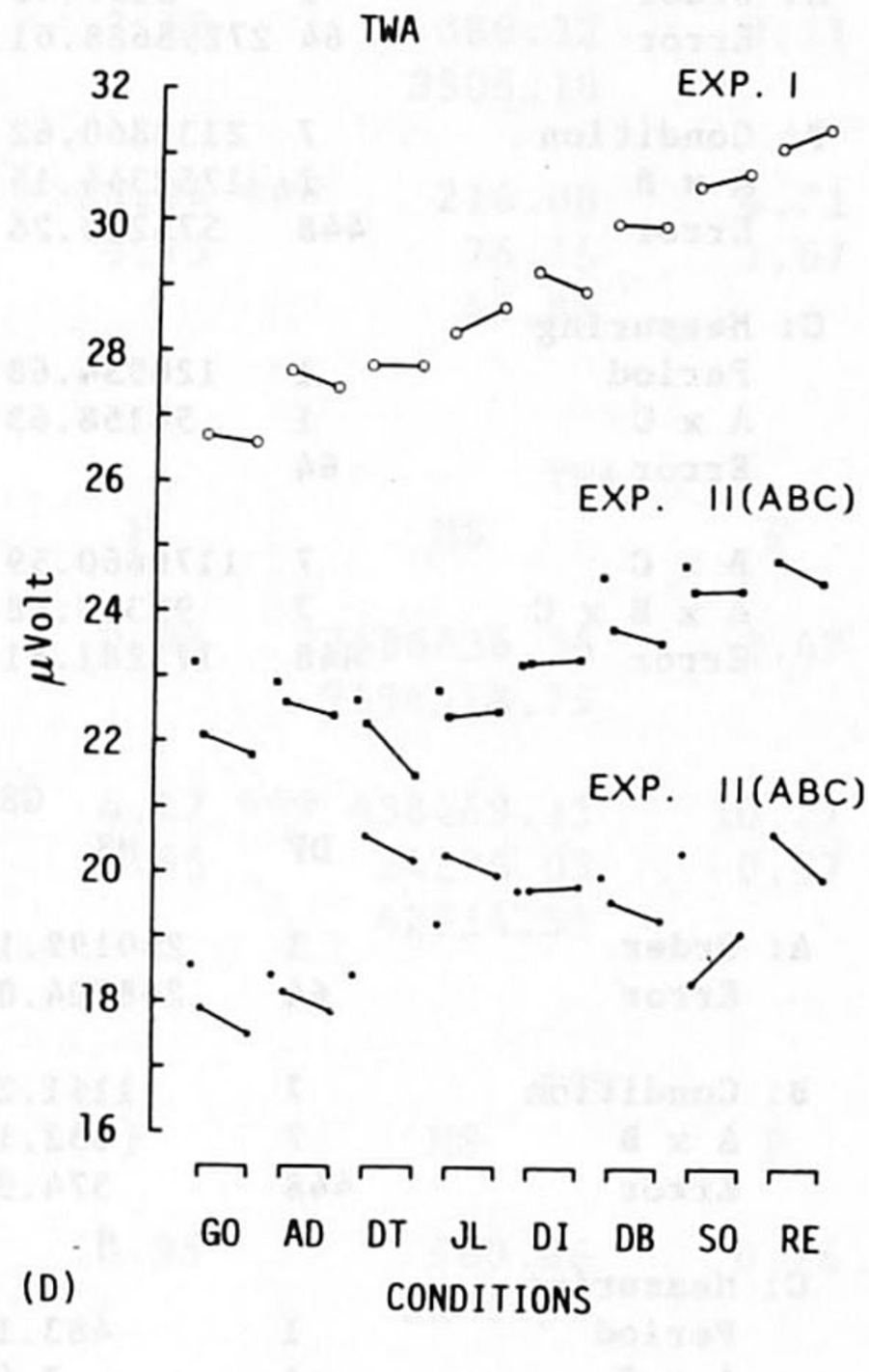
		S		TWA	
	DF	MS	F	MS	F
A: Order	1	2137.46	0.00	33371037.12	2.10
Error	64	27295688.61		15919433.29	
B: Condition	7	2138860.62	3.72 ***	825167.63	10.70 ***
A x B	7	1752344.15	3.05 **	501581.12	6.50 ***
Error	448	575229.26		77136.12	
C: Measuring Period	1	120954.68	0.63	72873.50	3.66 T
A x C	1	54158.63	0.28	1378.05	0.07
Error	64			19893.80	
B x C	7	1170660.59	6.83 ***	26929.99	1.91 T
A x B x C	7	99340.68	0.58	9629.16	0.68
Error	448	171281.81		14098.17	

		GSL		FTT	
	DF	MS	F	MS	F
A: Order	1	250199.13	0.93	358.38	0.09
Error	64	268304.07		4057.01	
B: Condition	7	1161.29	3.10 **	620.08	3.52 **
A x B	7	632.19	1.69	451.52	2.57 *
Error	448	374.94		175.96	
C: Measuring Period	1	483.19	6.49 *	591.82	34.47 ***
A x C	1	3.49	0.05	33.50	1.95
Error	64	74.41		17.17	
B x C	7	131.79	2.97 **	264.11	34.33 ***
A x B x C	7	60.91	1.37	6.13	0.80
Error	448	44.31		7.69	









-Fig. 6.5 to be continued-

Fig. 6.5 cont.

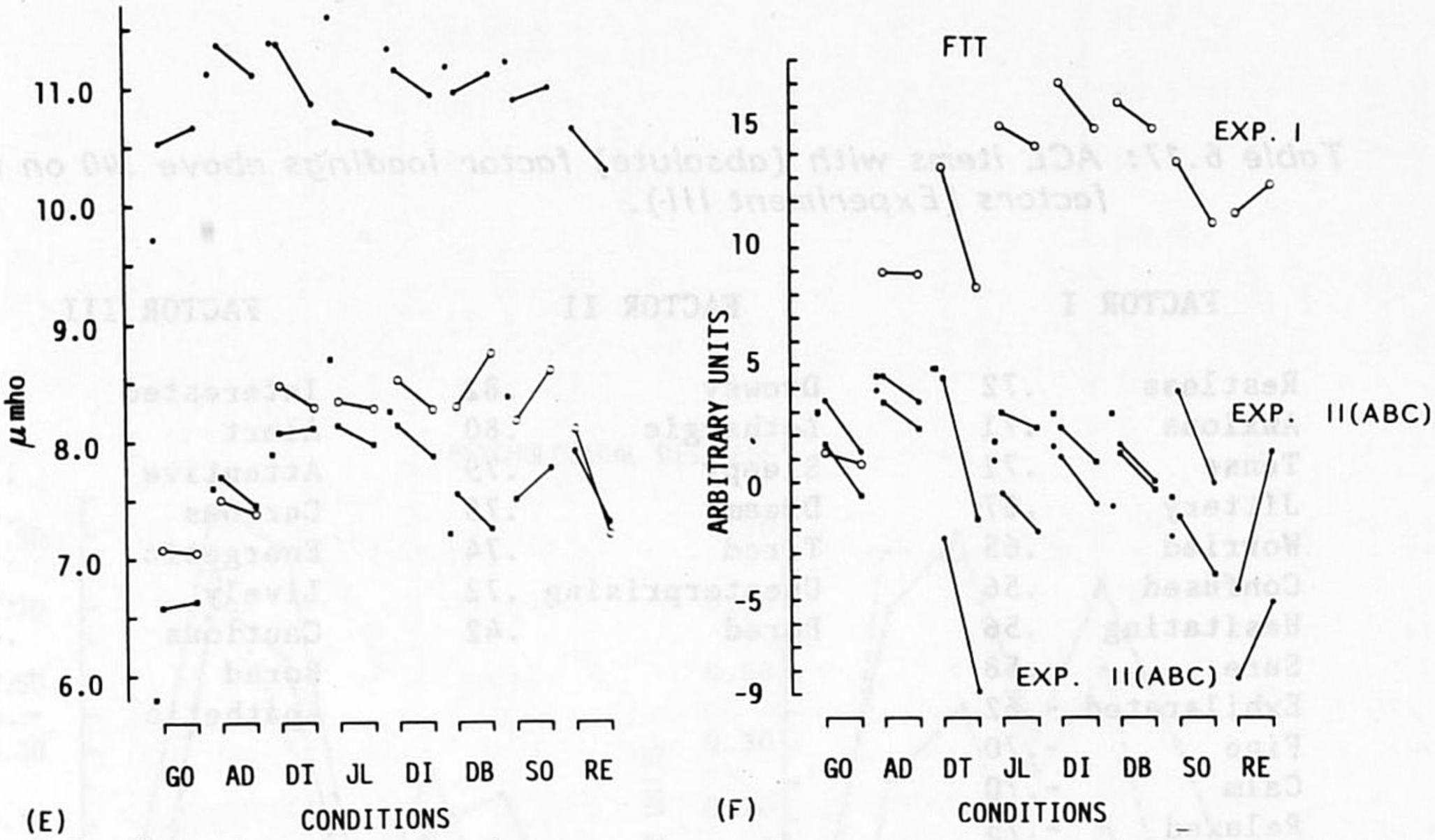


Fig. 6.5: Grand averages of the values of the (electro-)physiological variables of Experiment I and II. Each condition includes two measuring periods. Experiment II includes two treatments: original film order (ABC) and reversed film order (CBA). A correction is made for the reversed order of presentation.

6.3. *Experiment III*

6.3.1. *Introductory remarks*

Here, the most important results concern: (1) the stability of the responses over time (Experiment II *vs.* Experiment III); and (2) the stability of the responses after systematic variations in order and context ("Context" *vs.* "Latin Square" *vs.* "Stability").
These two issues were tested within one ANOVA design. Subjects were nested within factor A (Treatments: Context *vs.* Latin Square *vs.* Stability), whereas factor B (Replication: Session I *vs.* Session II), factor C (Conditions), and factor D (Measuring Period) (in case of physiological variables) were within-subject factors.

6.3.2. *ACL*

The ACL was considered in the same way as in experiments I and II. This again yielded 3 factors with eigenvalues greater than 2.0. Also, the amount of variance explained (50 per cent) proved to be about equal. The labeling also was identical to the previous experiments. Table 6.17 gives a listing of those items which have loadings greater than .40. Comparison of these ACL factors to those from experiment II again indicates a similarity (factor 1-1: phi= .99; factor 2-2: phi= .98; and factor 3-3: phi= .94).

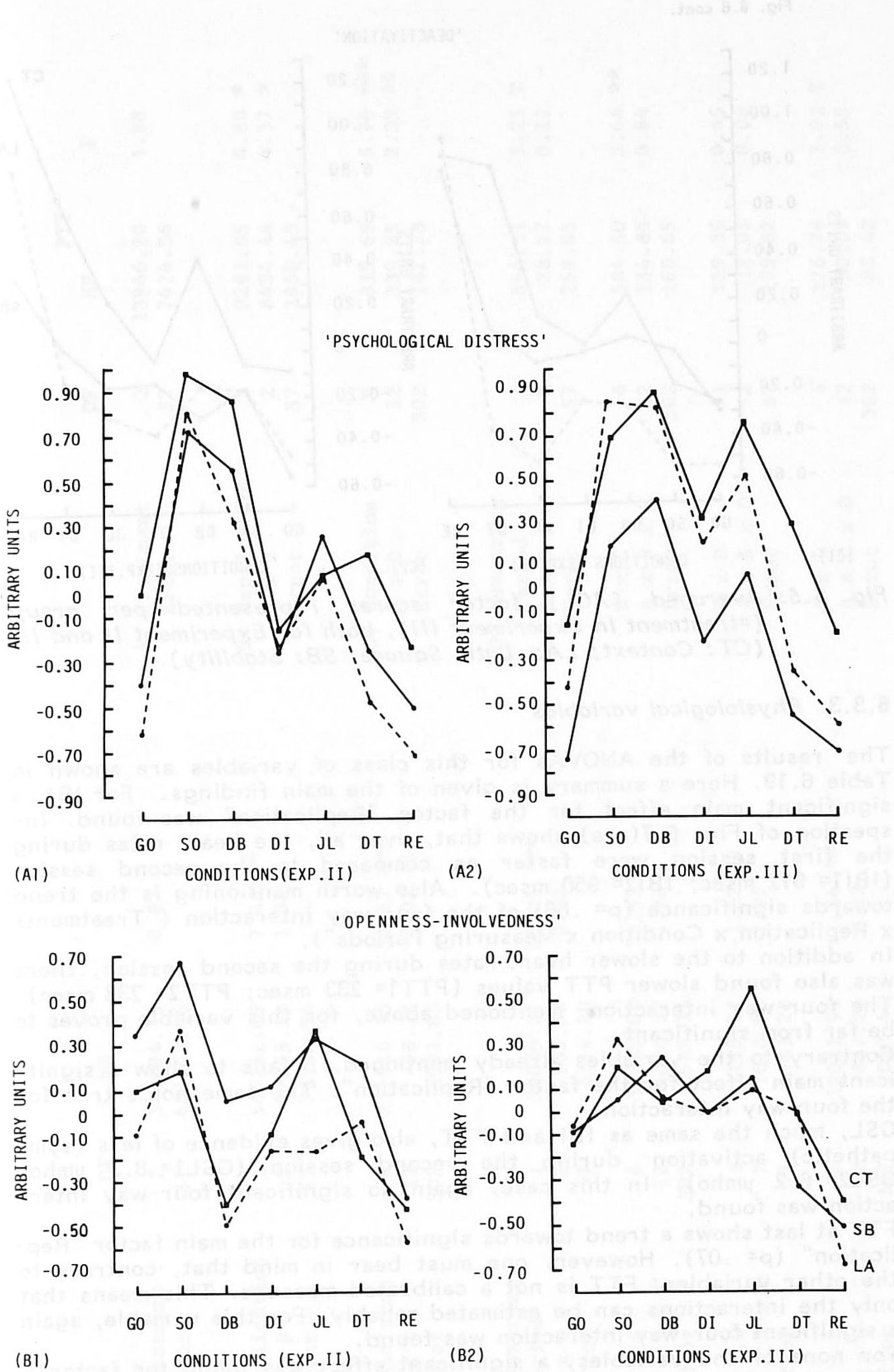
Table 6.17: ACL items with (absolute) factor loadings above .40 on the factors (Experiment III).

