A NORMATIVE STUDY OF HUMAN COVERT MUSCLE ACTIVITY DURING MOVEMENT IMAGING

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CURRICULUM STUDIORUM

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ABSTRACT

Using the method of surface electromyography, covert muscle activity in five body locales was recorded while subjects imagined various activities associated with the locales. Prior research, particularly that of Jacobson (1938), had demonstrated electromyograms (EMG) to imaginal stimuli, but had not interpreted the amplitude variability between subjects. This study undertook an individual differences approach in an attempt to account for subject variability in psychological terms.

According to many theorists, for example, Werner (1948), mental development entails progressively greater involvement of central mechanisms and a decrease in the role of peripheral events with maturation. It was proposed that the mental act of imagining human movement ought to take place with less peripheral (covert muscle) response at higher ontogenetic levels than at lower levels.

It was postulated that the less myoactive subjects would also be the more psychologically mature individuals. Accordingly, both physiological (EMG) and psychological test data pertaining to maturity were obtained on each subject. While the study was exploratory in nature, it was anticipated that levels of psychological maturity would predict levels of myoactivity in the aforementioned direction.

The imaginal stimuli employed were self- and other-referent and neutral and affective in content. It was hoped that specificity effects might be found along these dimensions. For the psychological factors, maturity indices were created by first employing tests with good construct validity vis a vis maturity and then by having experienced clinicians weight them as a consensual validation.

The EMG survey yielded highly skewed distributions in the positive direction, with a preponderance of zero scores. Factor analyses of the data yielded interpretable factors in terms of body regions, but not in terms of self-other reference or neutral-affective content.

Multivariate analyses of variance were done on levels of independent (psychological) variables, with summated EMG scores for each locale as dependent variables. Tests of differential effects of levels of maturity were negative. On the basis of the statistical analyses, EMG differences were not related to maturational differences. These results were interpreted in terms of sampling limitations rather than as an outright disavowal of the relationship, since there was observational evidence in the data that it did obtain in some cases.

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INTRODUCTION

This study sets out to explore relationships between covert muscle activity, movement imaging, and certain psychological characteristics of human subjects. The study arose out of scattered suggestions in the literature on motor processes and mental activity that while many subjects are myoactive during imaging, not all are, and, further, that there are large individual differences among those that are myoactive. The literature is devoid of studies which attempt to account for this variability.

In this study it was contended that these individual differences may be construed within the framework of organismic theories of development, such as that proposed by Werner (1948), which postulates progressive differentiation and internalization of psychophysiological functions in the maturation of the organism. As applied to muscle activity and movement imaging, such theories would hold that the maturing organism is progressively less motorically active during mental activity and more reliant on an abstract mode of cognition. Covert muscle activity accompanying imaging was proposed as a way of indexing the maturation status of the organism, as it is conceived in organismic terms.

The study has two parts. In the first part the method of electromyographic measurement of discrete muscle response was employed. EMG measures were taken simultaneously from five body regions while the subject responded to movement imagery instructions. In the second phase, conducted following the gathering of the EMG data, the same subjects were given a battery of psychological tests. On the assumption of the self-consistency of human subjects, it was anticipated that the physiological (EMG) levels of subjects would be paralleled by levels of psychological maturity, with lower EMG levels corresponding to higher levels of maturity. Accordingly, tests were employed which were regarded theoretically as measuring various aspects of maturity. The task of the study was to survey the relationship between magnitude and specificity of covert myoactivity and psychological maturity.

Chapter I reviews literature from several fields and arrives at a rationale for the study. Chapter II presents the experimental methodology and describes the psychometric instruments used. Chapter III reports on scoring methods and all statistical analyses. Finally, Chapter IV contains interpretations and discussion of the results.

CHAPTER I

REVIEW OF THE LITERATURE

The literature surveyed is from several different areas. Material pertinent to the role of motor processes in psychological maturation is presented in the first section. The second section reviews the earliest speculations and formulations as to the role of motor processes in thinking. The third section considers the peripheral-central controversy with coverage of representative points of view. The fourth section is a detailed review of the experimental study of motor correlates of movement imagery. A fifth section deals briefly with the role of emotionality in muscle contraction. Lastly, a section is devoted to a synthesis of the material covered and the rationale for the exploratory study.

The Role of Motor Processes in Maturation

An Organismic View

Werner (1957) describes psychological development in terms of the biological principle of orthogenesis: all development is in the direction of increasing differentiation. The earliest levels of functioning are primitive in that referent object and subject are one undifferentiated entity and thought processes are syncretic, consisting of a fusion of sensorimotor and affective functions (p. 213).

As Werner says:

> the function of representation is that much more primitively constituted . . . the closer it is to immediate bodily action; that is the more thoroughly the representation is fused with some motor activity (p. 253).

In Werner's terms, the maturational process entails increasing hierarchization and subordination whereby the activities at the motor, sensory, and emotional levels are subjected to the dominance of the higher functions of mentality. In advanced forms, mental activity is detached from the concrete; the more complex organization integrates the lower-level functions. To quote Werner, "the more completely detached from the concrete course of events, the higher the genetic level with which the mode of representation is identified" (p. 253). Higher-level mentality is thus viewed as "increasing centralization by means of superior ordering functions which give form and direction to the lower activities" (p. 253). By way of illustration, there is Werner's conception of the development of the naming function (p. 266). Initially, the name is the physiognomic aspect of the thing, i.e., its immediate concrete expression. Next, it becomes a picture of the thing. Later still, it is a schema by means of which an abstract idea is made sensible and thus represented. Ultimately, "this sensuous character of a representation can be lost, so that nothing remains but the name as a sort of algebraic sign no longer felt but simply 'known' as the symbol of the object" (p. 266).

In a later work on the development of symbolic processes, Werner and Kaplan (1963) speak of progressive distancing between person and referent object. At the childhood stage, objects are defined in conative-pragmatic terms; formed through the changing affective-sensory-motor patterns of the individual. With development, a gradual shift occurs whereby the externalized sensory-motor pattern by which an object is apprehended is transformed into an internalized cognitive schema. Objects hence become susceptible to symbolic representation independent of particular surface properties. Similarly, there is increasing polarization between person and symbolic vehicle. The earliest modes of representation are bodily movements and images which are relatively undifferentiated from the individual's pragmatic activity. With development, the dominant mode becomes vocal speech and, presumably, other internalized and abstract modes.

Werner (1948) supports his orthogenetic position with examples of de-differentiation, meaning incomplete or arrested maturation. Obviously such is the case in childhood. In certain pathological conditions dynamization (affective-motor processes) increases to the point that perceptual and conceptual processes are disrupted. In the primitive mentality as well, thought processes appear to be more or less fused with functions of a sensory-motor and affective type.

If, childhood, pathological, and primitive thought is syncretic in nature, it would follow that at this undifferentiated level the organism could not carry out cognitive activity without the involvement of motor and affective components. It is conceivable, therefore, that high degrees of such traits as impulsivity, emotionality, and other components of action-orientation may bear positive relationships to degrees of myoactivity during thought.

Related Theories of Cognitive Development

The following viewpoints on cognitive development have much in common with a Wernerian hypothesis.

Bruner (1964, 1966) describes the emergence in sequence of three distinct stages of representation in the cognitive growth of the individual. The earliest to appear is the enactive stage, in which the child knows and deals with the world in habitual action patterns, patterns which are intimately and rigidly tied to the concrete object or event. In Bruner's (1964) words:

> By enactive representation is meant a mode of representing past events through appropriate motor response . . . Segments of our environment, e.g., bicycle riding, tying knots, etc. get represented in our muscles, so to speak (p. 2).

The second stage is one of iconic representation whereby the world is represented in images which are relatively independent of actions, but which are determined by the surface sensory features of objects. Thirdly, there emerges the symbolic stage in which language is the principle mode of coping with the world. Language progressively releases the organism from the earliest bounds of immediacy and concreteness and forms the basis of abstraction. Experiments reported by Bruner (1964) show how language shapes, augments and supersedes the earlier modes of cognition.

Bruner (1964, p. 2) maintains that the development of each stage is dependent on the previous one, yet that all three remain more or less intact for life. However, the manner in which their fusion and interaction takes place is unexplained. He appears to be arguing for the integrative role of verbal symbolic processes, since he states that maturation is a process by which the component operations of earlier stages are combined into integrated sequences (1964, p. 2). Enactive modes are retained, but their function and nature in the cognitively mature, i.e., verbal, individual, are not stated.

The motoric aspects of children's thought are central to Piaget's theory of cognitive development (Piaget & Inhelder, 1971). For example, image formation in the stage of concrete operations consists of internalized imitations, wherein experience with objects involves perceptual-motor exploration that traces the contours of the object and is then incorporated as a schema upon which more complex operations can be based. Although such a view lends itself to the role of eye movements, there is no logical reason why it could not subsume other sensory modalities. Piaget and Inhelder (p. xvii) in fact contend that a motor image consists of internalized imitation.

The ontogenetic evolution of thought, in Piagetian theory, is characterized by a decrease in sensorimotor modes and an increased ability in adulthood to employ abstract modes. However, since later representational thought evolves from childhood schemas, motor components may be present in the thinking of adults.

The Russian school of Leonteve-Galperin conceived of the development of intellectual operations such as Piaget did (Rahmani, 1967). The process of internalization of mental operations is regarded as being linked to a continuous narrowing of action, a reduction of action to the level of automatization, and an increasing abstraction of the essential conditions of the action.