FACTOR I		FACTOR II		FACTOR III	
Restless	.72	Drowsy	.82	Interested	.77
Anxious	.71	Lethargic	.80	Alert	.75
Tense	.71	Sleepy	.79	Attentive	.73
Jittery	.67	Dreamy	.75	Curious	.61
Worried	.65	Tired	.74	Energetic	.61
Confused	.56	Unenterprising	.72	Lively	.60
Hesitating	.56	Bored	.42	Cautious	.45
Sure	-.58			Bored	-.41
Exhilarated	-.62			Apathetic	-.45
Fine	-.70				
Calm	-.70				
Relaxed	-.75				
Comfortable	-.77				

*Table 6.18: Results of the ANOVAs on the ACL factor scores of Experiment II and III, testing the consistency of the ACL data (T: .10 < p < .05; *: p < .05; **: p < .01; ***: p < .001).*

		'PSYCHOLOGICAL DISTRESS'		'OPENNESS/INVOLVEDNESS'		'DEACTIVATION'	
	DF	MS	F	MS	F/	MS	F
A: Treatment	2	6.63	2.06	2.00	0.38	13.37	2.86 T
Error	57	3.21		5.24		4.67	
B: Replication	1	0.38	0.33	0.13	0.07	0.01	0.01
A x B	2	4.55	3.91 *	3.20	1.72	2.36	1.33
C: Condition	6	24.90	34.70 ***	7.38	13.15 ***	18.34	30.13 ***
A x C	12	1.13	1.57 T	0.50	0.89	0.66	1.08
Error	302	0.72		0.56		0.61	
B x C	6	1.05	3.16 **	1.35	4.24 **	0.17	0.50
A x B x C	12	0.18	0.54	0.18	0.56	0.27	0.83
Error	302	0.33		0.32		0.33	

Table 6.18(a-c) represents the results of the analyses of the psychological data. The most important result is that, for each variable, the triple interaction "Treatment x Replication x Condition" is far from significant. In addition, except for a tendency for the main factor "Treatment" for the Deactivation dimension (p= .06), no significant main effects were found neither for this main factor as well as for the factor "Replication". The factor "Condition" again yields reliable effects for each of the three dimensions. The results are shown in Fig. 6.6(a-c).



-Fig. 6.6 to be continued-

Fig. 6.6 cont.

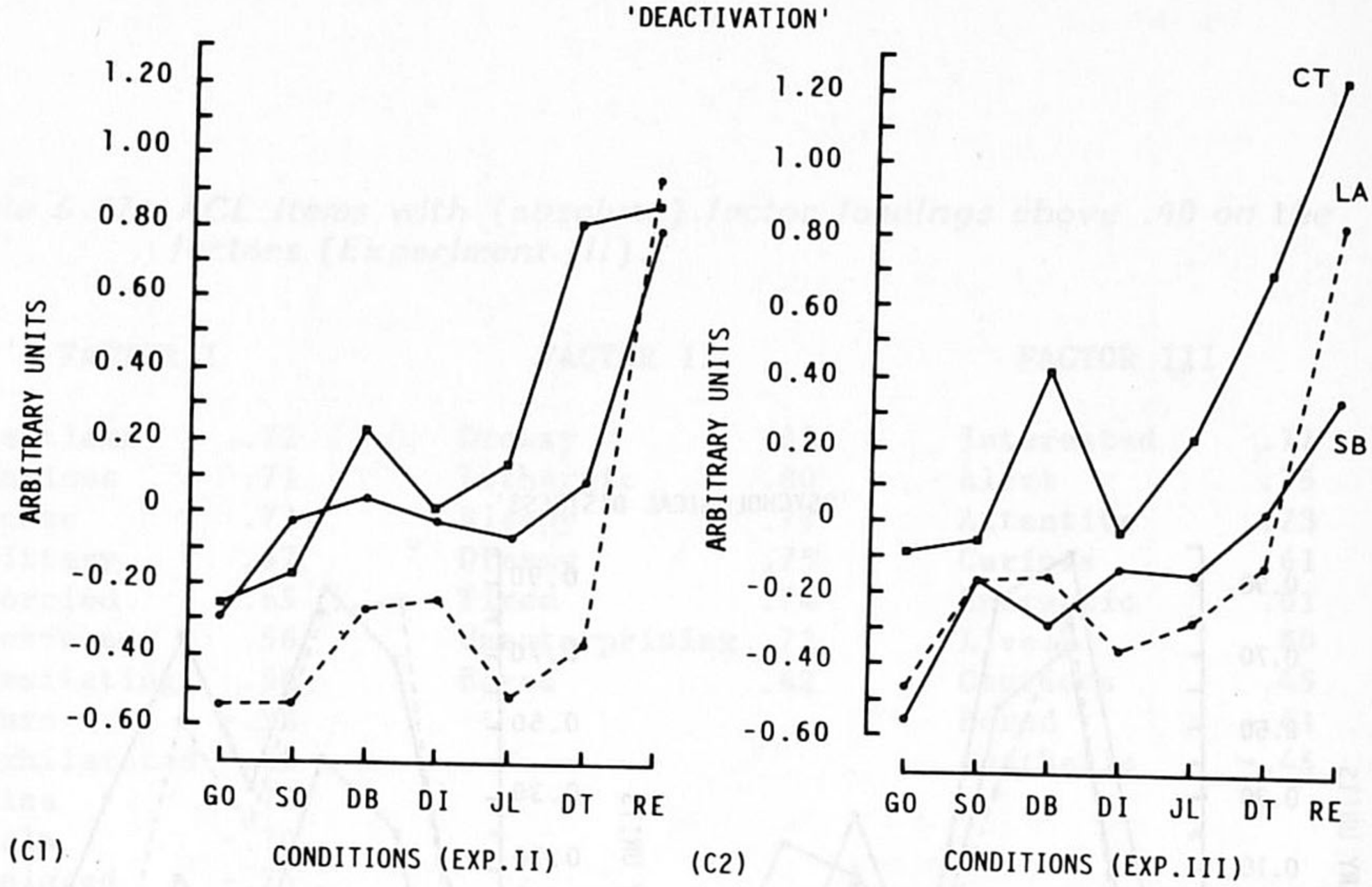


Fig. 6.6: Averaged (ACL) factor scores represented per group (=treatment in Experiment III), both for Experiment II and III (CT: Context; LA: Latin Square; SB: Stability).

6.3.3. *Physiological variables*

The results of the ANOVAs for this class of variables are shown in Table 6.19. Here a summary is given of the main findings. For IBI, a significant main effect for the factor "Replication" was found. Inspection of Fig. 6.7(a-e) shows that, over all, the heart rates during the first session were faster as compared to the second session (IBI1= 912 msec; IBI2= 950 msec). Also worth mentioning is the trend towards significance (p= .06) of the four-way interaction ("Treatments x Replication x Condition x Measuring Periods").
In addition to the slower heart rates during the second session, there was also found slower PTT values (PTT1= 233 msec; PTT2= 238 msec). The four-way interaction, mentioned above, for this variable proves to be far from significant.
Contrary to the variables already mentioned, S fails to show a significant main effect for the factor "Replication". The same holds true for the four-way interaction.
GSL, much the same as IBI and PTT, also gives evidence of less (sympathetic) activation during the second session (GSL1= 8.3 µmho; GSL2= 6.2 µmho). In this case, again no significant four-way interaction was found.
FTT at last shows a trend towards significance for the main factor "Replication" (p= .07). However, one must bear in mind that, contrary to the other variables, FTT is not a calibrated measure. This means that only the interactions can be estimated reliably. For this variable, again a significant four-way interaction was found.
For none of the variables, a significant effect was found for factor A ("Treatment"), whereas the results show reliable differences between conditions (factor C).

Table 6.19: Results of the ANOVAs on the (electro-)physiological data of Experiment II and III, testing the consistency of the physiological data (T: .10 < p < .05; *: p < .05; **: p < .01; ***: p < .001).

	IBI			PTT		
	DF	MS	F	DF	MS	F
A: Treatment	2	347694.13	0.87	2	13946.20	1.88
Error	57	401261.06		57	7424.36	
B: Replication	1	546242.69	7.46 **	1	9261.85	4.80 *
A x B	2	97855.58	1.34	2	8434.44	4.37 *
Error	57	73170.94		57	1930.43	
C: Condition	6	211510.33	53.52 ***	6	819.69	5.76 ***
A x C	12	-98.73	-0.02 1)	12	339.85	2.39 **
Error	302	3951.83		302	142.28	
D: Measuring						
Period	1	50089.77	41.25 ***	1	844.31	3.25 T
A x D	2	989.33	0.81	2	28.27	0.11
Error	57	1214.20		57	259.83	
B x C	6	35265.00	13.92	6	584.50	3.64 **
A x B x C	12	4866.32	1.92	12	134.84	0.84
Error	302	2532.73		302	160.65	
B x D	1	-1193.77	-1.22 1)	1	129.36	0.65
A x B x D	2	1028.98	1.05	2	12.05	0.06
Error	57	981.28		57	199.82	
C x D	6	12021.93	11.34 ***	6	176.76	1.92 T
A x C x D	12	867.26	0.82	12	50.67	0.55
Error	302	1060.40		302	92.42	
B x C x D	6	4232.77	6.32 ***	6	46.79	0.59
A x B x C x D	12	1152.44	1.72 T	12	40.50	0.51
Error	292	669.88		292	79.41	

1) N.B. negative F-ratio.

-Table 6.19 to be continued-

Table 6.19 cont.

S

		DF	MS	F	
A:	Treatment	2	56095220.00	1.42	
	Error	57	39560152.00		
B:	Replication	1	1732221.10	0.34	
	A x B	2	9417629.00	1.85	
	Error	57	5086564.00		
C:	Condition	6	2968919.30	6.10	***
	A x C	12	1297265.00	2.66	**
	Error	302	487055.84		
D:	Measuring Period	1	1322.2	0.00	
	A x D	2	8802.87	0.03	
	Error	57	304761.53		
	B x C	6	225946.33	0.42	
	A x B x C	12	332816.75	0.62	
	Error	302	532542.75		
	B x D	1	905869.13	4.05	*
	A x B x D	2	347767.69	1.55	
	Error	57	223885.61		
	C x D	6	918371.25	2.88	**
	A x C x D	12	276074.53	0.86	
	Error	302	319372.91		
	B x C x D	6	788856.56	3.95	**
	A x B x C x D	12	134317.64	0.67	
	Error	291	199874.34		

-Table 6.19 to be continued-

Table 6.19 cont.

	GSL DF	GSL MS	GSL F	FTT DF	FTT MS	FTT F
A: Treatment	2	4478.89	0.08	2	210.48	0.08
Error	57	57356.53		57	2459.11	
B: Replication	1	154547.05	5.26 *	1	9379.22	3.18 T
A x B	2	9907.87	0.34	2	340.37	0.12
Error	50	29379.04		56	2945.89	
C: Condition	6	2018.86	5.90 ***	6	2491.69	16.31 ***
A x C	12	1188.65	3.48 ***	12	307.93	2.02 *
Error	302	341.90		302	152.75	
D: Measuring Period	1	2034.30	13.56 ***	1	931.85	67.96 ***
A x D	2	147.08	0.98	2	39.44	2.88 T
Error	57	150.04		57	13.71	
B x C	6	1149.02	5.34 ***	6	312.18	1.85
A x B x C	12	226.69	1.05	12	234.78	1.39
Error	263	215.10		277	168.49	
B x D	1	358.04	4.41 *	1	21.53	0.91
A x B x D	2	82.33	1.01	2	24.43	1.03
Error	50	81.25		56	23.60	
C x D	6	302.74	6.93 ***	6	199.70	13.69 ***
A x C x D	12	134.66	3.08 ***	12	12.15	0.83
Error	302			302	14.59	
B x C x D	6	81.44	1.92 T	6	90.31	10.01 ***
A x B x C x D	12	23.46	0.55	12	17.04	1.89 *
Error	262	42.41		273	9.02	

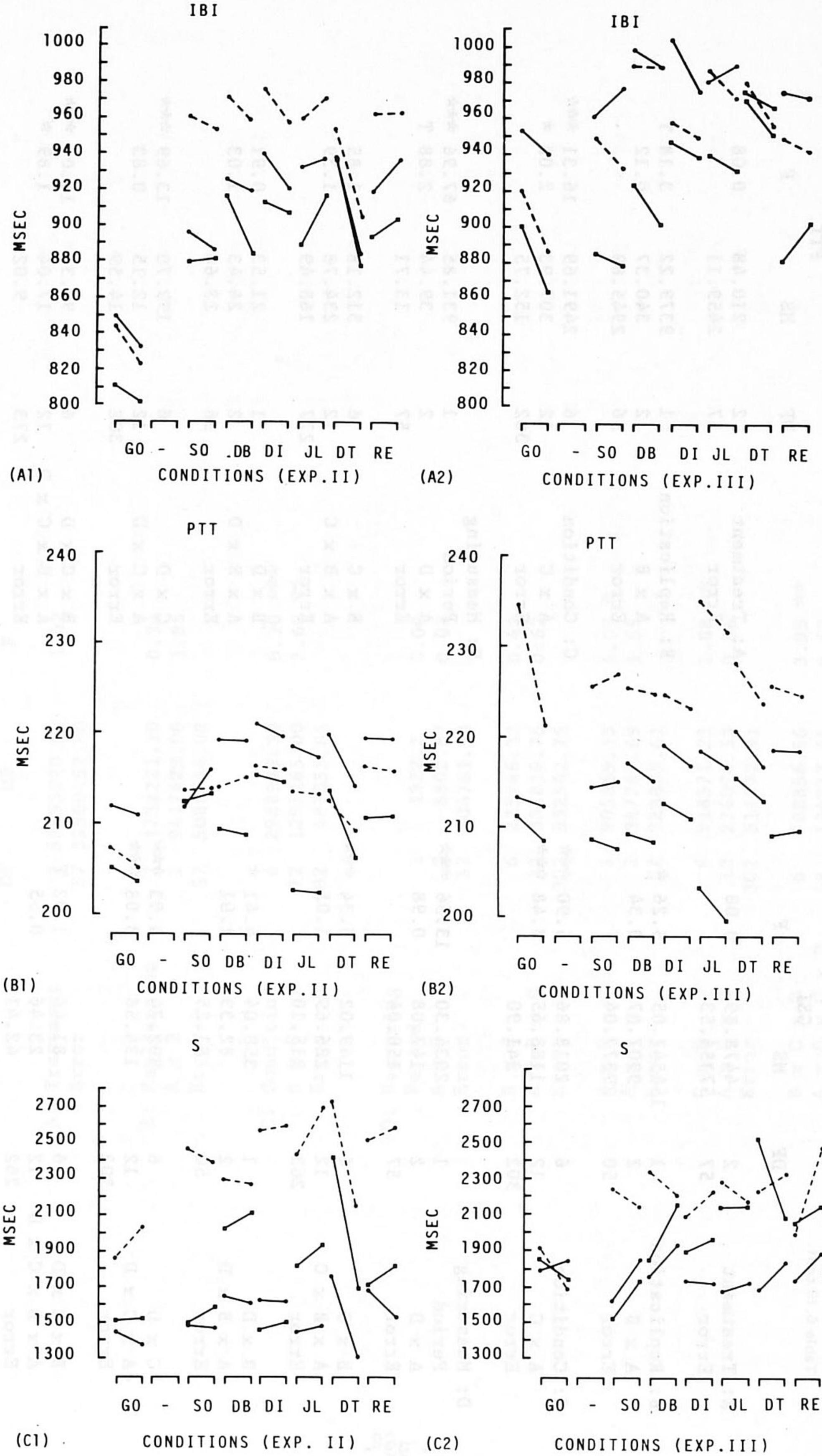

IBI
1000
980
960
940
920
900
880
860
840
820
800
MSEC
GO - SO DB DI JL DT RE
(A1)
CONDITIONS (EXP.II)
IBI
1000
980
960
940
920
900
880
860
840
820
800
MSEC
GO - SO DB DI JL DT RE
(A2)
CONDITIONS (EXP.III)
PTT
240
230
220
210
200
MSEC
GO - SO DB DI JL DT RE
(B1)
CONDITIONS (EXP.II)
PTT
240
230
220
210
200
MSEC
GO - SO DB DI JL DT RE
(B2)
CONDITIONS (EXP.III)
S
2700
2500
2300
2100
1900
1700
1500
1300
MSEC
GO - SO DB DI JL DT RE
(C1)
CONDITIONS (EXP. II)
S
2700
2500
2300
2100
1900
1700
1500
1300
MSEC
LA
CT
SB
GO - SO DB DI JL DT RE
(C2)
CONDITIONS (EXP.III)

Fig. 6.7 cont.

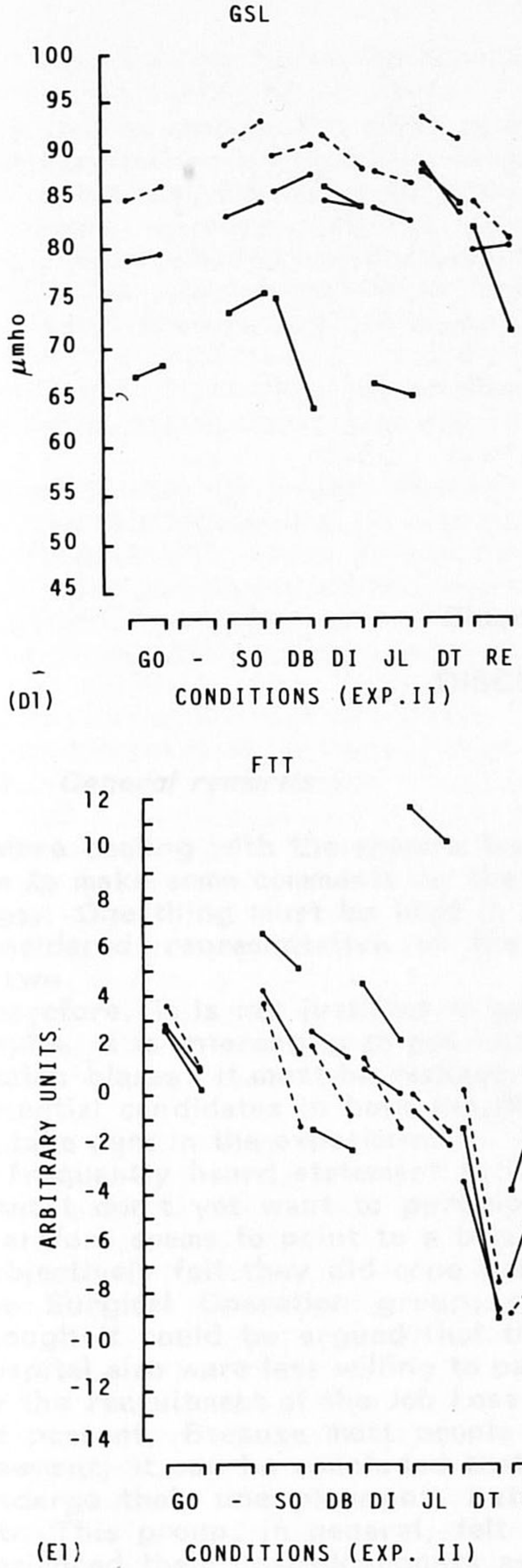


Fig. 6.7: Averaged values of the (electro-)physiological variables, represented per group (=treatment in Experiment III), both for Experiment II and III (CT: Context; LA: Latin Square; SB: Stability).

Chapter VII

DISCUSSION

7.1. *General remarks*

Before dealing with the specific issues in this study, it seems appropriate to make some comments on the generalizability of the present findings. One thing must be kept in mind: the present samples cannot be considered representative of the populations from which they were drawn.
Therefore, it is not justified to generalize beyond the present samples. Maybe, it is interesting to put forward some hypotheses on possible selection biases. It must be realized that only about thirty per cent of the potential candidates in both the Divorce and the Death group consented to take part in the experiment.
A frequently heard statement in the Death group was "No, at this moment I don't yet want to participate. I haven't digested it yet". This therefore seems to point to a bias in the direction of those people who subjectively felt they did cope well with the situation. With respect to the Surgical Operation group, speculations can hardly be made, although it could be argued that those men who had a hard time in the hospital also were less willing to participate.
In the recruitment of the Job Loss group probably also large biases may be present. Because most people in this group reacted to our advertisement, it can be concluded that most of these men did not passively undergo their unemployment, but invested great efforts to find a new job. This group, in general, felt very uncomfortable because they experienced their unemployedness as boring and often made remarks concerning their feelings as being second grade or inferior people. A main reason for taking part was that they then could do something useful.

Therefore, the possibility may not be ruled out that in the Death and the Divorce groups, there is a bias towards people who dealt adequately with their problems, whereas in the Job Loss group, there is an overrepresentation of people who did not cope well with their unemployment.

7.2. *Life events and coping*

As can be concluded from the results in Table 6.1, scores on both scales of the WCC(gen) were not influenced by having experienced a specific life event. However, when being asked for the specific coping strategies used to deal with their specific stressful encounter (WCC(spe)), differences were found (Table 6.2). Especially the Death group gave proof of less P-coping, and, more surprizingly, also of less E-coping, although in the latter case the difference did not reach statistical significance.
These results seem to imply that specific coping patterns to a large extent depend on the characteristics of the situation, as suggested by Folkman and Lazarus (1980) and Fleishman (1984).
The correlations between WCC(gen) and WCC(spe) (.53 and .54 for the E-scale and the P-scale, respectively) give an estimate of the degree, to which coping is determined respectively by personality factors and situational factors. Given the above mentioned correlations, one could conclude that, at best, 25 per cent of the variance can be attributed to (more stable) personality characteristics, leaving about 75 per cent for the specific situation and error.

One must bear in mind, however, that these correlation coefficients were calculated over situations. This may tremendously affect the results, because the possibility may not be overlooked that the relationship between general coping tendency and actual coping behavior differs greatly dependent on the specific situation. Although the samples are rather small to warrant firm conclusions, these suggestions seem to be supported by the great differences that were found between the four experimental groups.
This seems to hold true especially for the P-scale. These correlations vary from .83 (for the Divorce group) to .13 (for the Death group). The Job Loss and Surgical Operation groups, respectively, have correlations of .32 and .60.
For the E-scale the correlations are .81 for the Divorce group; .41 for the Job Loss group; .46 for the Surgical Operation group; and, for the Death group, the correlation between the WCC(gen) and the WCC(spe) for the E-scale is .42.
It may be considered to what extent these differences between correlations may be explained by the degree to which all items apply to a specific situation. For example, in case of death, mostly, no one can be held responsible for it. This implies that for several items (especially of the P-scale) the response had to be "do not apply", rather than simply "no". In this way, the correlation between the WCC(gen) and the WCC(spe) more or less artificiallly became relatively low, because a number of items only applies in the WCC(gen). This point of view seems to be supported by the fact that the lowest values were found for the P-scale in the Death group.

For this reason, it is believed that the present approach of taking the general version of the WCC in which it is considered the dominance of P-coping to E-coping as a more stable person characteristic, is warranted. The alternatives do not appear to be practical. That would imply that a reference group for each experimental group was taken. In

practice, that means four reference groups of people who also did experience that particular life event.

7.3. *Coping and baseline endocrine activity*

Low but significant associations between coping and endocrine (baseline) values were found. These results may be considered to favor the conclusion that coping strategies, to some degree, are determined by the physiological make-up of the person, or, alternatively, that the levels of endocrine variables are partly dependent on the characteristic behavior pattern of the organism.

The evidence from animal research cited by Henry and Stephens (1977) and Henry (1982) clearly supports the latter view. Changes in endocrine functioning appear to be secondary to changes in the environment, or, to put it more precisely, to changes in the interaction or relationship with the environment. Research with Type A persons leads to the same conclusions. The results of several studies indicate that differences in physiological functioning between Type As and Type Bs can only be found in those situations, which specificially appeal to the characteristic features of the Type A personality, such as aggressiveness and time pressure. This conclusion challenges the validity of the concept of a "cortisol personality" and a "catecholamine personality" as put forward by Ursin (1980).
In my opinion there are more reasons to question the conclusions of Ursin *et al.* (1978) and Ursin (1980). I think it is warranted to speak of a "cortisol personality", only if (1) it has been shown that *rest* (baseline) values of plasma cortisol show an association with psychological and/or behavioral characteristics; or (2) if it has been shown that, regardless of the nature of the stimulation, an individual *always* responds with an increase in cortisol ("individual response specificity").

Until now, however, in the literature no data are available corroborating either of the two statements. Ursin *et al.* (1978) only showed that, in a relatively small sample (N= 44), relationships existed between some indices of change ("rise", "activation" and "fall" index) and psychological variables. For the basal values some associations were found for the accepted men only, not for the total sample. Remarkably, in a more recent study by coworkers of Ursin (Vaernes *et al.*, 1982), data are analyzed in a totally different way.....to reach the same conclusions as in the earlier experiments.
In the Vaernes *et al.* (1982) study absolute post-stress levels of endocrine variables were factor analyzed, and, next, correlations were calculated between the factor scores on the endocrine factors and the psychological data. In the Ursin *et al.* (1978) study, on the contrary, psychological and endocrine data served as input for one and the same factor analysis.
Nevertheless, Ursin (1980) adheres to the following theory: The somatic response to external and internal central nervous system stimulation is a general "activation" response, affecting most or all bodily processes. Although a general response, individuals may vary to a large extent in the patterns of reactions. Ursin does not deny the importance of the

nature of the stimulation, but rather he emphasizes the individual variance related to specific personality traits.

Rose *et al.* (1982b) examined seventy-six psychological variables (both trait and state measurements) for their potential relationship to endocrine responses and levels in a comprehensive study involving 416 air traffic controllers.
In a normative approach (*i.e.*, utilizing average values for each subject and comparing subjects with each other) no stable psychological predictors of differences in cortisol and hGH responses were found. These results therefore also appear to cast doubt on the existence of stable trait characteristics as predictors of endocrine (more precisely, cortisol and hGH) baseline levels.