Guilford (1967), in his structure-of-intellect model, defines the concrete as basic figural information upon which conceptual thought is built. He contends that such information is retained in memory storage in the same form in which it was committed to storage--"things are stored much as they are cognized" (p. 211)--and in connection with the same cues present at the time of learning. It would follow that, where figural information is concerned, to the extent that the concrete involved motor components, the memory encoding would include these same components which could then be available for decoding under the relevant stimulus conditions, e.g., imagining.

Humphrey's (1951) thoughts on the connection between thinking and motor reaction are pertinent. Phylogenetically, action as a response to environmental danger is dominant in species lower on the evolutionary scale. Ontogenetically, children make more use of overt, trial-and-error behavior during problem-solving tasks than do adults in whom thought is implicit, although Humphrey states that the separation of thought and action is never complete (p. 188). Elsewhere (Humphrey & Coxon, 1963), he states that where the CNS, the "supreme integrative apparatus," is inadequately developed, locomotion plays a relatively large part. He reiterates his contention that muscular tension is still to be found in much if not all thinking "where it now serves its own special function." What this function is and its mechanism of operation are not stated.

Dashiell's (1925) earlier analysis is similar to Humphrey's:

> For an understanding of the process of thinking it is essential to note one aspect of the further development of language: the gradual shift from overt speech and gesture to covert forms. The movements and gross bodily acts that become conveniently abbreviated and delimited to vocal and manual signs . . . gradually become further condensed and more nascent (p. 69).

Finally, two important theoretical postulates of Osgood deserve mention. In an extensive review of the peripheral-central controversy in thought, Osgood (1953) proposed a compromise position which is a virtual synthesis of the views already presented: "the <u>development</u>[1] of symbolic processes may require peripheral mediation, which becomes telescoped to a largely central representation in the mature individual" (p. 655). Later, Osgood (1957) elaborated on this speculation in discussing his representational mediation theory. He suggested three stages of progressive integration in motor encoding, as follows:

> (1) a very slow and uncertain patterning or ordering of responses on the basis of exteroceptive controls, as in imitating the seen movements of another person; this makes possible
>
> (2) a transfer gradually to proprioceptive controls (feedback) accompanied by considerably increased speed of execution; and this more rapid and stable organization in turn makes possible
>
> (3) a transfer to central programming in the integrational motor system (p. 84).

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[1]Underlining present author's.

It can be seen how Osgood's proposal parallels Piaget's internalization model and how it is consistent with Werner's orthogenesis theory. The proposed development toward central integrational systems is also consistent with Hebb's (1968) position on perception and imagery, in which peripheral activity, e.g., eye movement, is essential to image formation. According to Hebb, the production of an image is a function of higher-order cell assemblies which are independent of earlier sensory-based first-order assemblies, hence are "pure" central events.

Early Hypotheses Concerning the Role of Motor Processes in Thinking

In recent history, attention was first given to the role of motor processes in thinking toward the latter part of the nineteenth century. According to James (1890), Bain appears to have been one of the first to consider the relationship. On the recall of words or sentences, Bain is quoted: "a suppressed articulation is in fact the material of our recollection, the intellectual manifestation, the idea of speech" (James, p. 494). Stricker claimed to have a keen sense of kinesthetic imagery. Quoted in James:

> His recollection, both of his own movements and of those of other things are accompanied invariably by distinct muscular feelings in those parts of the body which would naturally be used in effecting or in following the movement (p. 493).

Ribot is quoted as saying, on the subject of motor images:

> all our perceptions . . . contain as integral elements the movements of our eyes and limbs; and that, if movement is ever an essential factor in our really seeing an object, it must be an equally essential factor when we see the same object in imagination (James, p. 492).

James himself stated, by way of an ideomotor theory of consciousness, "we may then lay it down for certain that every representation of a movement awakens in some degree of actual movement which is its object" (p. 792), and:

> the consciousness of muscular exertion, being impossible without movement effected somewhere[2] must be an afferent and not an efferent sensation; a consequence and not an antecedent of the movement itself. An idea of the amount of muscular exertion requisite to perform a certain movement can consequently be nothing other than an anticipatory image of the movements sensible effects (p. 799).

Kulpe, in 1895, had stated, "Movements are everywhere important. It is perhaps not too much to say that voluntary recollection never takes place without their assistance" (Jacobson, 1938, p. 165). Pavlov contended that one had only to think about hand movements for such movements to be initiated and that it was possible to record them by means of appropriate apparatus (Bassin & Bein, 1961, p. 196).

In a volume of lectures entitled Experimental Psychology of the Thought Processes (1909), Titchener made certain statements that are germane to the topic in question. He considered the crucial forms in carrying thought to be

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[2]Underlining present author's.

kinesthesis and verbal images. In his words:

> we are animals, locomotor organisms; the motor attitude, the executive type of attention, is therefore of constant occurrence in our experience; and as it is much older than the elaborative, so it is the more ingrained. There would be nothing surprising in the discovery that, for minds of a certain constitution, all non-verbal conscious meaning is carried by kinesthetic sensation or kinesthetic image. And words themselves . . . were at first motor attitudes, gestures, kinesthetic contexts . . . essentially akin to the gross attitudes of primitive attention . . . There would again be nothing surprising in the discovery that, for minds of a certain constitution, all conscious meaning is carried either by total kinesthetic attitude or by words (p. 176).

Titchener did not maintain that meaning must necessarily be conscious. Rather, it may be physiologically based. To illustrate his point, he drew comparisons between preparing a lecture and composing a letter to a friend. In each case, sitting down to the typewriter involves different sets, which are experienced as different feeling states throughout the body:

> there are different visceral pressures, different distributions of tonicity in the muscles of back and legs, differences in the sensed play of facial expressions, differences in the intervals between striking the keys, rather obvious differences in respiration, and marked differences of local or general involuntary movement. It is clear that these differences, or many of them, could be recorded by the instruments we employ for the method of expression, and could thus be made a matter of objective record (pp. 180-181).

These passages of Titchener's are relevant for several reasons. In the first place, there is implied the assumption that there are individual differences in the use of motor processes in cognitive behavior--the "minds of a certain constitution" are presumably different than other "minds" in this regard. Secondly, there is the suggestion that the organism differentiates out of gross motor activity ("primitive attention") and becomes progressively less motoric, more verbal. Thirdly, the above quotation leads to speculation regarding localization versus generality of activity. Are all the cited sensations and tensions reactivated during the recall or imagining of the activity? This question has not been adequately explored. In an earlier lecture, Titchener (1909) did suggest a difference between kinesthetic images favoring localization: "actual movement always brings into play more muscles than are necessary, while ideal movement is confined to the precise group of muscles concerned" (pp. 20-21). He suggests that a comparison between an actual nod of the head and a mental nod would illustrate the difference, the sensed nod being "rough and coarse," the imagined nod being "clearly and delicately traced." This distinction would seem to imply that the internalization of the image is accompanied by the elimination of the auxillary movements that were present during the original overt performance. Whether the covert muscle correlates of the imagined nod were localized would have to be determined by means other than introspection, as Titchener had foreseen.

The Peripheral Theory of Thought

While the earlier psychologists such as Bain, James, and Titchener had pointed out the part played by motor processes in mental functioning, they did not accord them the preeminent status they were to have during the first few decades of this century when the so-called peripheral theory of thought was in vogue. This theory had many proponents such as Dunlap (1912), Langfeld (1927, 1933), Dashiell (1925, 1926), Watson (1930), and Max (1934), and many variants, but the common tenet was that mental activity was not purely mental, but was functionally dependent on changes in the peripheral musculature.

Perhaps the theory has been most closely identified with Washburn, whose publication in 1916 of Movement and Mental Imagery was an elaborate treatment of it. The principle hypothesis of the work was that "all consciousness is related to movement" (p. 20). In more specific terms:

> The kind of consciousness which we call an "image" or "centrally excited sensation," such as remembered or imagined sensation depends on the simultaneous excitement and inhibition of a motor pathway. The "association of ideas" depends on the fact that when the full motor response to a stimulus is prevented from occurring, a weakened type of response may take place which we call "tentative movement." These movements are actual slight contractions of the muscles which the larger movements would involve (p. 26).

Washburn's position was that consciousness depended on a certain excitation-inhibition ratio, i.e., when the motor response is partly but not fully made. It is this partial discharge that constitutes the slight muscle contraction, hence consciousness. Every stimulus was thought to have its own unique tentative movement, however intricately combined it was with others. By way of example, the articulatory muscles were thought to contract slightly during memorization (p. 32); the ocular muscles during visual image formation (p. 33). Complex mental activity was regarded as almost unanalyzable, given the number of different implicit motor responses involved, e.g., in listening to music. Kinesthetic imagery was thought to be a matter of a peripherally excited movement sensation resulting from the slight actual performance of movement (p. 50).

While, for Washburn, consciousness always depended initially on movement, the movement systems could undergo change over time and practice, in some correlative function to central nervous mechanisms. Consider the following important statement:

> It may be that acquired movement systems become after a while so thoroughly organized that a direct connection is established between the motor centres concerned, so that the excitation of one immediately excites the others, without the intervention of any kinesthetic processes (p. 49).

Elsewhere (pp. 51, 216) Washburn contended that easy, smooth, and rapid thinking is not usually accompanied by imagery. To the extent that imagery involves motor processes, as the theory maintains, such processes will diminish as thinking becomes less effortful.

With the advent of behaviorism came a disavowal of consciousness. Thinking was given an exclusively peripheral locus. Whereas Washburn made room for centrally maintained thought processes as skills developed, Watson (1930) made no such provision. His doctrine of implicit speech was well known; muscular habits acquired during speech learning are retained as covert responses. These implicit habits constitute thought; thought is impossible without subvocal speech.

Watson's was a general peripheral theory, since he maintained that thought was not necessarily localized in the laryngeal muscles. He contended that any bodily response can become a substitute for any given word, and that reactions to objects are total bodily reactions.

Dashiell (1925) also favored a physiological-behavioristic approach to thinking, although a less extreme one than Watson's. Thinking is described as "a matter of interacting and mutually influencing motor sets or responses, not of intracerebral shifting of association impulses" (p. 72).

At the same time, tacit recognition was given to CNS processes, which were progressively more important with maturation, as the following statement implies:

> The integration of one's knowledge into a more and more inclusive conceptual organization is physiologically paralleled by the integration of part-reactions into higher level habits (Dashiell, p. 72).

The peripheral theory of thought was not without its detractors. Lashley (1930) argued that peripheral feedback was not essential to thought, but that peripheral excitation was merely the result of irradiating impulses from central processes, a kind of "motor over-flow" effect. In a later article (1951), Lashley criticized the peripheral position on the grounds that it revealed an inadequate understanding of the central nervous system. Freeman (1931) agreed with Lashley on the possibility of motor over-flow, but did maintain that sometimes muscular contraction facilitated mental activity. Instead of rejecting the peripheralist theory outright, as Lashley had done, he proposed a model of central-peripheral interaction, the gist of which was that muscular contraction irradiated excitation which lowered the thresholds or irritability in the higher cortical centers, thereby producing the essential conditions for these centers to react to specific patterns of internal and external stimulation. Freeman claimed that the facilitation of higher mental integration that resulted from muscle contraction was not a universal necessity, citing evidence that the most efficient brain-workers used a minimum of muscular tension (p. 437).

Experimental Studies of the Motor Correlates of Imaging

The Jacobson Studies

It is generally acknowledged that the first technically sophisticated studies of the neuromuscular correlates of mental imaging were done by the physiologist Jacobson (McGuigan, 1966). In the initial stages of his extensive investigations, the methodology consisted of eliciting verbal subjective reports from subjects trained in relaxation as to their feelings of tension in specific body regions while engaged in imaginal activity (Jacobson, 1925). As it turned out, this method was but a crude beginning to the more refined studies that were to follow, hence results obtained need not be considered. Suffice it to say that this early work gave introspective evidence that during relaxation, imagery disappeared. In Jacobson's words, "the experience of muscular tenseness is a <u>sine qua non</u> of imagery, attention and thought process"(1938, p. 186). This finding was to become a behavioral principle, in Jacobson's view, by the time it was supported in several ensuing investigations (Jacobson, 1930a, 1930b, 1930c, 1930d, 1931a, 1931b).

In 1927, electrophysiological methods of measurement were introduced (Jacobson, 1938, p. 189) providing for the first time the means for quantitative comparisons of the discrete contractions of the skeletal muscles under various mental tasks. Since the Jacobson studies employing these methods are to a large extent the prototype of the present investigation, they will be considered in necessary detail.

The experimental procedure, as outlined by Jacobson (1932), entailed having the subject lie relaxed on a couch, eyes closed, in a darkened, quiet, partially sound-proof room. Distraction by the experimenter was avoided. Signals were given the subject by means of a click of a telegraph key. The first was to begin imagining; the second, shortly after, to cease imagining.

Recordings of muscle action-potentials were taken simultaneously by means of a string galvanometer. Wires of platinum iridium were inserted through the skin into the muscle near the motor end plates of efferent fibers. These electrodes detected voltage changes (potentials) in the muscle. Potentials were then fed through a vacuum tube amplifier magnified many thousands of times and recorded on moving photographic film. The greater the contraction of the muscle in the vicinity of the electrodes, the greater the vibration of the galvanometer string indicator. With this device, potential changes as small as one millionth of a volt were detected. In 1937, the apparatus was replaced by the more refined integrated neurovoltmeter (Jacobson, 1940), but only after the foundation experiments had been completed.

In one of the main Jacobson experiments (1932), the signal to imagine was followed by the instructions: "Imagine bending your right arm." Readings from the galvanometer indicated potential changes corresponding to, but smaller than, the actual overt movement of the limb in question. Twenty subjects were used in this study. Once a subject was given the experimental task, he then had seven control tasks: imagine bending the left foot; imagine bending the left arm; actually bending the left arm one inch; imagine the right arm perfectly relaxed; imagine extending the right arm; don't bother to imagine. No myoactivity was detected in the right arm in any of the control conditions. Jacobson (1932) interpreted these results as ruling out the effects of sound per se and as indicating that action currents were localized in the particular region being imaged (p. 681).

In a related experiment (Jacobson, 1938), the task of imagining lifting a 10-pound weight with the right forearm yielded similar results. Action potentials were recorded in 54 out of 62 tests with trained subjects, 41 out of 63 with untrained subjects. On 24 control tests, results were negative for all trained subjects and with 80% of untrained subjects. In another experiment (Jacobson, 1932), the scope of the treatment was extended to various other imagined activities, 28 in all, including "sweeping the floor," "writing your name," and other acts commonly performed with the right arm. The galvanometer deflections were "marked" in only half the cases. Four trained subjects were then selected from the original group and asked to mention various acts that they would normally perform with the right arm. Results were positive for potentials from the right biceps-brachial region in 97.5% of the tests (159 of 163). All control tests were negative.

An adjunct to the above study had nine subjects engage in recollection of activities commonly involving the right arm. The testing procedure was the same as for imagining. Subjects were instructed to recall such activities as sweeping, hitting a tennis ball, lifting a cup of tea, etc. Seven subjects had biceps-brachial movements in 60 of 90 tests. The two other subjects reported engaging only in visual recollection, hence action-potentials were absent for them in most cases. As a rule, microvoltages were of smaller amplitude and briefer duration than was the case with imagining, but activity continued to be localized.

Another study (Jacobson, 1932) described the testing of visual imagination and recollection. Electrodes were placed above the medial portion of the right orbital ridge and over the right mastoid bone of the eye. It was demonstrated that imagined visualization produced records corresponding in pattern to the actual movement of the eyes. For example, instructions, "Imagine the Eiffel Tower," yielded a myogram nearly identical to that of the same subject actually looking upward. The typical microvoltage was four or five times that which obtained during relaxation.

Having obtained evidence for localized muscle correlates of imagined activities of arm and eye, Jacobson (1932) then did a test for the variation of specific muscle contraction during imagination. He had three subjects instructed to "visualize bending the right arm." Action-potentials were taken concurrently from the ocular region and right arm muscles. In "almost all instances" (p. 691) there were contractions in the former but not the latter. Under instructions to "imagine bending the right arm" all three subjects had arm muscle contraction, but in some instances there was eye movement as well, as indicated by both objective record and subjective report. Jacobson offered this important comment:

> In different subjects, then, the same muscles do not always contract during the imagination or recollection of a particular act or object. But the results indicate that during imagination or recollection, muscular contraction, if absent from one region, will be found in another. It is presumed that this principle explains why the instruction to imagine using the right arm is not invariably followed by the occurrence of action-potentials in the right arm: in such instances, we assume, subject merely visualizes the act. Further tests in this direction remain to be performed (p. 691).

A final series of investigations on the role of the speech musculature during imagination were done (Jacobson, 1932). Measurements from the tongue and underlip muscles were taken from five subjects, all of whom were more or less trained to relax, under various conditions of imagination, e.g., imagine counting, imagine telling your friend the date, recall a certain song, etc. As in previous tests, the action-potentials were absent during the pre- and post-relaxation periods, present only after the signal to imagine. Control tests were those that had previously been demonstrated to involve no muscular contraction ("Don't bother to imagine"), contraction of eye muscles ("Imagine the Eiffel Tower"), and contraction of right arm muscle ("Imagine lifting a 10-pound weight"). Results were that there was localized myoactivity in the speech muscles during imaginal activity, but not in control areas, with the exception of one subject in two imaginal conditions. These results were therefore consistent with those obtained from limb and eye muscle locales.

Critique of the Jacobson Studies

The results of the aforementioned studies demonstrate the correlation between the thought process of imagination and implicit muscle activity in those subjects in whom the phenomenon was observed. All of Jacobson's reported findings indicate that muscle potential changes from baseline relaxation were localized in the body region involved in the imagined action. Furthermore, the fact that mental activity did not take place during relaxation appeared to indicate that change of specific muscle tonus was essential to it.

The evidence presented by Jacobson is interpretable as validation for the peripheral theory of thought, although he himself did not so regard it (Jacobson, 1967, p. 59). Nevertheless, he was led to conclude, on the basis of his accumulated findings:

> every mental act of perception, imagination, fantasy, recollection, reflection or emotion at the moment of occurrence is a function measurable and recordable in neuromuscular action-potential patterns no less than a function of brain-spinal cord patterns (1967, p. 97).

The pioneering studies of Jacobson are, in light of contemporary scientific discipline, open to criticism on several counts. In all reported studies, data are obtained from only a very few subjects, as the research already cited shows. This is a serious limitation on interpretation, considering the range of individual differences known to exist in the field of covert processes (Davis, 1957). In addition, statistical treatment has been virtually non-existent, consisting usually of simply tabulating raw scores and drawing conclusions from the observed differences between experimental and control conditions. Equally relevant, negative results have not been interpreted, beyond the assumption that if the myoactivity is not in one region, e.g., the arm muscle, it will be in another, e.g., the ocular muscles. This may be the case, but it is not proven. It is evident, from exceptions to be noted in his raw data, that the pattern of myoresponse is not a fixed, invariant one across subjects. Both Hathaway (1935) and Osgood (1953, p. 650) have raised this objection. Although of lesser importance, it should also be mentioned that, while the peripheral motor theory implicitly assumed by Jacobson holds that motor response exists somewhere in the skeletal musculature (Humphrey, 1951, p. 216), the maximum number of regions sampled to any one imaginal stimulus was two (arm and eye) (Jacobson, 1932).