Summarizing the results for cortisol, the following picture emerges:

1. Henry and Stephens (1977) and Henry (1980, 1982) point out much evidence emphasizing the importance of the specific person-situation interaction.
2. Rose *et al.* (1982b) failed to find significant relationships between psychological trait variables and cortisol. In an ipsative approach (comparing each man with himself), however, significant differences between a high cortisol day and a low cortisol day were found for some psychological variables (*e.g.*, depression, fatigue, vigour, subjective difficulty and psychological response to work).
3. Baade *et al.* (1978) carried out several analyses both with basal values, as well as absolute rise levels and a fall index. In another study by the group of Ursin (Vaernes *et al.*, 1982), analyses were carried out on samples collected after an acute stress situation. This makes things complicated. It is not clear to what extent Ursin's theory is based on reactivity scores or on absolute level scores.
4. In the present investigation, much the same as in the Rose *et al.* (1982b) study, there was not found a relationship between baseline values of cortisol and the present operationalization of coping.

Taken together the results of these studies, one must conclude that the evidence for a "cortisol" personality, indicating a relationship between rather stable psychological characteristics and plasma level of cortisol is meagre at best. That amplitudes of reactions are dependent on psychological variables fits well within the hypothesis that "uncertainty" and "degree of perceived control" are important determinants of activation of the pituitary-adrenal axis. This, however, does not necessarily imply that "how one sees it" is independent on more stable personality characteristics. Nevertheless, in the present study, coping style and cortisol levels apparently were unrelated.

A somewhat different picture emerges for the catecholamines. Here a relationship between baseline levels of both adrenaline and noradrenaline and P-coping was found. These results seem to corroborate the findings in several investigations which all point to an association between catecholamines and adequate, active functioning, and good performance in terms of speed, endurance and attention as well as perceptual motor performance (*cf.* Frankenheauser, 1971, 1975, 1980a,b). The data presented by Ursin *et al.* (1979), as well as our own data seem to corroborate this point of view.

There remains the finding of an association between hGH and ACTH and E-coping. As far as is known, until now, there hardly were investigations studying the relationship between these two pituitary anterior hormones and psychological variables. It is interesting that the present findings seem to fit well within the hypothesis relating cortisol and psychological functioning. The E-scale consists of items of the domain of defense mechanisms, such as suppression, avoidance, and wishful thinking. However, Baade *et al.* (1978) do not report on any relationship between hGH and defense. In contrast, both Kurokawa *et al.* (1977) and Kosten *et al.* (1984) point out the relevance of "defensiveness" as a characteristic of hGH responders to stressful encounters.

Given the findings hitherto, the conclusion mostly warranted is that, although there probably is a personality structure which predisposes to a particular way of coping, the major determinant appears to be the (evaluation of the) situation. Once more, this is not to say that this appraisal is totally independent of personality characteristics.
Except for cortisol, the present results are in agreement with the hypothesis to be tested. P-coping and E-coping, at the endocrine level, show a differentiation as could be expected from the model of Henry and Stephens, under the assumption that P-coping is related to "fight-flight", and E-coping is associated with "conservation- withdrawal".

7.4. *Life events, coping, and MQ*

Contrary to expectations, no extraordinarily high scores on the MQ were found for the experimental groups, except for the Job Loss group. Striking are the particularly low scores for the Death group. This result may be interpreted as supporting the above mentioned views concerning biases in the sampling procedure. Perhaps, especially in the Death group, the subjects who took part can be described as rather indifferent and careless. This point of view receives some support from the finding that this group also showed a tendency towards lower overall scores on the ACL factor I ("Psychological Distress"). This (in some sense nearly pathological) strategy of not letting things get to you and minimizing the things that are happening has been characterized as an efficient buffer against the malignant effects of stress.

The association between coping and MQ is clearer. People qualified as E-copers show higher scores on the MQ than P-copers. Much the same as with many similar problems, the question of "cause and effect" here also arises.
Theoretically, there are at least three alternatives: (1) E-coping is a less efficient coping style, which implies that the adverse effects of stress are not sufficiently buffered against resulting in psychological and physiological malfunctioning; (2) people suffering from vague complaints generally are not prone to active coping, but take a more resigning way of dealing with problems; and (3) both coping style and complaints are associated with a third (*e.g.*, personality) variable, such as neuroticism.
Since, as far as is known, no more information is available about the WCC and the MQ, it is difficult to make a well reasoned choice between

these alternatives. However, data are reported indicating a significant association between neuroticism and self-reports of being "worn-out" and being "up-tight" (Cox *et al.*, 1983). In addition, Costa and McCrae (1980) provide direct evidence favoring the hypothesis that neuroticism is associated with a tendency to report more somatic complaints.
Apart from the exact nature of the relationship between E-coping and complaints as measured by the MQ, this is an interesting finding because, in the literature, "conservation-withdrawal" has been reported to be associated with concepts as "depression" and "learned helplessness" (Engel and Schmale, 1972; Henry and Stephens, 1977).

7.5. *Life events, coping, and ACL*

It appeared from the Experiments II and III that the ACL that was used is factorially stable. The results of the PCAs favor this conclusion. The phi values (all greater than .90) clearly show that this ACL measured the same concepts on all occasions.

Contrary to what was hypothesized, there was a failure to find a significant "Group X Condition" interaction. This means that, irrespective of the specific life experience, all groups reported the same level of distress, deactivation and openness/involvedness during each condition. It was generally agreed that the Death Bed and Surgical Operation film were most distressing, and that, except for the Rest condition and, to some extent, for the Death Bed film, there was little difference between conditions with respect to "openness/involvedness". "Deactivation" showed the highest values in the Rest condition, whereas between films differences were rather small.
Remarkable were the qualitatively different findings of the "openness/involvedness" reactions to the two films rated as most distressing. The Surgical Operation film, although distressing, favors an "open mind". This film attracts the attention, and one becomes interested in the things happening, although, at the same time, the film evokes feelings of tension. On the contrary, the Death Bed film, rated as about equally upsetting, shows a decrease in "openness/involvedness" as measured by the ACL. It appears as if one wanted to seclude oneself of the things that were happening on the film screen. This effect seems to disappear on reexposure as can be learned from the comparison of Experiment II and Experiment III (see Fig. 6.6).

A last remarkable finding concerns the absence of any association between "Coping" and the ACL factors. Except for the "openness/involvedness" factor the same holds for the main factor "Group". Thus, whereas there is an association between "Coping" and some biological variables, at the psychological level no such relationships were found.
Since I also failed to find a reliable "Group X Condition" interaction for the ACL data, this seems to mean that having experienced a particular life event does not systematically affect the psychological responses upon renewed (symbolic) exposure. This seems to hold both in an absolute and a relative sense.

7.6. *Life events, coping, and endocrine reactions*

The results of the endocrine variables appear to be rather unsystematic.
ACTH shows a clear effect for the main factor "Coping". E-coping and high ACTH levels are clearly related. This finding is in agreement with the results indicating a relationship between ACTH baseline values and coping dominance. At variance with the results of the catecholamines, for this variable the relationship with coping is consistent, regardless of stimulation by films.
Whether this implies that watching films does not affect ACTH levels remains the question. It must be recognized, however, that Fig. 6.2(a) indeed shows very little variations between films.
It is difficult to speculate what this finding actually means. Until now, as far as is known, no human studies aimed at investigating the relationship between ACTH (as a dependent variable) and psychological functioning have been reported. Especially the group of De Wied (*cf.* De Wied, 1980) focuses attention on the relationship between certain categories of animal behavior (especially concerning learning and motivation) and ACTH. Generalizations to human behavior, however, are difficult to make. Moreover, their research efforts particularly focus on ACTH (fragments) as an independent variable.
Fig. 6.2(a) also reveals high values for the Job Loss group. ANOVA on the raw data indicates a significant main effect for the factor "Group". However, after log transformation this effect completely disappears. Such discrepant findings once more emphasize the problems one is confronted with when working with endocrine data of relatively small groups.

Cortisol shows the most straightforward results (a systematic linear decrease during the course of the experiment). Although adaptation may not be excluded, the most probable explanation for this finding is the circadian rhythm of this hormone. In several studies (*cf.* Rose *et al.*, 1982a) it has been shown that in the morning cortisol plasma levels show a systematic downward trend, much the same as can be seen in Fig. 6.2(b).
Remarkable is the dissociation between cortisol and the self-reports of psychological distress (ACL factor 1). Whereas subjective distress ratings show a clear increase during the last films, the decreasing trend in cortisol secretion does not appear to be affected. Such a disturbance in the decreasing pattern was found by Brown and Heninger (1976) in their study with anxiety provoking films.
In addition, there is a trend towards statistical significance for the main factor "Group". The Divorce group appears to have the highest cortisol levels. This however does not seem to have any relationship with other biological (*e.g.*, ACTH) or psychological variables (*e.g.*, scores on the MQ), except, perhaps, the higher heart rates for this same group. It is difficult, however, to give a plausible explanation for such a relationship, although both, of course, may be seen as an indication of a state of stress within the organism.

Adrenaline is the only variable showing a significant "Group X Condition" interaction. However, inspection of Fig. 6.2(c) does not reveal an interaction as hypothesized. In no case were averaged values of a par-

ticular group extremely high during the specific film relating to their problems. I also failed to find a consistent "Condition" or "Group" effect for this variable.

Noradrenaline shows a trend towards a significant main effect for the factor "Condition". Fig. 6.2(d) shows that the highest values were found during the last film (Surgical Operation), and, more surprizingly, during the Rest condition. It is difficult to speculate and try to explain these findings. Recently, many investigators agree that noradrenaline levels are related to (tendency to) muscle activity (*cf.* Dimsdale and Moss, 1980; Fibiger *et al.*, 1984).
Do the subjects become more restless near the end of the session, after already having been sitting for about ninety minutes? This is a possibility that may not be overlooked. Alternative explanations are difficult to find.

Another remarkable finding concerns the relationship between catecholamine levels and coping preference. Whereas the baseline values indicate a significant association with coping, this relationship does not emerge in the results of the ANOVAs. This seems to imply that such a relationship can only be found during baseline measurements. When being stimulated, however, this association seems to disappear. This indeed could be caused by the fact that the films were appraised by the subjects in different ways (although independent of the fact whether one had experienced that particular event or not, and independent of coping style). For, only in that case, it can be expected that the correlation between baseline measures and measures during films disappears, resulting in the present findings. This does not seem to hold for ACTH and testosterone, because for these variables the results of the ANOVAs further substantiate the correlational findings of the baseline measurements.

Contrary to ACTH, where it was found that analysis on the raw data revealed significant differences between groups which were lost after log transformation, hGH shows the opposite pattern. A significant effect was found for the factor "Group" after log transformation of the raw data, while it was not found before. As can be seen in Fig. 6.2(e), this effect clearly must be attributed to the relatively high levels of the Control group.
Although speculative, two possible "explanations" may be put forward. The first one is based on the findings of Greene *et al.* (1970). As already mentioned in Chapter III, these investigators found elevations of hGH to be a function of whether or not the subjects (in their case cardiac catheterization patients) used the adaptive strategy of relating or becoming engaged with the people in their environment such as nurses, cardiologists and technicians. Only those patients who were not able to use this adaptive maneuver appeared to show such a hormonal response. This raises the question whether we (*i.e.*, the experimenter and the nurse), maybe unintentionally, behaved in a different way (*e.g.*, less sollicitously) toward the Control group.
The second possibility is a relationship between the extent to which one feels involved (ACL factor II) and hGH levels. However, in the literature there are no findings supporting such a hypothesis.

Much the same as with the catecholamines, the relationship between coping and hGH found for the baseline measurements disappeared when reactions to films were taken into account.

Testosterone showed a significant effect for the factor "Condition", whereas "Coping" revealed a trend towards significance (p= .07). Inspection of Fig. 6.2(f) shows that this hormone, just like cortisol, develops a systematic change during the course of the experimental session.
However, whereas cortisol shows a downward trend, testosterone goes upward. As far as is known, in the literature no data are available suggesting such a circadian or ultradian rhythm for this hormone. An alternative explanation may be that the psychological stressor of taking part in the present study caused a decrease in testosterone levels, returning slowly to normal levels in the course of the experiment. Much the same as with cortisol, however, it can be objected that this is contrary to what one would expect on the basis of the psychological (ACL) data. Possibly related to this topic is the striking finding that, in comparison to the normal values (*cf.* Table 6.8), the absolute levels of this hormone for all groups are rather low.
The trend for the relationship between coping preference and testosterone is in line with the findings during the Rest condition. P-copers tend to produce more testosterone than E-copers. This finding may be seen as corroborating the hypothesis concerning the relationship between testosterone and coping as formulated in Chapter IV.

Summarizing the main findings of the endocrine data, it is concluded that, contrary to expectations, no well interpretable "Group X Condition" interactions were found. In addition, I also failed to find clear "Condition" effects. In contrast, for some hormones, differences between groups or between coping preferences could be distinguished.

A possible explanation may be that our data show the same pattern as those reported by Hofer *et al*. (1972). In their study on cortisol excretion rates of parents during the two years after the death of their children, they found that the overall group mean rates remained unchanged. However, a more detailed analysis pointed out that this apparent stability was the result of an interaction between people with low rates during the illness period whose rates significantly increased afterwards, and those with high values during the illness period whose levels fell after the death of the child. It therefore remains to be established whether such rather consistent, but different reaction patterns are at the basis of the present findings.

A last aspect concerns the method that was used for blood sampling. Although the procedure applied may be qualified as rather "subject friendly", it has some disadvantages. It is well known that catecholamines, hGH, and ACTH are hormones that are rapidly secreted and also have short half life time values. Therefore, the possibility cannot be ruled out that the procedure itself led to some error variance. There is also no estimate of the effectiveness of the insertion of the two buffer-films with respect to the behavior of these variables.
Nowadays, withdrawal pumps are available with the great advantage that blood samples can be integrated over longer time periods. Such a

method combines the advantages of blood sampling and urine sampling. Without doubt, to a large extent such procedures increase the validity and reliability of the measurement of endocrine variables in plasma.