Explicit validation of Jacobson's results are virtually absent in the literature. One study (Hathaway, 1935) failed to detect action-currents in the action-relevant muscles during the anticipatory period of a reaction-time experiment. The author hypothesized that if potentials were present in the conditions employed by Jacobson, they certainly should have been present under conditions of heightened set to respond. Results were interpreted, not as a refutation of Jacobson, but rather that tensions need not be present in the specific muscle during mental activity. However, it would seem that the paradigms employed by Jacobson and Hathaway are insufficiently similar to warrant comparison.

Related Studies Employing Electrophysiological Methods

Studies by Rohracher (1958), Blumenthal (1959), Max (1935, 1937), and Shaw (1938, 1940) employed designs comparable to those of Jacobson. Rohracher's (1958) was a brief report stating that in 40 subjects, imagining movements such as clenching the fist, jumping, and swimming resulted in amplitude of microvoltages 69.9% higher than in the "normal" resting position. Recording was by surface electrodes, apparently from many body regions, but exactly which ones are not indicated.

Max (1937) recorded action-currents from the flexores digitorum of deaf subjects during kinesthetic imaging ("Imagine holding a squirming fish," "Imagine telegraphing an SOS signal," etc.) and during abstract thinking (e.g., multiplication, rearranging mixed sentences, memorization). In an earlier article, Max (1935) had explained the rationale for the use of deaf subjects: the hands of the deaf are the locus of oral, written, and gestural speech, hence should be more motorically active during thinking, compared to "hearing" controls. The measuring apparatus was a system of two amplified string galvanometers, similar to those employed by Jacobson, permitting simultaneous recording from two sets of muscles. Experimental conditions were contrived to maximize relaxation. Control records were obtained from leg muscles of deaf subjects and arm muscles of hearing subjects.

Imagining kinesthetic activities was "usually accompanied by actual contraction of the muscles concerned" (Max, 1937, p. 307). Data from 41 kinesthetic records of seven deaf-mutes were 88% positive, i.e., indicated localized peripheral action-potentials. Control records were positive in 73% of the cases. Abstract thought problems elicited manual action-currents in 84% of the cases in 18 deaf subjects but in only 31% of the cases in 16 control subjects. In simultaneous recording from arm and leg (control) muscles of the deaf subjects, positive response was 73% in the former, 17% in the latter. (The abstract thinking findings of this particular study are included at this point to emphasize the magnitude and extent of the covert effects that can occur during another form of mental activity besides imaging.)

In synopsizing his results, Max (1937) concluded that action-current responses have some specific connection with the thinking process itself, rather than being "the adventitious effects of irradiated tensions" (p. 337). He interpreted his results as support for the motor theory of consciousness.

Shaw (1938) investigated the distribution of muscle action-potentials during various imagery conditions. Anywhere from seven to 15 subjects were used in each condition. Action-potentials were obtained by means of a cathode ray oscillograph and amplifier. As a preliminary step, measures of overt muscle activity were taken (the squeezing of a hand dynamometer), which revealed that action-potentials were not definitely localized, but appeared in several body regions. The first imagery task was to "imagine squeezing a hand dynamometer with the right hand." Different subjects were used for this task than were used in the overt muscle task. Procedure was similar to that employed previously by Jacobson (1932), with the addition that subjects, following each trial, reported whether they had successfully imagined as per instructions. The apparatus allowed for measurements to be taken from only two muscle groupings at a time. Each subject had electrodes placed on either the right or left arm and either the right or left leg. Positive results, i.e., muscle activity increases significantly greater than baseline rest, were obtained for the right arm group. The successful imagers of the left arm group had a tendency, approaching statistical reliability, to have greater-than-rest action-potentials, whereas the unsuccessful imagers did not. The right leg group also showed a tendency approaching statistical significance to have more myoactivity in that limb during right arm imaging than during rest. A left leg group showed the same directional tendency, more so for the successful imagers. Control subjects, who were instructed not to image, in all cases had negative results. The second imagery task was "imagine typing." With potentials taken from one arm of each subject, the results were that the focus of activity was in both arms. A third imagery task was "imagine singing." An increase in action-potential described as "moderately strong" (p. 211) was found in both arms. For this task potentials were taken from both legs, but neither showed an increase above rest. The fourth image task was "imagine playing a wind instrument" A "moderately strong tendency" (p. 214) was found for potential increases in the left arm and leg.

Shaw's studies included an interaction between myo-activity and quality of imagery, a feature which in effect was a control condition that was absent from previous studies of this sort (Jacobson, 1932; Max, 1937). They also employed slightly less rudimentary statistical analysis. In summarizing his results, Shaw concluded that there was "no good evidence of localization to the muscle groups commonly thought to be involved in such performances" (p. 215). He also offered a provocative interpretation that would fit an organismic differentiation hypothesis:

> The distribution of these action-potentials seems to indicate that during the revival of vestigial responses one can expect to be present any muscular activity that accompanied the original response (p. 215).

In a related work, Shaw (1940) had three subjects engage in the actual lifting of weights with the right arm, then, after a suitable period of relaxation to resume resting potential, imagine lifting the weights. Surface electrodes were placed on the right forearm only. The weights used were graded in heaviness. All subjects had numerous trials with each magnitude of weight. For all three subjects, the degrees of amplified action-potentials during imaginal lifting was found to vary directly with the magnitude of the weight, as had been the case with actual lifting. A check on the vividness of imagery was added, whereby the subject rated his imagery on a 4-point scale, from vague to vivid. Each subject also classified his imagery as to modality. For all subjects, the greater the reported vividness of the imagery, the greater the muscular activity. Imagery was classified as kinesthetic by all subjects in all but a few cases.

Blumenthal (1959) pretested 81 subjects and selected 11 who demonstrated superior tongue movements (EMG) during thinking. Among other tasks, they had to imagine licking a postage stamp, sucking a lemon, and saying words back to the experimenter. Their tongue EMGs were significantly greater to the motor image tasks than to control tasks. It should be noted that the use of an extreme group in this experiment limits the extent to which the findings can be generalized.

Muscle Contraction and Emotionality

Skeletal muscle tension has long been regarded as a manifestation of emotional arousal (Duffy, 1951, 1957; Goldstein, 1964). Gellhorn (1967), in discussing the role of the reticular formation in peripheral activity, stated that muscle contraction is not related to intelligence level or problem difficulty, but to the emotional responsiveness of the subject. Jacobson (1967) has held much the same position. Whatmore and Koli (1968) regard muscle contraction as effort response, prevalent in cases where strong emotionality is a factor.

If emotionality is a causal factor in muscle contraction, certain questions are therefore raised concerning the nature of muscular involvement during thinking. Are the contractions involved during low-stress activity, such as responding to neutral imagery stimuli, of the same category as those contractions evoked under high-stress conditions, e.g., fear? Presumably the same physiological processes are operative in both situations, e.g., reticular action, and both are adaptational efforts of the organism. It is hence worth considering the role of emotionality and muscle contraction within the maturation-differentiation terms of reference of this study.

There is some evidence that emotional expression undergoes a shift from external to internal loci with maturity. Jones (1950) contended that the relatively undifferentiated emotional dynamic of infancy and childhood is extraversive in nature, but that with maturity it assumes an inner pattern of response. Adolescent high GSR reactors were found to have less motor activity, indicating emotional processing through internal, autonomic channels. High GSR, low EMG subjects (internalizers) were found to be less talkative, constant in mood, generally more stable. Low GSRs were regarded as being characterized by strong motivational strivings suggestive of maladjustment. Jones compared them with Fenichel's "impulse neurotic" who discharges tension by a generalized motor process reminiscent of the mass activity of the infant. Goldstein (1964) cites findings that the accompaniments of high-level muscle tension include traits of immaturity. Wenger (1943) found significant correlations between muscle tension and energeticness, restlessness, and impulsiveness. Shipman, Heath, and Oken (1970) investigated a small clinical sample and found tense frontalis muscle patients tended to be repressed and depressed on personality scales, while patients with high levels of calf muscle tension tended to be activity prone with prominent hostile urges, strong dependency cravings, and low self-control.

Some investigators have demonstrated that certain subjects respond primarily with one organ system to various kinds of stimuli. In a number of studies, Lacey and his associates have demonstrated autonomic response specificity, e.g., Lacey and Lacey (1958). Goldstein, Grinker, and Heath (1964), Shipman, Heath and Oken (1970), and others have found that a substantial number of subjects show muscle specificity effects where emotional stimuli are concerned. For the most part, these studies employed aritificial stress situations where the probability of some kind of affective response was high. An important study, for the purpose of this investigation, was done by Lundervold (1952) who found that tense subjects had high levels of myoactivity not just in single muscles, but in muscles which did not participate directly in the movement, i.e., their responsiveness was general, not specific. Malmo, Smith, and Kohlmeyer (1956) found hostility themes were associated with increased forearm tension and sexual themes associated with increased leg muscle tension in a single subject during a clinical interview.