7.7. *Life events, coping, conditions, and physiological activity*

For this class of variables, the "Group X Condition" interaction hypothesis also was not realized. At variance with the endocrine data are the reliable main effects of the factor "Condition". "Group" effects are restricted to PTT and FTT, whereas "Coping" appears to influence galvanic skin functioning differentially.
The present data clearly show a differentiation between several physiological variables with respect to their reactivity and sensitivity.
These results allow the conclusion that the first film (Gossip) and the first experimental film (Driving Test) evoke most physiological activation, as measured by IBI and PTT. During the Death Bed film, on the contrary, the least cardiovascular activity was recorded (slow heart rates and relatively long PTTs). Other variables, such as FTT, GSL and TWA, however, do not show these remarkable differences.
The finding that the first film causes much activation probably may be attributed to a nonspecific "start of the experiment" effect, a kind of "anticipation" activation. This, however, does not hold for the first experimental film (Driving Test). Subjects were not aware this film being the first experimental film. The results of Experiment II, where this film was shown last in order, favor the conclusion that the strong activation recorded during the second measuring period can be attributed to the content of the film.

The point of most concern is "How to explain these findings?" In my opinion, apart from the possible conclusion that the concept "appraisal" either is not valid, not validly operationalized, or does not take the central position as stated by the theory, there are several other possible theoretical explanations. The first, of course, is that the hypotheses were not well founded. It could be that it is not warranted to generalize findings with patients (Wolff, Theorell) to healthy people. Also, the assumption that having experienced a particular stressful life event does (systematically) affect the appraisal when being exposed to films depicting related matters could be false.
Yet another explanation may be the one suggested in Capter IV. If some subjects tend to the "fight-flight" pattern, whereas others lean towards "conservation-withdrawal", averaging these patterns can result in "no change". Alternatively, by hindsight, it could be argued - assuming that biological reactions are secondary to psychological reactions - that there was no reason to expect divergent biological reaction patterns between groups, because at the psychological level (the ACL) "Group X Film" interactions also were absent.
All these life events in some cases may mark the the end of a period of suffering. For example, enduring marital conflicts, a long and lingering disease, suffering pain may be considered strong potential sources of stress. Therefore, a definite separation, death, or a surgical operation may be evaluated as relieving. This means that the appraisal of these events, also for those people who really did experience these things,

may vary to a great extent resulting in different (biological) reaction patterns.
Another possibility may be that film is not the most appropriate medium for this kind of research. The social situation of being interviewed (Wolff, Theorell) perhaps much more appeals to repressed feelings, and it is far more difficult to use adequate defense mechanisms in interviews as compared to watching films. Still another explanation is that these results are related to the already mentioned unintentional biases in the recruitment procedures of the subjects. For example, if only those subjects who coped well with their problems consented to take part in the present study, whereas men who did not adequately deal with their stressful encounters refused to participate. In that case, the present results confirm the effective coping and well-adjustment of those who consented to participate; hence no differences are found between groups.

The content of the films also may have been relevant. It could be that the content of the film is so strong and universal that, more or less reflexively, the same (both psychological and physiological) emotional reaction patterns were evoked in all subjects, irrespective of experience. These reaction patterns also may result from social learning processes that shape behavior and attitudes rather uniformly in such circumstances. In contrast, one may hypothesize that the content of the films is too weak. As a result, the film effects may be overruled by another, more general and comprehensive, physiological phenomenon such as adaptation to the experimental situation. Since the above mentioned alternatives are not all mutually exclusive, a last possibility is that the present results are the consequence of a complex interaction in which two or more of the above mentioned alternatives may contribute. Evaluating the last three alternatives one-by-one, one must conclude that the magnitude of the effect of a bias in sampling is speculative. I think it is a real alternative, but I am aware that it will never be possible to estimate the magnitude of such an effect. The two remaining possibilities allow for more discussion. Since I think these alternatives to be more or less mutually exclusive they are discussed together. Relevant information can be extracted from the results of Experiment II. If adaptation did not play a role, and, by consequence, all effects found have to be attributed to film content, it can be expected that reversal of the order of presentation yields the same results (if being controlled for the reverse order). In contrast, if adaptation is the major factor determining the effects found, then the results will be exactly the same if one does not control for the reverse order. The results of the ANOVAs with "Order of Presentation" as a main factor (Table 6.13) provide the decisive answer. If the triple interaction "Order of Presentation X Condition X Measuring Period" (after having controlled for the order of presentation) is significant, one has to conclude that adaptation plays a major role. If this is not the case, the conclusion is warranted that the effects found may be attributed to film content. Table 6.13 shows that the triple interaction does not reach statistical significance. This seems to support the hypothesis that condition effects were measured. However, this is not the complete story. A closer inspection of Table 6.13 shows that, for all physiological variables, the two way interaction "Condition X Order of Presentation" yields significant results. What does this mean? The only correct interpretation seems to be that a distinction has

to be made between: (1) the *absolute level* (averaged over the two measuring periods within a condition) of a particular variable during a specific condition; and (2) the *direction and magnitude* of change from the first to the second measuring period. The present data favor the conclusion that the absolute level of a particular variable during a specific condition also to an important extent is determined by the rank order of presentation. In contrast, the variations within a condition do not appear to be affected by rank order, but only by the content of the film.
The data of Experiment I warrant the conclusion that, for the present samples, neither the course of adaptation (as found by Pardine and Napoli (1983)) nor the specific film effects are affected by having experienced a particular stressful life event.

7.8. *Experiment II and Experiment III*

As the main results of Experiment II and Experiment III have been partly discussed in preceding sections, I restrict this to an enumeration and discussion of the most important findings not fully discussed previously.

7.8.1. *ACL*

The first important finding concerns the consistent results of the ACL. This instrument proved to be factorially stable, as can be concluded from the results from the PCAs and, especially, from the high values of the (Phi) coefficients of congruence.
Furthermore, it appeared that the psychological reactions to the different conditions, as measured by this ACL, were not influenced by the blood sampling, nor by the specific order in which the subjects saw the films.
In addition, upon reexposure, no clear differences were found for either of the three psychological dimensions. This means that all films were rated as about equally distressing, boring, or arousing when one saw them for the second time. Therefore, it may be concluded that, at the psychological level, there were no indications for adaptation to occur.

7.8.2. *The physiological variables*

At variance with the psychological data are two physiological findings. First, the course of the physiological activity seems to be influenced by the "Order of Presentation" (as shown above) and, second, upon reexposure the subjects gave evidence of less physiological activation as reflected in lower heart rates, slower PTT values and diminished sweat gland activity.
Moreover, the trend towards significance for the four-way interaction (for IBI) (see Table 6.19) suggests that not only the subjects were generally physiologically less activated, but also the responsivity of the physiological system appeared to be flattened (see Fig. 6.7).

It is a remarkable finding that blood sampling does not seem to affect the cardiac variables and PTT, whereas for FTT and GSL interactions were found. One may wonder to what degree this result indeed is related to the fact that in Experiment I blood sampling occurred, or, alternatively, that this finding results from the divergent reaction patterns of the Job Loss group.

The main result, however, is that these findings clearly emphasize the importance that measurements were made for two periods in each condition. In this way, some insight into the dynamics of the physiological activity within one condition was obtained. This change within conditions, ultimately, proved to be far more reliable than the average of one condition. For, averages (over the whole film period) appear to be influenced, to a large extent, by content-independent factors such as position in the order of presentation and whether the film already has been seen before. This, however, does not hold (or to a less degree) for the changes within conditions.

7.9. *Intermediate recapitulation*

When evaluating the research topics and hypotheses presented in Chapter IV, the following picture emerges: Concerning our hypothesis that E-coping and P-coping may be conceptually linked to "conservation-withdrawal" and "fight-flight" respectively, considerable support was found. The biological patterns and the MQ results both appear to be in agreement with the model of Henry and Stephens (1977).
On the contrary, I failed to find a well interpretable "Group X Film" interaction for any of the variables. Several possible explanations have been put forward for this result. It is, however, very difficult to make a well-reasoned choice between these alternatives.
Comparison of the scores on the WCC(gen) and the WCC(spe) leads to the conclusion that behavior in a specific context, for about 25 per cent depends on more stable personality characteristics, leaving about 75 per cent for the situation and other sources. However, caution is needed because large variations were found between situations.
MQ scores yield differences between E-copers and P-copers. E-copers have been found to report more symptoms of a psychosomatic nature (reflecting a state of vital exhaustion and depression) than P-copers. This seems to fit in with the hypothesis on E-coping and "conservation-withdrawal", because in the literature a relationship has been suggested between "conservation-withdrawal" and concepts such as depression and learned helplessness. However, the exact nature of this association remains to be established.
A further research topic concerns the effects of blood sampling. The data of Experiment II suggest that, generally, no differences were found that can be attributed to blood sampling, except, maybe, for FTT and GSL.
Reversal of the order of presentation of the films revealed an interaction between the position in the order and the content of the film. This, however, only holds for the absolute level of some physiological variables. The direction and magnitude of changes between measuring periods within conditions shows very consistent patterns, not affected by the position in the order.

In the remainder of this chapter I will focus on the relevance of the present findings for theorizing on stress, coping, and disease.

7.10. *Coping, psychobiological functioning, and health*

Thus far the results were discussed and several possible explanations for the findings were proposed. Here a more widespread discussion of those findings that pertain to health and disease is given. More specificially, the following findings are considered: (1) the relationship between coping, MQ scores and psychobiological data; and (2) the particular results of the Job Loss group. Until now, theorizing on the biopsychological aspects of coping is rather limited. In addition, the use of the same terms for several operationalizations makes it difficult to compare the viewpoints of different investigators. Often in psychophysiology, the psychological aspects are neglected or inadequately condidered. In my opinion, the present study yields several interesting results which can be seen as a stimulating source for further research.

The results of several studies lead to the conclusion that psychosocial stressors bring about disease, particularly when that stress has not been adequately dealt with (*e.g.*, French *et al.*, 1974; Haan, 1977). There is also a high level of suspicion that interacting psychosocial factors and physical factors can prevent pathophysiology. Several investigators agree that in search for the pathogenic pathways and mechanisms, attention has to be focused, among others, on endocrine processes, especially hypophyseal, adrenal and thyroid function (Henry and Stephens, 1977; Kagan and Levi, 1974). However, data in support of this view are rather scarce and often contradictory. Although, at first, it looked as if Type As always reacted with more adrenal medullary activity when being confronted with a challenging stimulus, the results of recent studies often show no difference between Type As and Type Bs, or even show the opposite picture (*cf.* Van Doornen, 1984; Vingerhoets, 1983).
Also, Rose *et al.* (1982c) in their comprehensive study on the relation between psychological variables and endocrine functioning in air traffic controllers, failed to find a positive association between cortisol and physical and psychiatric morbidity. Rather, the opposite relationship emerged. It was observed that subjects with *less* frequent illness had higher levels of cortisol. In contrast, men who gave evidence of psychiatric symptomatology (*e.g.*, alcohol abuse, subjective distress or impulse control problems) had slightly higher average cortisol values at work.

In the present study, it was found that E-coping both showed an association with high psychosomatic symptomatology, and with relatively high ACTH and hGH (baseline) values, whereas both catecholamines and testosterone were rather low. This reaction pattern corresponds well with what Henry and Stephens (1977) called "conservation-withdrawal". This seems to indicate that the distinction in E-coping and P-coping, at the physiological level is attended with distinct reaction patterns. As these results seem to square nicely with the data of Henry and Stephens (1977), and to some extent of Obrist (1981), these findings may open new avenues for bringing together evidence from animal experimenta-

tion, experimental psychophysiology, and human (psychological and clinical) research.

In order to attain a more direct test of the relationship between psychosomatic, vague complaints, and psychobiology, data have to be analyzed in an alternative way, in which MQ scores, instead as a dependent variable, will be used as an independent variable. This procedure allows for contrasting subjects with high and low scores on the MQ.

Also interesting are the results of the Job Loss group. In the first place, their scores on the MQ are rather high, as compared to the other groups. In addition, their ACTH plasma levels are rather high, and the same seems to hold for their PTT and FTT values. On the contrary, their GSL values are rather low indicating a low sympathetic tone. The other variables (coping included) do not show any differences in comparison to the other groups. The above mentioned characteristics have been reported before in depressed patients. However, I do not know of any report in which one dealt with all these variables together.

Rens *et al.* (1983) point to evidence both pro and con to the hypothesis that depressed patients have disturbances in the hypothalamic-pituitary-adrenal regulation, resulting in increased ACTH release. Their own data clearly show higher baseline ACTH values in the depressed group in comparison to the values noted in normal volunteers. They therefore conclude: "Although baseline ACTH values have generally proven unhelpful in distinguishing depressive subgroups, the select nature of our patient population may indicate utility of this assesment in studies in which subjects have been screened for a particular constellation of symptoms and severity" (Rens *et al.*, 1983, p. 787). The present results rather point to a qualitative difference in coping. Whether there exists any relationship between their "particular constellation of symptoms and severity" and coping as measured by the WCC remains to be investigated.

The findings of lower levels of galvanic skin activity are consistent with previous reports. Bagg and Crookes (1966), Noble and Lader (1971), and Donat and McCullough (1983) all provide evidence of diminished palmar sweating in depressed subjects. Noble and Lader (1971) found a high correlation between skin conductance level and weight (a clinical manifestation frequently seen in depression). These authors attributed both manifestations to hypothalamic dysfunction.
An alternative explanation has been presented by Donat and McCullough (1983). Their hypothesis states that this specific physiological activity is related to the characteristic manner in which individuals with well-established depressive behavior patterns cope with the environment. Depressive symptoms such as guilt, feelings of inadequacy and chronic pessimism easily lead to a consistent withdrawal from transactions with the environment. Both Lacey (1967) and Henry and Stephens (1977) present evidence that such a way of dealing with the environment is associated with lowered sympathetic tone, which may be reflected in diminished electrodermal activity.

With respect to FTT and PTT, as far as is known, in the literature no data are available concerning depression or related psychological states

and these specific cardiovascular functions. However, as early as 1950, Stevenson and Duncan (op. cit. Ruetz *et al.*, 1976) showed the existence of two different response patterns in cardiac patients subjected to deliberate emotional trauma. This involved both the more common anxiety or resentment (fight-flight) reaction characterized by increased blood pressure and heart rate, and a "dejection or despair" reaction, at the physiological level accompanied by a fall in heart rate and blood pressure.

Still earlier, Kling (1933) in his attempt to tackle the Cannon's theory, pointed to the role of the parasympathetic nervous system in states of what he called "emotional exhaustion and depression". More recently, Theorell *et al.* (1974) provided evidence of enhanced parasympathetic activity during depressive mood. Similarly to the present study, Theorell and associates failed to find differences in heart rate. However, when concentrating on the results of the ballistocardiographic recordings to measure contractile force of the myocardium, indications were found of enhanced parasympathetic activity.

In addition (as already described in Chapter I), the "Rochester group" also mentions trophotropic dominance as a characteristic physiological concomitant of their "given up-giving up" complex, which, according to these investigators, is a psychological state conducive to disease. Engel (1978) and Vingerhoets (1984) also put forward the hypothesis that the second limb in the fainting response (a strong parasympathetic activation) is related to the psychological "giving up" or "withdrawal" response.

So far, data seem quite consistent and supported by previous findings. However, some anomalies emerge considering the results of the whole group of subjects. Table 6.4 reveals an association between coping and MQ scores. E-copers have higher MQ scores than P-copers. The same holds for ACTH plasma levels. However, GSL levels show the reverse picture. E-copers give evidence of more sweat gland activity than P-copers.
This seems to imply that the low GSL values of the Job Loss group are a specific group effect rather than being more directly related to the high MQ scores, unless one wants to make the assumption that the relationship between MQ scores and GSL is curvilinear. This means that both people with very low and very high scores on the MQ have low skin activity, whereas intermediate scores have enhanced electrodermal activity. It has to be noted, however, that their are neither empirical data nor theoretical points of view in support of this hypothesis. Therefore, further research is needed to elucidate this nearly paradoxical finding.

Now time has come for a critical evaluation of the present study. Are there any reasons for a follow-up of the present approach? And, if this is to be answered positively, what kinds of studies should these be?

7.11. *Concluding remarks*

The present data do not support the hypothesis that having experienced a particular life event systematically does affect the psychological

and/or physiological reactions to films of related topics. I have tried to put forward possible explanations why I did not find what was expected. However, it remains to be established whether these speculations have sufficient explanatory power, or, alternatively, that the theory needs readjustment.
On the other hand, one must not forget that, fortunately, only a small portion of the people being confronted with serious troubles will develop bodily symptoms. This means that, if the current hypothesis was confirmed, it would be necessary to explain why most people do *not* develop symptoms, in spite of their disturbed physiological functioning. Therefore, in a next study a design should be used in which people having experienced a particular stressful life event are distinguished on whether or not they suffer from psychosomatic complaints. If the reactions of people with complaints and without complaints are identical, then it can be concluded that the hypothesis of a psychosocial stress-illness relationship is disconfirmed.
I expect that in such a study interesting findings will emerge. Of interest with respect to this are the data of two people both discarded in the present study. The first subject (belonging to the Divorce group) developed signs of syncope when being exposed to the Divorce film.
A second subject (participating in Experiment II, and not having experienced a particular life event) nevertheless developed cardiac rhythm disturbances when looking at the Death Bed film (evoking strong parasympathetic activity).

It appears that these examples may be considered to strongly favor the expectation that such an intensive psychological and physiological screening as was done in the present approach may be useful to detect (pre)pathophysiological functioning.
I therefore hope that this study will stimulate investigators to explore the possibilities of this approach.

In addition, the present experiment yielded evidence in favor of a relationship between coping and psychobiological functioning. This seems to strengthen the hypothesis that the mediating role of coping in the stress-illness relationship is exerted principally via neuroendocrine, mechanisms. The importance of the present results, in my opinion, especially lies in the fact that, using the WCC (a new and theoretically well founded questionnaire, especially concerning the distinction in P-coping and E-coping) I was able to give support to and to extend findings from theoretically and psychologically more restricted areas of research as experimental psychophysiology and animal experimentation. Therefore, I think, it is warranted to conclude that the objective to study psychosocial stressors under more rigid experimental conditions, at least partially, has succeeded. The present findings therefore may be considered a basis for future research in which special attention must be paid to patient populations.

Chapter VIII

FUTURE DIRECTIONS IN STRESS RESEARCH

8.1. *Introduction*

"Despite the impressive quantity of research, understanding of the stress phenomenon until now remains rather limited". This was the conclusion of Payne *et al.* (1982), and similar conclusions can be read in the panel reports of the study by the Institute of Medicine of the National Academy of Sciences (IMNAS) (Elliott and Eisdorfer, 1982).
In the last mentioned publication, several aspects of stress research are examined and each line of research is discussed, emphasizing the weaknesses of some approaches, the promising aspects as well as the fields of research until now not yet explored.

Some scientists believe that the stress concept has become useless and that the available research is of questionable quality. Rijsman (1984) wonders whether the modern stress concept has not simply replaced the "demonical possession" of the middle ages as an explanation for the occurrence of illness. Other investigators are convinced of the importance of this research and are of the opinion that, in spite of the apparent anomalies and weaknesses of several studies, carrying out such studies must be preferred above simply doing nothing. Concerning the hypothesis of the stress-illness relationship, they evaluate a Type I error as far less worse than a Type II error.
Another point of relevance, of course, is what may be expected from the future. Whereas some traditional hindrances will also make themselves felt in future (*e.g.*, ethical aspects), others may profit from new developments. Furthermore, the use of creative experimental designs also may expand horizons. It indeed must be acknowledged that, often, researchers have to content themselves with next to best or even worse solutions. In addition, because of the lack of studies of a particular kind, theorists are more or less forced to derive concepts from studies that originally had nothing to do with the specific topic.

Nevertheless, the steering functions of such hypothesizing must not be underestimated.

Notwithstanding the controversies, inconsistencies, and uncertainties, an important step for science in general will be the cooperation between investigators of several disciplines. Stress research brings together the psychologist and the immunologist, the physician and the sociologist, the biologist and the epidemiologist. Without doubt, mobilizing such forces, in the long run, will result in progress in the understanding of such important phenomena as health and disease.

In the remainder of this chapter I will discuss the major conclusions and research needs. In this I will be guided by the IMNAS study (Elliott and Eisdorfer, 1982) and the paper by Payne *et al.* (1982).

8.2. *Major conclusions concerning stress and health*

The following conclusions are enumerated in the IMNAS study:

* stress may have important effects on health;
* the stress response is a complex and interactive process;
* reactions and consequences are determined by the interaction of potential stressors with mediators imposed by the individual and the setting;
* particular reactions and consequences to stressors often may be understood best when viewed in the context of the life course of the individuals;
* stressors, reactions, and mediators are neither "good" nor "bad"; only consequences can appropriately be qualified as being desirable or undesirable.

For a more complete understanding these conclusions need additional comment. In the first place, stress neither is a sufficient nor a necessary condition for the onset of a specific disease. As Cassel pointed out correctly already about ten years ago (Cassel, 1974), psychosocial stressors may not be considered directly pathogenic (as a microorganism), and probably exert their influence multidimensionally. This finds expression in the great number of both physical and mental disorders found to be associated with stress such as the common cold, peptic ulcers, cardiovascular disturbances, depression, alcoholism, and suicide.

Although in most instances the only conclusion warranted is that of an association, in some cases evidence is put forward favoring a more direct relationship. As an example, consider the already mentioned interview studies by Wolff (*cf.* Holmes, 1982), and Theorell and associates (*cf.* Theorell, 1980).
Another illustration is the study by Totman *et al.* (1980). These investigators experimentally induced the common cold in volunteers by nasal inoculation with rhinoviruses. It was found that psychosomatic elements played an important role with respect to magnitude of infection. The results showed that Introverts developed significantly worse symptoms than Extraverts. In addition, life events, especially

when they involved changes in the person's general level of activity, also showed a relationship with the extent of infection with rhinoviruses.

It is generally agreed that several mediating factors play an important role in the stress-illness relationship. Personality characteristics, genetic dispositions, and early experience all may have tremendous effects on several stages in the cause-consequence chain. Hyman and Woog (1982) and the panel on "Psychosocial assets and modifiers of stress" (*cf.* Elliott and Eisdorfer, 1982) enumerate several potential mediators of the relationship between psychosocial stress and illness. A few of the best known are: Type A behavior, neuroticism, sensation seeking, age, education, social support and job satisfaction.

Generally, people attach negative descriptors to stressful events. Nevertheless, there are some indications that exposure to stressors may have positive effects. Man has the ability to learn from earlier experiences resulting in an improved management of similar situations in the future. Of clinical relevance is the procedure referred to by Henderson *et al.* (1972) as "psychological immunisation". In an analogous way to how artificial administration of derivatives of infecting organisms provides immunity, resistance to psychiatric symptoms may be similarly conferred.
This seems to have some parallels with Hettema's concept of long-term adaptation (Hettema, 1979). As already stated, Hettema emphasizes the importance of - what at first glance may seem maladaptive - reactions to stressful events for a more adequate dealing with situations which share common features in the future.

Also at the physiological level, there are illustrations of the limitations of the conception of stressors as bringing about only adversive effects. For example, it has been shown that, in some cases, resistance to viral infections is enhanced, rather than decreased (*cf.* Elliott and Eisdorfer, 1982, p. 218-223).

Considering these conclusions, it will be possible to identify which avenues of research are most fruitful and what gaps remain to be addressed.
Also more clarity is needed on the theoretical level. For example, coping is generally agreed upon as being important in the stress-illness relationship. However, the definition of this concept is ambiguous. In addition, what is the relationship with physiological processes? It seems that some investigators conceive of coping as a moderating variable, whereas for others coping *is* the psychological response to a particular situation. I believe that these problems need much more attention, since the lack of clear definitions of concepts is a great hindrance to scientific progress.
Although a framework as presented by IMNAS (Elliott and Eisdorfer, 1982), distinguishing "Potential activators", "Reactions", "Consequences" and "Mediators" certainly has attractive elements, a more precise description of what is exactly meant is needed badly. The passage "Reactions are the biological or psychosocial responses of an individual to an activator" apparently overlooks the possibility that the biological consequences are, at least partly, secondary to the

psychosocial responses. Physiological consequences will probably be determined more by the emotions evoked by a certain event, than by that event itself.
Furthermore, in the IMNAS study it can be seen that the use of denial is not considered a "psychosocial response" but rather a mediator. In contrast, inspection of the WCC reveals items such as "Getting mad at the people or things that caused the problem". If "getting mad" also should be considered a mediator, one may wonder what behavior is left for the category "psychosocial reactions".
These illustrations conceivably clearly demonstrate the lack of adequate definitions, which may lead to confusion and controversy. Probably it is a useful suggestion to make a distinction between emotional behavior and non-emotional behavior. Then, only non-emotional behavior may be considered "coping"-responses. In contrast, emotional behavioral reactions can be classified under the category "psychosocial reactions".
It is beyond the scope of the present study to expand further on these matters. Nevertheless, I hope that it will be clear that not only there is a lack of experimental data, but that there are also shortcomings at the theoretical level.
The remainder of this chapter is restricted to a consideration of the gaps in the availability of data. It must be kept in mind that there are hardly any studies in the literature where more than 20 per cent of the variance in the dependent stress measure is accounted for (Payne *et al.*, 1982). Therefore, efforts have to be invested to explore and explain (parts of) the remaining 80 per cent.

8.3. *Research needs of the stress phenomenon*

In this section, a consideration is given of a classification and evaluation of research needs. Concentration is primarily on two questions: "How should we study stress?", and "What should we study?".
To start with the last question, a point of great concern, as may be concluded from the previous discussion, is clear distinction must be made among stressors, reactions, consequences and mediators.
In addition to the already mentioned definitional problems, no clear descriptions are given of what constitutes a "stressor". Apparently a distinction has to be made between field research and laboratory research. In laboratory animal research the stressors mostly are chosen to insure that as many test subjects as possible will react. In such a setting, mediators are seldom of concern, although the studies by Weiss (1972) and Corley and associates (Corley *et al.*, 1975; 1977) seem to challenge this statement.
In contrast, few studies exist which have properly investigated the objective, as opposed to the subjective environment in life event research. This may be important because the results of some studies suggest that strained people see the world as more pressing, almost regardless of the objective characteristics of the situation (*e.g.*, House *et al.*, 1979).

Another point, already touched upon, is the need for a more adequate subclassification of "stressors". It is agreed upon that stressors may

differ along several important dimensions, all having their specific characteristics. In the IMNAS study, the following classification (which differs in some respects from the already mentioned classification by Burchfield (1979)) is made:

* stressors which are discrete and time limited (*e.g.*, exams, public performances, parachute jumping);
* sequences of events such as the series of life changes that follow a divorce or job loss;
* intermittently recurrent stressors (*e.g.*, sexual difficulties, conflict-filled encouters with colleagues or relatives);
* chronic stressors (*e.g.*, marital problems, job stress, physical handicaps).