Summary and Synthesis

This chapter has reviewed material from three areas of psychological inquiry. Firstly, perspectives of important developmental and experimental schools of thought were presented in an effort to demonstrate that the cognitive maturation of the human organism entails decreasing peripheral muscular involvement and progressively greater employment of central mechanisms. It has been seen that the differentiation theory of Werner has essential features in common with Bruner, Piaget, Humphrey, Osgood, and others. Even the early peripheral theorists, e.g., Washburn, Dashiell, assumed the operation of central factors with maturity. Before that, Titchener recognized the possibility of relative degrees of motor processing in thought, as well as anticipating later theories of progressive differentiation. It should be mentioned that it is not the intent of this study to attempt a resolution of the central-peripheral controversy, but it is suggested that these constructs are useful as indices of the maturational state of the organism.

Secondly, the major experimental studies of the motor correlates of movement imagery have been presented. It will be noted that these studies are hardly contemporary, yet they remain the main reference works in this area. Despite the emergence of a sophisticated electromyographic technology, investigations utilizing it have been primarily in the field of covert language processes, e.g., McGuigan (1969), Hardyck and Petrinovich (1970) and therapeutic biofeedback (Budznyski, Stoyva, et al., 1973) and not at all in movement imagery studies. Therefore, one is left only with outdated works as comparative models for this type of investigation. These earlier studies, e.g., Jacobson, Shaw, left off at simply demonstrating the phenomenon and applying gross statistical methods to the data. A major impetus to the current study was the absence of any discussion of the variability of the results of these studies. The attempt will be made in this investigation to account for myoresponse differences among individuals in terms of psychological variables.

Thirdly, the role of emotionality in muscle response was considered. The general indication in the studies reviewed was that muscle tension is frequently found in active, emotional, and "immature" individuals, although there again wide variability could be expected. The usefulness of these studies for this project is that they suggest dimensions on which an individual's maturational state might be assessed.

This study will survey, by means of surface electromyography, the myoactivity of normal subjects to a wide range of human movement imagery tasks. According to the proposed maturational hypothesis, the low EMG scorers are conceived of as the more centralized, biologically integrated individuals. High scorers would, conversely, be more peripheralized and less integrated. It is expected that the "centralized" individuals will be able to imagine various familiar activities associated with certain muscle groupings with either a minimal or non-existent involvement of the peripheral motor system. That is, in these cases development would have reached the stage of abstraction, meaning the attainment of a degree of differentiation of self from object such that verbal-abstract channels are sufficiently independent of the earlier peripheral components to carry the thought. "Peripheralized" individuals, on the other hand, would show less differentiated EMG patterns, perhaps of greater amplitude in task-specific locales or non-task-specific locales or both.

The survey will also be considering the question of what happens to the myoresponse if it is not detectable in the action-relevant muscle. There are suggestions in the literature, e.g., Freeman, Shaw, that it may be found in other muscles. If not detectable in the gross skeletal muscle, is it found in the ocular muscle, i.e., a shift from motor to visual systems, as Jacobson had maintained? By simultaneously monitoring several body regions, it is hoped that information pertinent to this question will be obtained.

An important question will be how to account for the EMG variation among subjects. In what ways, related to myoactivity, might subjects differ? Some possibilities arising from the literature are as follows:

1. Does abstract capacity, meaning a developed intellective skill, correlate with a low level of EMG, as could be inferred from many theories, e.g., Werner, Bruner, Piaget, Goldstein?

2. Given that a muscle response, regardless of its cause, is an effort response, are those subjects who tend to be more action-oriented, extraversive, etc., likely to have greater levels of EMG than those who tend to be less so?

3. To the extent that the myoresponse is residual emotionality, do those subjects who are greater responders tend to score higher on measures of emotionality? Further, would they also score higher on such psychopathological measures as anxiety and neuroticism?

4. To the extent that developed psychological differentiation is manifested by the presence of positive psychological health, do measures of sound personal adjustment correlate with lower EMG levels?

What is proposed in this study is that the more integrated, centralized imagers are also the more psychologically mature. The above theoretically and empirically derived hypotheses suggest that individuals may, in fact, be measured on significant components of maturity. An important task will be to formulate a composite meausre of maturity from existing instruments. Psychological profiles of maturity can then be compared with EMG Profiles. At this point, it should be re-emphasized that this study does not have a typical hypothesis-testing design. Essentially, two sets of data on each subject will result, but the nature of the data will determine the experimental design and statistical procedures to be used.

CHAPTER II

METHODOLOGY

The main methodological task was to devise a way of detecting and measuring the muscle contractions that are postulated to occur in response to instructions to imagine activities. In an earlier pilot study (Barry, 1973), a research team at the University of Ottawa had experimented with surface electromyography (EMG) on a small sample (N=24) of students enrolled in the Faculty of Psychology. Using a random assortment of movement imagery stimuli, the researchers found covert EMG in most subjects from arm, leg, and lip locales. This pilot research demonstrated the physiological fact of myoactivity with the available recording methods and was to a large extent the impetus for the present, more extensive study.

A second methodological task was to devise appropriate indices of psychological maturity from existing psychological tests. Two separate sets of data were obtained on subjects in a repeated measures paradigm. The first experimental session (Part 1) entailed the recording of covert muscle response (EMG). The second session (Part 2), conducted approximately two weeks later, consisted of the administration of a battery of psychological tests. This chapter will present each part in turn.

Subjects

The subjects for this study were 120 males, 90% of whom were enrolled in English-language introductory psychology courses at the University of Ottawa. The remainder were members of the Federal government civil service recruited from French-language training courses. The age range for the total sample was 18 to 40 years, with a mean age of 19.8 (median = 19.6; mode = 19). In the case of the University students, participation was rewarded by course credit marks. The civil servants were each paid $10.00 for their participation.

Part 1 - Physiological Recording

Apparatus

EMG was recorded by means of Beckman silver-silver chloride surface electrodes in bipolar placement with a separate ground. Signals were amplified by a factor of 1000, by means of an 8-channel Nihon-Kohden polygraph, model RM-85, then coverted to digital form by integrating over a 10 sec. interval and sampling at a rate of 1000 per sec. using a PDP8-E computer. The digital signals were fed through an 8-channel multiplexor which permitted the simultaneous output of EMG from five leads. The resulting analog conversions were recorded on a 6-channel Watanabe multicorder, model MC611.

Procedure

Upon arrival at the laboratory, subjects were requested to put on a pair of tennis shorts, to allow for electrode placement on the thigh, and to roll up the sleeve of the preferred arm. Facial area accessories, such as eyeglasses, were removed. Subjects were then seated in a padded reclining chair in a 12' X 6' darkened, soundproofed room, which was located within the larger laboratory room containing the EMG recording equipment. Figure 1 is a schematic design of the laboratory layout. Once seated, subjects were issued the general instructions for the experimental session. These are found in Appendix 1.

Surface electrodes were then applied to the five body locales chosen for this experiment. Placement site and application parameters as recommended by Davis (1959) were followed where possible, augmented where necessary with details of muscle location and structure from a standard anatomy text (Gardner & Osburn, 1967). Beckman electrodes, 16 mm. in diameter, were applied to the fore-arm flexor, leg quadriceps, and frontalis muscle. Electrodes of 11 mm. diameter were located near the endpoints of the orbicularis oris (lip) and the orbital ridge of each eye. The ground electrode was attached to the inner surface of the opposite knee. Appendix 2 contains a schematic representation of the fully prepared subject.

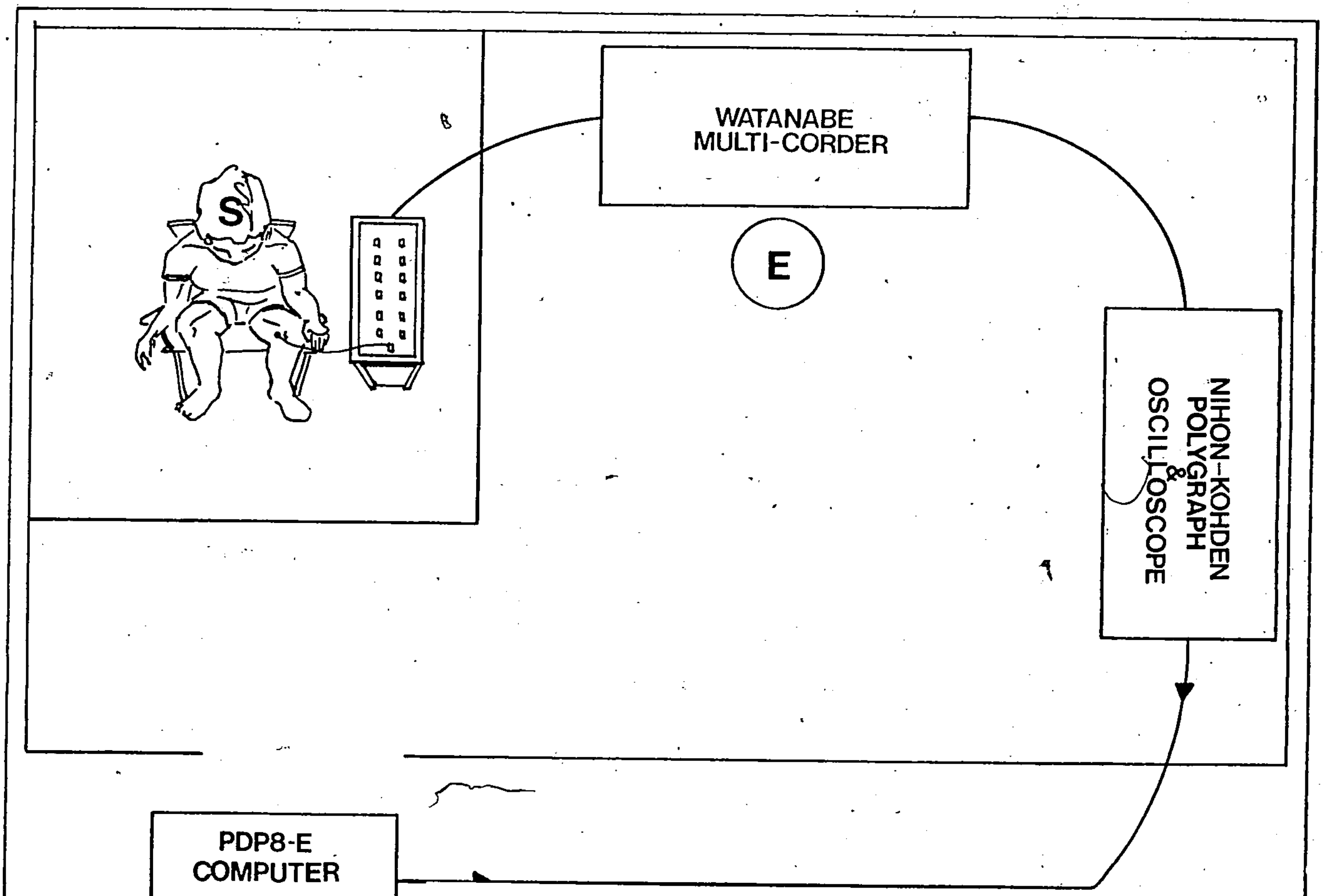

Figure 1. Schematic Lay-out of Laboratory with EMG Recording Components.

All electrodes were thoroughly cleaned in a saline solution before and after each use. They were applied with standard Beckman electrode collars and Beckman isotonic electrode jelly. Surface skin resistance was reduced by abrading with a "Scotchbrite" scouring pad and cleansing with acetone-soaked cotton. The interelectrode resistance for each placement was checked with an impedence meter and was in every case less than 1.5 K ohms.

Once prepared, subjects were instructed to relax, following relaxation instructions derived from Jacobson (1938). These instructions appear in Appendix 3. Approximately five minutes were allowed for relaxation and adjustment to the presence of the electrodes. During this time resting EMG levels were monitored on a Nihon-Kohden oscilloscope. Extra time was provided for those subjects slower to arrive at a stable relaxation baseline. Image task presentation commenced once the subject was relaxed.

Image Tasks

The image tasks were presented by oral instructions to the subjects over a one-way intercom system. Approximately 10 secs. following the instruction to image, the subject was simply instructed to relax, which was the signal to cease imagining. The intertask rest interval was approximately 30 secs., although in some cases a longer period was necessary for the response amplitude to diminish to baseline. The time reference points were carefully indicated on the recording paper. The rate of speed of the recording chart was 600 mm/hr.

The duration of the EMG recording session was, on the average, about 12-14 minutes. Following the session, subjects were instructed to postpone any questions about their experience until completion of the project and not to discuss their experience with friends or classmates who themselves may serve as subjects at a later date.

The image tasks themselves consisted of a series of 15 different imagined activities. Order of image task presentation was randomized for each subject. Each image task was intended, as nearly as possible, to maximize the probability of the relevant muscle or muscle group being activated. The experiment was so constructed that EMG could be recorded simultaneously from all five locales while the subject was responding to each task instruction. Thus, for example, forearm-specific image instructions were presented while EMG was recorded from the forearm and concurrently from the four other regions.

Selection of image tasks was based, to a large extent, on the exploratory and survey rationale of the study. Accordingly, a wide range of image tasks was chosen. In many cases, the type of task selected had not previously been employed in covert EMG studies. It was, therefore, decided to include images that were not only self-referent, but other-referent as well and not just neutral images, but also those with more emotional content. Four categories of imagery were formed.

(a) self-referent: neutral

(b) self-referent: affective

(c) other-referent: neutral

(d) other-referent: affective

These categories will be considered in order and items representing each category presented.

(a) The self-referent: neutral category is comprised of image tasks essentially similar in nature to those employed historically in covert myoactivity research, e.g., Jacobson (1932), Shaw (1938), Blumenthal (1959). Tasks employed in this study, in the form as presented to the subject, are:

1. "Imagine squeezing a tennis ball."
2. "Imagine tightening your thigh muscle."
3. "Imagine whistling a tune."
4. "Imagine moving your eyes from side to side."
5. "Imagine wrinkling your forehead."

(b) The self-referent: affective category is comprised of items having an emotional loading, thereby differentiating them from those of the previous category. To the extent that emotive stimuli evoke muscle tension

(Goldstein, 1964), there may be a myoresponse difference from neutral items. Examples used were:

1. "Imagine squeezing a girl's breast."
2. "Imagine kicking a small child."
3. "Imagine kissing someone."

An eye-referent image is not included in this category. While the eye is reactive to emotional stimuli, the response is pupillary, not muscular.

(c) The other-referent: neutral category is comprised of imagery items wherein the subject is instructed to imagine another person engaged in a neutral activity. The literature on thought processes and muscle response contains no reference to a variation of this kind, although Berlyne (1965) has commented on its potential theoretical interest. In speculative terms, it may be that there is a response differential between self- and other-initiated movement imagery based on differences in such variables as certainty of ego boundaries, sense of separate identity, field independence, etc., although these are not directly investigated in this project.

The other-referent: neutral image tasks employed were:

1. "Imagine someone squeezing a lemon."
2. "Imagine someone bending his knee."
3. "Imagine someone chewing."
4. "Imagine someone looking out of the corner of his eye."

(d) In the other-referent:affective category were the following items:

1. "Imagine someone clenching his fist in range."
2. "Imagine someone kicking a dog."
3. "Imagine someone vomiting."

In addition to the constraints on the use of éye-referent imagery, the frontalis locale was sampled specifically only once, in the self-referent:neutral category, because of its limited motoric function. It was included because of its known involvement in various experimental tasks of muscular response specificity (Shipment, Heath & Oken, 1970; Sainsbury & Gibson, 1954).

For both the neutral and affective categories, items were selected initially on an a priori basis. Twenty subjects not included in the main study then rated the items on a series of 7-point semantic differential scales (see Appendix 5) as an objective validity check on the neutral-affective distinction. Results appear in Appendix 4.

Part 2 - Psychological Testing

This part of the study consisted of the administration of various psychological tests to all those subjects who had completed Part 1. Testing was done in small groups of 10 - 20 subjects. Mean duration time of group testing sessions was 2-1/2 hours. In order to avoid fatigue effects, order of test presentation was randomized across groups.

The paramount concern in selecting the tests was that they theoretically pertain to aspects of "psychological maturity," as described variously in the literature (Heath, 1965). That is, they must purport to measure variables that, by informed consensus, could comprise some of the major dimensions implicit in "maturity." Given the multidimensionality of such a higher-order construct, there is no good reason to believe that any one test would be a valid measure of the construct. Therefore, existing tests had to be surveyed and selected on an a priori basis. Procedures analogous to this have been used in a study by Witkin et al. (1962) of psychological differentiation, and by Heath (1965) in an exploratory study of maturity. Further requirements were that the tests be objective and readily administered to groups.

Following are the tests selected by inclusion in the battery and a brief rationale for the choice. A description of how they were used will be found in the next chapter. Test data forms are found in Appendix 5.

The Cattell 16 PF (Cattell, Eben & Tatsuoka, 1970) was selected on the basis of its empirical derivation of factors representative of the total domain of personality. It was at once objective and comprehensive. In general, it was regarded as an adequate measure of personality adjustment. For example, it was felt that more mature individuals would have different score patterns than those less so on such 16PF scales as Emotional Stability (high vs. low ego strength), Tension (high vs. low ergic tension), and the like.

The IPAT Culture Fair Intelligence Scale (Scale 3: grades 10-12 and superior adult) (Cattell & Cattell, 1959). This is a nonverbal test which yields a single score IQ. It was selected because of its high loading on fluid intelligence (genetic endowment), as opposed to crystallized intelligence (learning and environment) (Cattell, 1963). To the extent that psychological maturity is a function in part of "innate" intelligence, this test was believed to be a useful measure.

The Eysenck Personality Inventory (EPI) (Eysenck & Eysenck, 1968). This is a factorially based test designed to measure the dimensions of extraversion-introversion and neuroticism-stability, the two orthogonal dimensions which, according to Eysenck (1967), account for most of the variance in the realm of personality. In view of the theory underlying the test (Eysenck, 1967), one may conceptualize the more mature or integrated individual located differently on these scales than the less mature or integrated individual, i.e., toward the introversion and stability poles.

Parenthetically, it was anticipated that overlap could potentially occur between the EPI extraversion-introversion scale and the 16PF second-order factor of exvia-invia, scales which have been shown to be statistically correlated (Adcock, 1965). Should this be the case, certain data reduction procedures could be implemented to accommodate the duplication. Both the EPI and 16PF were felt to be intrinsically valuable tests to employ regardless of what correlations might ensue.

The Personal Orientation Inventory (POI) (Shostrom, 1966). The POI is a self-report instrument designed to assess those values, attitudes, and behavior that define self-actualization (Maslow, 1968). It includes 12 scales (time competence, inner support, self-actualizing value, existentiality, feeling reactivity, spontaneity, self-regard, self-acceptance, nature of man, synergy, acceptance of aggression, capacity for intimate contact). This test has good apparent construct validity in terms of its relevance to maturity. To the extent that the POI does in fact measure self-actualization, high scorers may be thought of as possessing a number of qualities commonly regarded as indicators of maturity, e.g., an internalized system of values which direct behavior, control, stability, self- and other-awareness, empathy, psychological health, etc.