Stressors share some common features; however, important differences may be found.
Therefore, the following research needs can be identified. Since many events, conditions and settings are potential stressors, much more must be learned about the critical determinants that actually make them stressfull. The importance of this point has been emphasized by the research of Mason (1974) and Weiss (1972). In these studies, it was demonstrated that an identical stimulus, in different circumstances, may lead to totally different effects. This makes it possible to define a stimulus as a stressor if it evokes a particular response. Aside from consideration what response that should be, critics are correct when they charge that this makes stress research tautological. More precisely, this touches upon appraisal. Until now, little is known about its determinants.
Therefore, as pointed out by Mikhail (1981), it is necessary to state the conditions that a stimulus has to satisfy in order to be qualified as a stressor independently of the results it brings about.

Another field of interest concerns the pathways through which a stressor will produce certain effects. Basic research in the neurosciences, psychology and sociology has identified many mechanisms through which stressors might act to produce reactions. Specific research is needed on the effects of stressors on those mechanisms.
Until now, evidence is lacking providing definite support for the hypothesis that a disturbed hormonal balance forms the basis of physical illness. Therefore, it will be necessary to introduce into stress research the newest techniques used in basic research.
Also attention must be focused on the newly discovered neuroregulators such as endorphins and other endogenous peptides. It is also necessary for research to be done on the precise actions of hormones such as ACTH, hGH, or PRL. Recently it has been found that for many hormones the brain serves as a target organ. This means that changing plasma levels of several hormones not only affect physiological processes, but also exert their influence on behavior.

Many major and minor disease consequences have been associated with stressors. Efforts to identify health changes that are associated with exposure to stressors should continue, particularly with respect to positive or neutral health consequences.

Better estimates are needed of the magnitude by which stressors increase the risk of such adverse health consequences as physical illnesses and mental disorders.
A hypothetically valuable point of view is that illness results if psychological and physiological risk factors co-occur in the same person. This may explain why a single variable at best explains only a few per cent of the variance. In such a case, simultaneous consideration of several risk factors may help to improve the predictive power and specificity of such an approach. In the IMNAS study, the example is given of a group of military inductees who had both high pepsinogen secretion and psychological profiles indicating major, unresolved conflicts over dependency and oral gratification. The coexistence of these physiological and psychological characteristics appeared to act as a much stronger risk factor for developing peptic ulcers during training than either of the measures alone.
One may wonder whether the same holds true for Type A behavior and catecholamine secretion. Here again it is believed that there is a need for a multidisciplinary cooperation to manage these important problems.

Current research on physiological and psychosocial reactions to extreme stressors provides a firm foundation for exploring the stressor and its reaction sequence. Further studies are needed to examine how stressor characteristics and specific mediators influence reactions under less extreme conditions.
Research on the reaction-to-consequence step has lagged far behind other aspects of stress research. Research techniques are needed for investigating this crucial step in stress-related illness.

The last need concerns interdisciplinary studies of the entire sequence from stressor through reaction to consequence.

Recently, Guze (1984) formulated his criticism on stress research in a paper entitled "Psychosomatic Medicine: A critique". The following quotation from this article summarizes the main objections against stress research, especially the stress-illness hypothesis: "Nearly always, the results are of marginal importance or they prove to be inconsistent or unconfirmed. All too often, faulty reasoning or conceptual confusion are evident in the study design or in the conclusion. Biased selection of subjects for study, poorly selected controls, imprecision in defining or measuring life events or psychosocial stress, failure to take into consideration the significance of the interval between stress and illness, difficulty in distinguishing the consequences of illness from causes of illness, and insufficient attention for the effect of observer bias are some of the more frequent, serious problems" (Guze, 1984, p. 23).

I believe that investigators in the field of stress have to seriously consider this, and must take it as a challenge to more creative and inventive research to overcome these problems.

Now the time has come to distinguish between "good" and "bad", "dead-end streets" and "promishing avenues". I therefore want to conclude by expressing the hope that, more than in the past, scholars of many disciplines will coordinate their research programs, aiming at one common goal: to fathom the stress phenomenon.

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SAMENVATTING

In dit proefschrift worden psychologische, (electro-)fysiologische en endocriene reacties op stressvolle situaties bestudeerd als functie van (1) ervaring met de situatie, en (2) de individuele geneigdheid om op een bepaalde manier met gebeurtenissen om te gaan ("coping").
De theoretische achtergrond wordt gevormd door de transactionistische stress-theorie van Lazarus (1966), die stelt dat zowel de kwalitatieve als kwantitatieve aspecten van stress-reacties bepaald worden door de interpretatie en evaluatie van de gebeurtenis ("appraisal") en de wijze van coping.

In hoofdstuk I wordt een overzicht gegeven van de historische ontwikkelingen van het begrip "stress". Aangetoond wordt dat de term stress gebruikt wordt om bepaalde responsen aan te duiden (dit geldt met name in de fysiologie), maar ook kan verwijzen naar stimuli. In meer recente theorieën wordt het fenomeen stress benaderd vanuit een interactionistisch of transactionistisch perspectief (bijvoorbeeld, Lazarus; Cox en McKay). Dit houdt in dat de nadruk wordt gelegd op de subjectieve waardering door de persoon van zowel de objectieve situatie als de eigen capaciteiten.
Ten aanzien van de relatie tussen stress en ziekte treft men in de literatuur verschillende opvattingen aan. Het psychologische element komt daarbij op verschillende manieren naar voren:

1) in de "life event" benadering wordt een totaalscore berekend voor de mate van "aanpassing" die een persoon in een bepaalde periode heeft moeten opbrengen, als gevolg van de confrontatie met bepaalde situaties. In hoeverre een bepaalde gebeurtenis aanpassing vereist is vooraf bepaald in een afzonderlijke, onafhankelijke steekproef met behulp van een methode uit de psychophysica. Regelmatig zijn in de literatuur significante, maar zwakke verbanden tussen deze totaalscore en diverse indices van (verminderd) lichamelijk of psychologisch functioneren gerapporteerd.
2) andere onderzoekers (bijvoorbeeld Engel, 1968) wijzen op een bepaalde psychologische toestand ("giving-up") die, doordat daarbij allerlei lichaamsprocessen ontregeld raken, kan leiden tot een

verhoogde vatbaarheid voor ziekte. Deze toestand zou met name optreden na het verlies van een geliefd persoon of object. Als meest kenmerkende eigenschappen gelden depressie, angst, hopeloosheid en passiviteit.

3) in de reeds genoemde meer recente theorieën worden appraisal en coping niet alleen gezien als mediërende variabelen tussen stimulus en (fysiologische) respons, maar ook tussen (fysiologische) respons en gevolg (bijvoorbeeld, pathofysiologie).

Bovengenoemde opvattingen worden uitvoerig besproken en van kritische kanttekingen voorzien.

Hoofdstuk II geeft weer hoe het begrip coping in de psychologie op verschillende manieren wordt omschreven en geoperationaliseerd. Men kan hierbij vier benaderingen onderscheiden. Op de eerste plaats kan coping worden beschreven in termen van defensie of ego-processen. Onderzoek vanuit deze traditie vertoont echter een gebrek aan goede, onafhankelijke criterium-metingen. Een tweede benadering is specifiek situatie-georiënteerd en beschrijft coping in de context van de actuele situatie. Een probleem hierbij is dat deze aanpak zo specifiek is dat het onmogelijk is om te generaliseren naar andere situaties.
Verder kan coping nog worden opgevat als verwijzend naar stabiele persoonlijkheidstrekken. Hierbij wordt er van uitgegaan dat, over situaties heen, de wijze van reageren in hoge mate consistent is. De voorspellende waarde van deze aanpak ten aanzien van specifieke situaties blijkt echter gering te zijn. Een laatste benadering is die van Lazarus. In diens transactionistische cognitief-fenomenologische benadering van stress wordt coping gezien als een deelproces binnen de continue interactie tussen persoon en omgeving. Daarbij wordt een onderscheid gemaakt tussen twee manieren om met stress om te gaan: (1) modificatie van de omgeving of het zelf met als doel de bron van de stress te verwijderen ("Problem focused (P) coping"); en (2) gedrag en intrapsychische processen gericht op de reductie van de emotionele belasting teweeggebracht door een bepaalde situatie ("Emotion focused (E) coping"). Aangetoond wordt dat deze tweedeling overeenkomsten vertoont met die welke in de experimentele psychofysiologie worden gehanteerd, namelijk "active versus passive coping", of "fight-flight versus conservation-withdrawal", en met een onderscheid, gemaakt door Hettema (1979), te weten "short-term adaptation versus long-term adaptation". In al deze tweedelingen staat de tijd-dimensie centraal. In het ene geval (P-coping) gaat het erom zich hier en nu te behoeden voor de directe negatieve gevolgen van een confrontatie met een stressor; in het andere geval (E-coping) gaat het erom de gevolgen op langere termijn beperkt te houden.
Geconcludeerd wordt verder dat, voor het meten van coping, de recent door Lazarus en medewerkers ontwikkelde Ways of Coping Checklist (WCC) (Folkman en Lazarus, 1980) een theoretisch goed gefundeerd instrument is, en daarom een goede basis vormt voor verder onderzoek.

Hoofdstuk III geeft een overzicht van de fysiologische aspecten van stress en emotie. Hier blijkt dat de diverse onderzoekers zich richtten op verschillende fysiologische systemen. Cannon's aandacht ging vooral uit naar de sympatische tak van het autonome zenuwstelsel en het bijniermerg, dat zorgt voor de afgifte van adrenaline en noradrenaline. Anderzijds richtte Selye de aandacht voornamelijk op het

hypofyse-bijnierschors systeem, met als bekende hormonale variabelen, onder andere, ACTH en cortisol. Hiermee zijn dan ook de meest frequent onderzochte endocriene variabelen genoemd.
Er wordt een overzicht gegeven van de diverse variabelen en/of parameters die als index kunnen fungeren voor de bijdrage van, respectievelijk, het sympatische en het parasympatische zenuwstelsel aan de stress-respons. Daarnaast wordt een beschrijving gegeven van de structuur van het neuro-endocriene systeem en de fysiologische functies van diverse (door de hypofyse vrijgemaakte of gestuurde) hormonen. Het hoofdstuk wordt besloten met een literatuuroverzicht van humaan onderzoek waarbij de samenhang tussen hormonale reacties en psychologische variabelen onderzocht werd.

In hoofdstuk IV wordt de vraagstelling van het huidige onderzoek geformuleerd en wordt een rechtvaardiging gegeven voor de gehanteerde aanpak. Daarbij is gepoogd te komen tot een integratieve benadering van stress, door een samenhang te postuleren tussen voorkeur voor copingstijl (WCC) en de activiteit van fysiologische reactiesystemen, analoog aan het model van Henry en Stephens (1977). In concreto betekent dit dat een samenhang wordt verwacht tussen P-coping en activiteit van het bijniermerg en het sympatische zenuwstelsel, terwijl E-coping wordt verondersteld geassocieerd te zijn met verhoogde activiteit van het hypofyse-bijnierschors-systeem en het parasympatische zenuwstelsel.
Om de effecten van ervaring en coping experimenteel te onderzoeken wordt gebruik gemaakt van een proefopzet waarbij proefpersonen die een specifieke belastende levenservaring hadden meegemaakt, geconfronteerd worden met films die juist op die ervaring betrekking hebben. Uit een literatuuroverzicht van onderzoek naar de gevolgen van de specifieke stress-situaties, waarmee in het huidige experiment gewerkt wordt blijkt dat de gekozen stressoren inderdaad zijn geassocieerd met een veelheid van uitingen van verminderd fysiek of psychologisch functioneren. Onderzoekingen, waarin directe fysiologische metingen zijn verricht blijken echter zeer beperkt in aantal.
Het gebruik van het medium film als stressor wordt gerechtvaardigd middels verwijzing naar andere onderzoekingen waarin dit medium gehanteerd werd. Verder wordt nadere informatie gegeven betreffende de keuze van de meetmethode van de coping-stijl (WCC) en de biologische variabelen. Besloten wordt met een opsomming van de diverse vraagstellingen waarop het huidige onderzoek zich richt.
Naast de hypothese betreffende coping-stijlen en endocriene activiteit bestaan er verwachtingen ten aanzien van de reacties van elk van de experimentele groepen op de films die specifiek betrekking hebben op de zelf ervaren belastende levensgebeurtenissen van elke groep. Dit impliceert een toetsing van de hypothese dat er in een ANOVA-design met als factoren "Groep" (= specifieke ervaring), Coping (E-coping *vs.* P-coping), en Conditie (films en rust), "Groep X Conditie" interacties zullen optreden die specifiek bepaald worden door de combinatie van groepen en de (qua onderwerp) daarbij horende film.
Daarnaast komen een vijftal andere vraagstellingen aan bod. De eerste betreft de vraag in hoeverre men coping mag zien als een min of meer stabiel persoonlijkheidskenmerk, dan wel als bepaald door de specifieke situatie. Verder krijgt de relatie tussen coping, psychobiologisch func-

tioneren, en de rapportage van vage (psychosomatische) klachten de aandacht. Deze onderwerpen komen aan de orde in Experiment I.
Een aparte studie (Experiment II) is gewijd aan het probleem van de betrouwbaarheid en validiteit van de gebruikte meetprocedures. Meer specifiek betreft dit de vraag in hoeverre het nemen van bloedmonsters interfereert met de (electro-)fysiologische reacties op de films, en in hoeverre deze reacties worden beïnvloed door een proces van adaptatie aan de experimentele omstandigheden.
Tenslotte is in een replicatie met verschillende manipulaties (Experiment III), de stabiliteit van de reactiepatronen van de diverse variabelen onderzocht.