The Hutt Adaptation of the Bender-Gestalt Test (HABGT). According to Hutt (1969), the Bender-Gestalt visual-motor test offers clues to the general style of adaptation, cognitive behavior, affective states, and maturational characteristics of the organism. His adaptation of the Bender-Gestalt test (HABGT) is designed as a semi-projective test, the rationale of which is that perceptual-motor style, as revealed on the Bender drawings, reveals personality characteristics. These are thought to be often unconscious, in the sense that perceptual-motor modes of functioning tend to be established early in life, before the development of language. This would mean, for example, that emotional experience that can be expressed only in action by the preverbal child remains encoded in the perceptual-motor system. It is presumably these idiosyncratic experiences that are tapped by the test.

Hutt has devised an objective scoring system based on his projective theory. It is called the Psychopathology Scale. On this scale, 17 Bender "signs" are assigned values of from 1 (least pathological) to 10 (most pathological), according to objective scoring criteria. The maximum possible score is 163.25, the minimum, 17.0.

This measurement scheme rests on the assumption that perceptual-motor integration decreases, i.e., distortions in drawing occur, in relation to the severity of the disturbance in the underlying personality dynamics. Optimum performance would demand a high degree of perceptual-motor integration and would presume relative freedom from functional and organic disorders.

CHAPTER III

RESULTS

Two distinct sets of data were obtained: the physiological (EMG) records from Part 1 of the experiment, and the psychological test records from Part 2. The task at this point was to decide on appropriate procedures for quantifying and analyzing these data. This chapter presents the procedures used and results of the statistical analyses.

The EMG Data

This section presents a step-by-step account of the treatment of the EMG data, from the scoring procedures to statistical analyses.

One hundred and twenty scorable EMG records were obtained. In appearance, the completed EMG record consisted of 5 ink-drawn lines representing outputs from the 5 channels. EMG amplitude change was indicated by the presence of histogram-shaped elevations from baseline. Onset points, that is the locations at which the stimulus tasks were presented, were indicated with the appropriate task number (e.g., "imagine wrinkling your forehead" was task #15). Cessation points, where the subject was instructed to stop imagining, were also indicated. Instances of interval period EMG were also indicated. Instances of interval period EMG were designated "R" in those cases where they occurred in close proximity to task-period EMG so that a differentiating indicator was necessary. Figures 2, 3, 4, 5, and 6 are samples of lower, medium, and higher amplitude EMG records with varying degrees of specificity.

Scoring procedures

Each EMG record was scored as follows: the distance in millimeters between pre-image task (relaxation) baseline and the maximum amplitude peak of the subsequent image-task segment were measured. This was the raw score used in later data analyses. In cases where two or more amplitude peaks occurred in the image-task period the largest was scored. In many cases, EMG occurred in the inter-task rest interval. For scoring purposes these EMG's were excluded and measurement restricted to the image-task period.

For each image-task there were 5 scores, one for each of the simultaneously recorded body locales. With 15 image tasks, there were 75 scores. A 15 X 15 raw data matrix was constructed for each subject. The 15 image-task variables were numbered, as shown in Table 1.

The variables are repeated across locales to make up the total of 75. Variables 1 - 15 are arm variables, i.e., scores on the arm lead on all image tasks. Leg

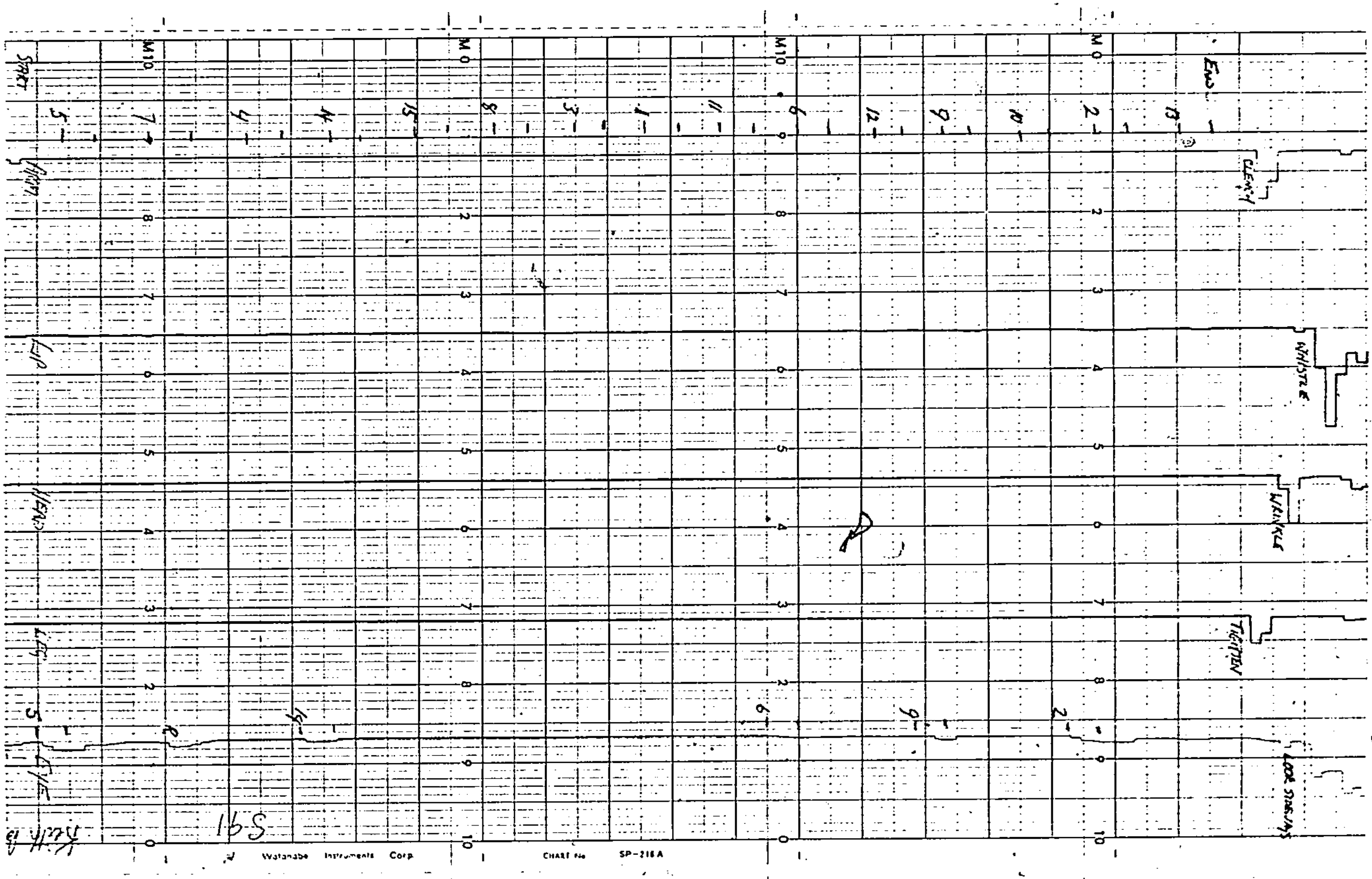

Figure 2. Example of Lower-amplitude EMG Record. Note: Numerals signify coded task variables (see Table 1) and R = response during inter-task interval.