In Hoofdstuk V wordt de methode beschreven. Belangrijke aspecten hierbij zijn de samenstelling van de proefgroepen alsmede de aard van de stimulatie en de meetprocedures. Als proefpersonen fungeerden mannen (25-40 jaar) die onlangs (minder dan zes maanden geleden) gescheiden waren, een sterfgeval in de familie hadden ervaren, werkloos waren geworden, of een chirurgische ingreep hadden ondergaan. Daarnaast nam een controlegroep deel bestaande uit personen die geen van deze gebeurtenissen recent hadden meegemaakt.
De onderwerpen van de films waren: (1) roddel; (2) toenaderingspoging; (3) rijexamen; (4) ontslag; (5) echtscheiding; (6) sterfgeval en (7) medische behandeling van een slachtoffer van een verkeersongeluk. In de laatste conditie (8) luisterden de proefpersonen naar muziek. De eerste twee films fungeerden als bufferfilms om de proefpersonen te laten wennen aan de experimentele situatie.
Tijdens elke film werden psychologische, (electro-)fysiologische en endocriene variabelen gemeten. De psychologische variabelen omvatten een Adjective Checklist, met bijvoeglijke naamwoorden die betrekking hadden op gespannenheid, aandacht, activatie, en dergelijke. Als (electro-)fysiologische variabelen werden geregistreerd: het gemiddelde Inter-Beat-Interval (IBI) van het ECG, alsmede de variabiliteit hiervan (S). Verder polsgolfflooptijd (PTT), de amplitudo van de T-golf van het ECG (TWA), de temperatuur van de vingertop (FTT) en huidgeleiding (GSL). De endocriene variabelen omvatten de catecholaminen (adrenaline en noradrenaline), ACTH, cortisol, hGH en testosteron.
Tijdens elke film werden de endocriene en psychologische reacties eenmaal gemeten, terwijl de (electro-)fysiologische variabelen gedurende twee meetperiodes werden geregistreerd.
Alle deelnemers hadden een drietal vragenlijsten ingevuld: (1) de Maastrichtse Vragenlijst (MV), die gevoelens van vitale uitputting en depressie meet (Appels, 1980, 1983); (2) een "algemene" versie van de WCC om na te gaan hoe men "in het algemeen" op stress-situaties reageert (WCC(gen)); en (3) een "specifieke" versie van dezelfde vragenlijst om de reacties te meten op de zelf ervaren gebeurtenis (WCC(spe)).
Op deze wijze kunnen dus de psychologische, fysiologische en endocriene reacties op films bestudeerd worden als functie van: (1) het al dan niet ervaring hebben met de betreffende situatie, en (2) van coping, zoals gemeten met behulp van de WCC. Dit alles betreft Experiment I.
Het totale onderzoek omvatte, zoals reeds gezegd, drie experimenten. In tegenstelling tot Experiment I, werd aan beide andere experimenten deelgenomen door "neutrale" proefpersonen. Verder werden in Experi-

ment II (en ook III) geen bloedmonsters genomen, werd de filmvolgorde omgekeerd, en werd er een meervoudige baseline-bepaling verricht (voorafgaand aan elke film).
In Experiment III werd de stabiliteit van de reacties bepaald door manipulatie van de filmvolgorde en van de context. Dit laatste geschiedde door steeds op systematische wijze twee films te vervangen door andere (die nog niet eerder gezien waren). Deze resultaten werden vergeleken met die verkregen in een klassieke stabiliteitsmeting. In Experiment III participeerden dus dezelfde personen die ook al in Experiment II als proefpersoon hadden gefungeerd.

In hoofdstuk VI worden de resultaten gepresenteerd. De gepostuleerde samenhang tussen coping-stijlen en de activiteit van verschillende biologische systemen werd bevestigd. De resultaten tonen aan dat er een lage, maar significante correlatie bestaat tussen P-coping en de catecholaminen enerzijds, en tussen E-coping en hGH en ACTH anderzijds. Dit betreft rustmetingen.
Vergelijking van beide coping-strategieën over films gaf als resultaat dat E-coping samenging met hogere ACTH-niveaus en hogere huidgeleidingswaarden, terwijl de testosteron niveaus lager waren. Verder bleek dat personen met een E-copingstijl hoger scoorden op de MV.
Tegengesteld aan de verwachting werd echter voor geen enkele variabele (psychologisch, (electro-)fysiologisch noch endocrien) een betrouwbare en goed interpreteerbare "Groep X Conditie" interactie gevonden. Vergelijking van de experimentele groepen had als resultaat dat de Ontslag-groep op diverse variabelen afweek van de overige groepen. Deze groep wordt gekenmerkt door hoge scores op de MV, hoge ACTH waarden, hoge FTT en PTT waarden en een lage GSL.
De correlatie tussen de WCC(gen) en WCC(spe) (.53 en .54 voor respectievelijk de E-schaal en de P-schaal) geeft een indruk van de mate waarin coping afhankelijk is van de specifieke situatie, dan wel van persoonlijkheidskenmerken.
In Experiment II bleek allereerst de stabiliteit van de in Experiment I gevonden factorstructuur van de ACL. Voorts werd aangetoond dat het nemen van bloedmonsters, in het algemeen, geen effect had op de fysiologische reacties. Ten slotte toonde de vergelijking van de twee volgordes van filmpresentatie aan dat het *absolute niveau* van een variabele tijdens een film bepaald werd door zowel de inhoud van de film, alsook door de positie in de volgorde van aanbieding. De *richting* en *amplitudo* van de veranderingen binnen een film (tussen meting 1 en meting 2) bleken echter zeer stabiel en uitsluitend door inhoud en niet door volgorde bepaald te worden.
In Experiment III werd de reeds tweemaal eerder gevonden structuur van de ACL opnieuw bevestigd. Bovendien bleek ook hier weer dat de veranderingen tussen de twee meetperiodes binnen een conditie, in het algemeen, zeer stabiel waren over sessies (*i.e.* Experiment II en Experiment III). Bij de replicatie duidden de waarden van verschillende variabelen op verminderde sympatische aktiviteit en/of toegenomen parasympatische aktiviteit. Tijdens deze tweede confrontatie met dezelfde stimuli waren de verschillen tussen de meetperiodes binnen de films enigszins afgevlakt.

In hoofdstuk VII worden de resultaten besproken in het licht van de bevindingen uit relevante literatuur. Een aparte discussie wordt gewijd

aan mogelijke biases in de selectieprocedure van de proefpersonen voor het hier gerapporteerde onderzoek.
Gezien de positieve bevindingen ten aanzien van coping-stijl en psychobiologisch functioneren wordt geconcludeerd dat dit resultaat de weg opent tot een mogelijke integratie van dier-experimenteel onderzoek, experimentele psychofysiologie en meer klinisch-psychologisch georiënteerd onderzoek. Ook wordt aandacht besteed aan de mogelijke implicaties voor de theorievorming betreffende de relatie tussen fysiologie en psychologische (persoonlijkheids)kenmerken.
Een aantal mogelijke verklaringen wordt naar voren gebracht voor het feit dat voor geen enkele variabele een duidelijk te interpreteren "Groep X Film" interactie werd gevonden.
De resultaten van Experiment II en III rechtvaardigen de conclusie dat de gehanteerde proefopzet betrouwbare en stabiele metingen mogelijk maakt, en dat deze methodiek daarom navolging verdient in stress-onderzoek.
Tenslotte worden de huidige resultaten in verband gebracht met bestaande literatuur over stress, coping en ziekte. Speciale aandacht wordt hierbij geschonken aan de opvallende uitkomsten van de Ontslag groep. Deze bevindingen worden in verband gebracht met resultaten uit onderzoek met depressieve patiënten.

Hoofdstuk VIII geeft een overzicht van wat het stress-onderzoek tot nu toe heeft opgeleverd, en waar zich knelpunten bevinden. Ook wordt gewezen op een aantal tekortkomingen, niet alleen op experimenteel, maar ook op theoretisch niveau. Gepleit wordt voor een multidisciplinaire aanpak, waarbij nieuwe ontwikkelingen uit fundamenteel onderzoek worden geïntegreerd in meer toegepast onderzoek.

CURRICULUM VITAE

Ad Vingerhoets werd geboren op 8 juli 1953 te Biest-Houtakker (NBr). Na het eindexamen Gymnasium β studeerde hij van 1972-1979 psychologie aan de Katholieke Hogeschool Tilburg. Hier specialiseerde hij zich in de experimentele psychologie en psychofysiologie. Tijdens de doctoraalfase verrichtte hij onderzoek naar klassieke en operante conditionering, intermodale interactie en de (electro-)fysiologische aspecten van preparatie op motorische responses. Van 1975 tot 1979 was hij tevens, als student-assistent, werkzaam bij de Vakgroep Persoonlijkheidsleer en Psychodiagnostiek, zowel ten behoeve van het onderwijs (testtheorie en testgebruik) als ten behoeve van onderzoek (registratie en analyse van oogbewegingen en andere fysiologische variabelen).
Na zijn doctoraal-examen in februari 1979 was hij tot november 1983 wederom werkzaam bij de Vakgroep Persoonlijkheidsleer en Psychodiagnostiek ten behoeve van het mede door ZWO gesubsidieerde onderzoeksproject "Experimentele Psychodiagnostiek". Dit proefschrift kan worden beschouwd als het eindverslag van één onderzoekslijn binnen dat project.
Sinds november 1983 is hij als project-medewerker in dienst van de Katholieke Universiteit Nijmegen. Hij is als Consulting Editor verbonden aan het "International Journal of Psychosomatics". Verder vertegenwoordigt hij Nederland in een cross-nationaal project betreffende onderzoek naar emoties (ISEAR).

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STELLINGEN

behorend bij het proefschrift:

'PSYCHOSOCIAL STRESS: AN EXPERIMENTAL APPROACH'

Life events, coping, and psychobiological functioning

door

A.J.J.M. VINGERHOETS

1. De opvattingen van Cannon met betrekking tot de fysiologische aspecten van emoties zijn ten onrechte gedurende lange tijd bepalend geweest voor de theorie en praktijk op dit gebied.
(C. Kling, The role of the parasympathetics in emotions. *Psychological Review*, 1933, *40*, 368-380;
I.C. Roddie, Human responses to emotional stress. *Irish Journal of Medical Science*, 1977, *146*, 394-417)

2. Onderzoek naar de fysiologische specificiteit van emoties, waarbij a priori reeds wordt uitgegaan van een bepaalde classificatie van emoties op semantisch niveau, is gedoemd negatieve of verwarrende resultaten op te leveren.

3. Het beschouwen van 'baseline'-metingen van fysiologische variabelen (verricht aan het begin van een experimentele sessie) als rustmetingen getuigt van weinig psychologisch inzicht.

4. Relaxatietraining bij gedragstherapeutische behandeling van flauwvallen (bijvoorbeeld bij een bloed-fobie) leidt tot een averechts resultaat.
(H.H. Babcock en D.H. Powell, Vasovagal fainting: Deconditioning an autonomic syndrome. *Psychosomatics*, 1982, *23*, 969-973)

5. De aanwezigheid van geavanceerde apparatuur op een hartbewakingsafdeling (ter voorkoming van pathofysiologische reacties) verhindert niet dat opname op een dergelijke afdeling leidt tot emoties, die genoemde pathofysiologische processen juist induceren.
(H.G. Mather et al., Acute myocardial infarction: home and hospital treatment. *British Medical Journal*, 1971, *3*, 334)

6. Aangezien verbale rapportage van fysiologische reacties voor een belangrijk deel bepaald wordt door subjectieve opvattingen over fysiologisch functioneren, dient men de nodige reserve te betrachten ten aanzien van de interpretatie van dergelijke vragenlijsten (zoals de zogenaamde SR-vragenlijsten).
(J.W. Pennebaker en D. Epstein, Implicit psychophysiology: Effects of common beliefs and idiosyncratic physiological responses on symptom reporting. *Journal of Personality*, 1983, *51*, 468-496)

7. Zowel de 'Bereidheids Potentiaal' als ook de laatste golf van de 'Contingente Negatieve Variatie' vertoont bij handbewegingen contra-lateraal, en bij voetbewegingen ipsi-lateraal de grootste amplitudo. Dit wettigt de conclusie dat aan beide EEG fenomenen een gemeenschappelijke generator ten grondslag ligt.
(C.H.M. Brunia en A.J.J.M. Vingerhoets, CNV and EMG preceding a plantar flexion of the foot. *Biological Psychology*, 1980, *11*, 181-191;
C.H.M. Brunia en A.J.J.M. Vingerhoets, Opposite hemisphere differences in movement related potentials preceding foot and finger flexions. *Biological Psychology*, 1981, *13*, 261-269)

8. De bewering dat er een *oorzakelijk* verband bestaat tussen het kijken naar gewelddadige films en agressief gedrag, is niet in overeenstemming met de resultaten van onderzoek daaromtrent.
(J.L. Freedman, Effect of television violence on aggressiveness. *Psychological Bulletin*, 1984, *96*, 227-246)

9. Zolang de kwaliteit van de weersvoorspelling niet beter is, bestaat er voor de beoefenaars van de exacte wetenschappen weinig reden zich laatdunkend uit te laten over de psychologie.

10. In de discussie over de verandering van de spelregels van het voetbal dient een belangrijk punt van overweging te zijn in hoeverre daarmee een verzwaring dan wel een verlichting voor de taak van de scheidsrechter wordt bereikt.

11. Politici behoren er voor zorg te dragen dat de uitdrukking 'vuile politiek' niet verwordt tot een pleonasme.

12. Kunstmatige intelligentie is pas dan maatschappelijk relevant, wanneer ze in het ziekenfondspakket kan worden opgenomen.

Tilburg, 3 mei 1985