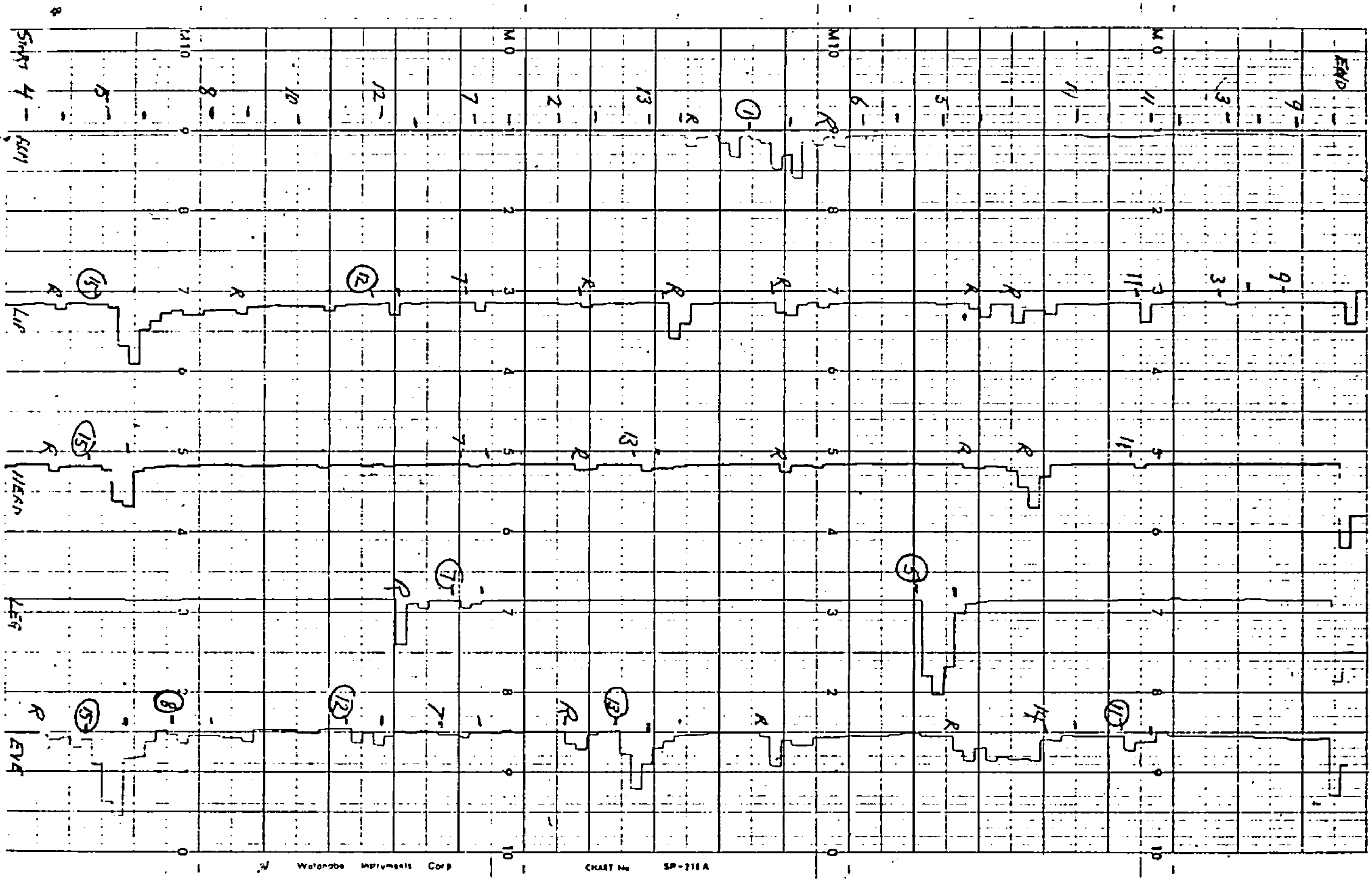

Figure 3. Example of Medium-amplitude EMG Record(a). <u>Note</u>: Numerals signify coded task variables (see Table 1) and R = response during intertask interval.

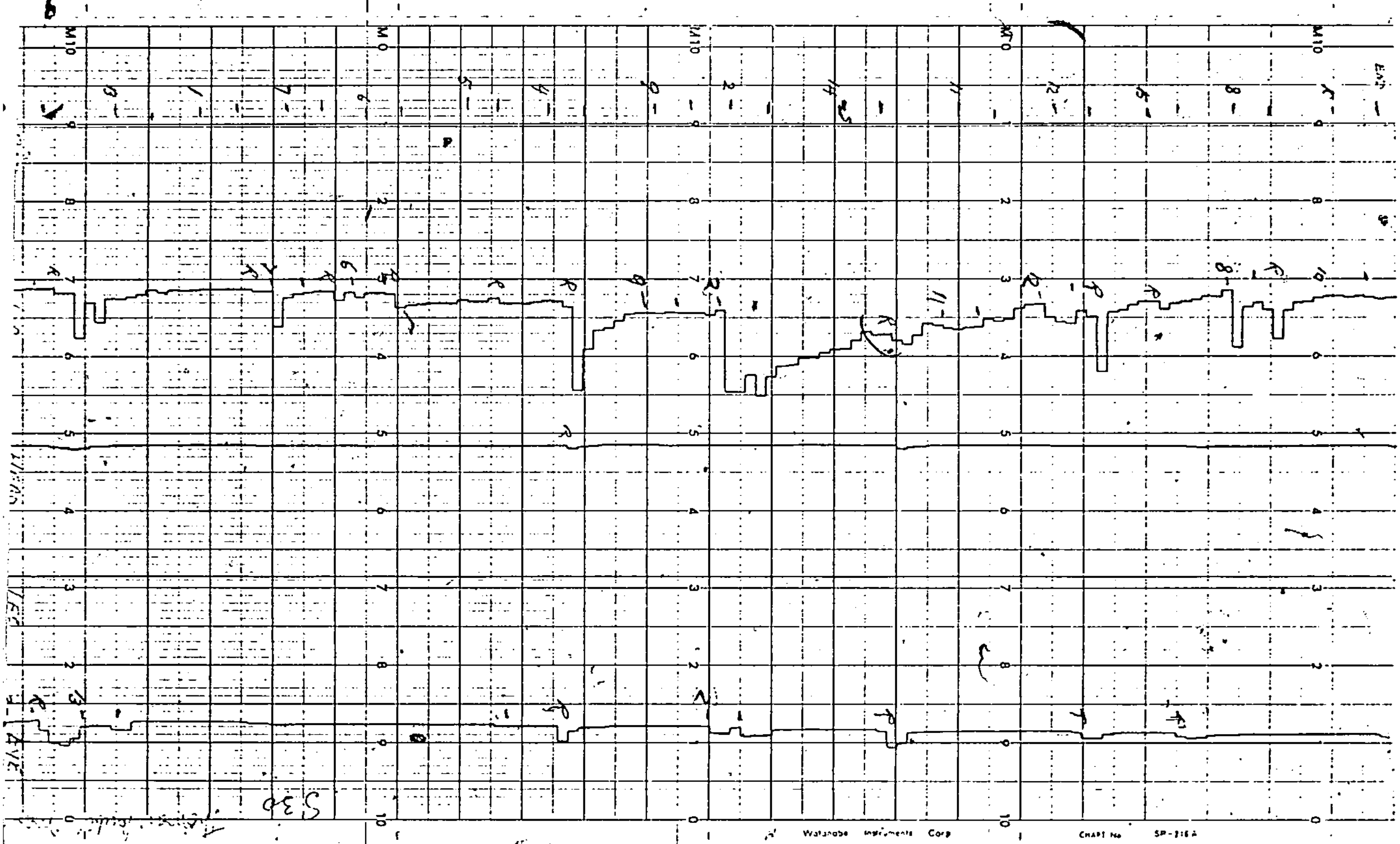

Figure 4. Example of Medium-amplitude EMG Record(b). <u>Note:</u> Numerals signify coded task variables (see Table 1) and R = response during intertask interval.

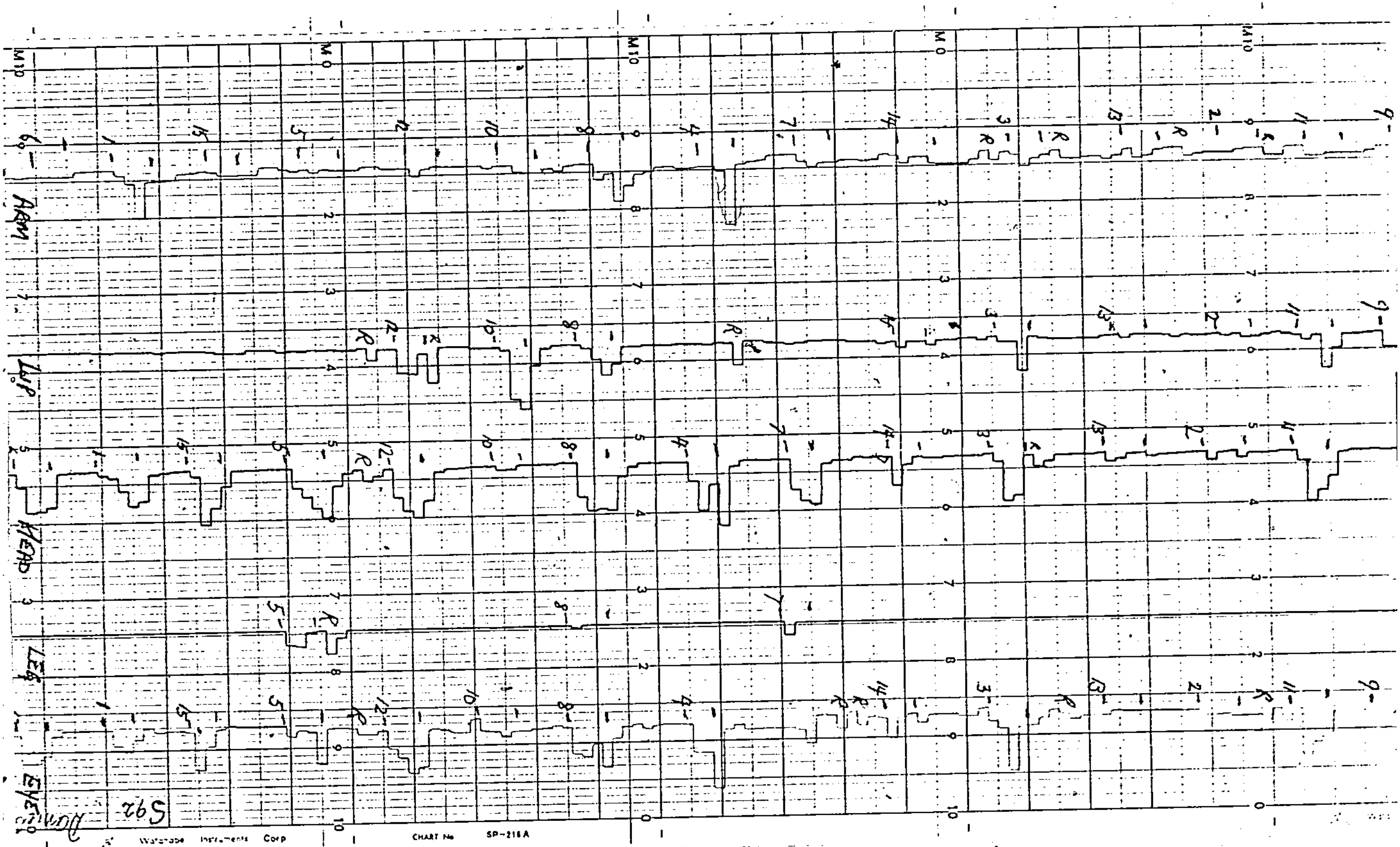

Figure 5. Example of Medium-higher Amplitude EMG Record. <u>Note:</u> Numerals signify coded task variables (see Table 1) and R = response during intertask interval.

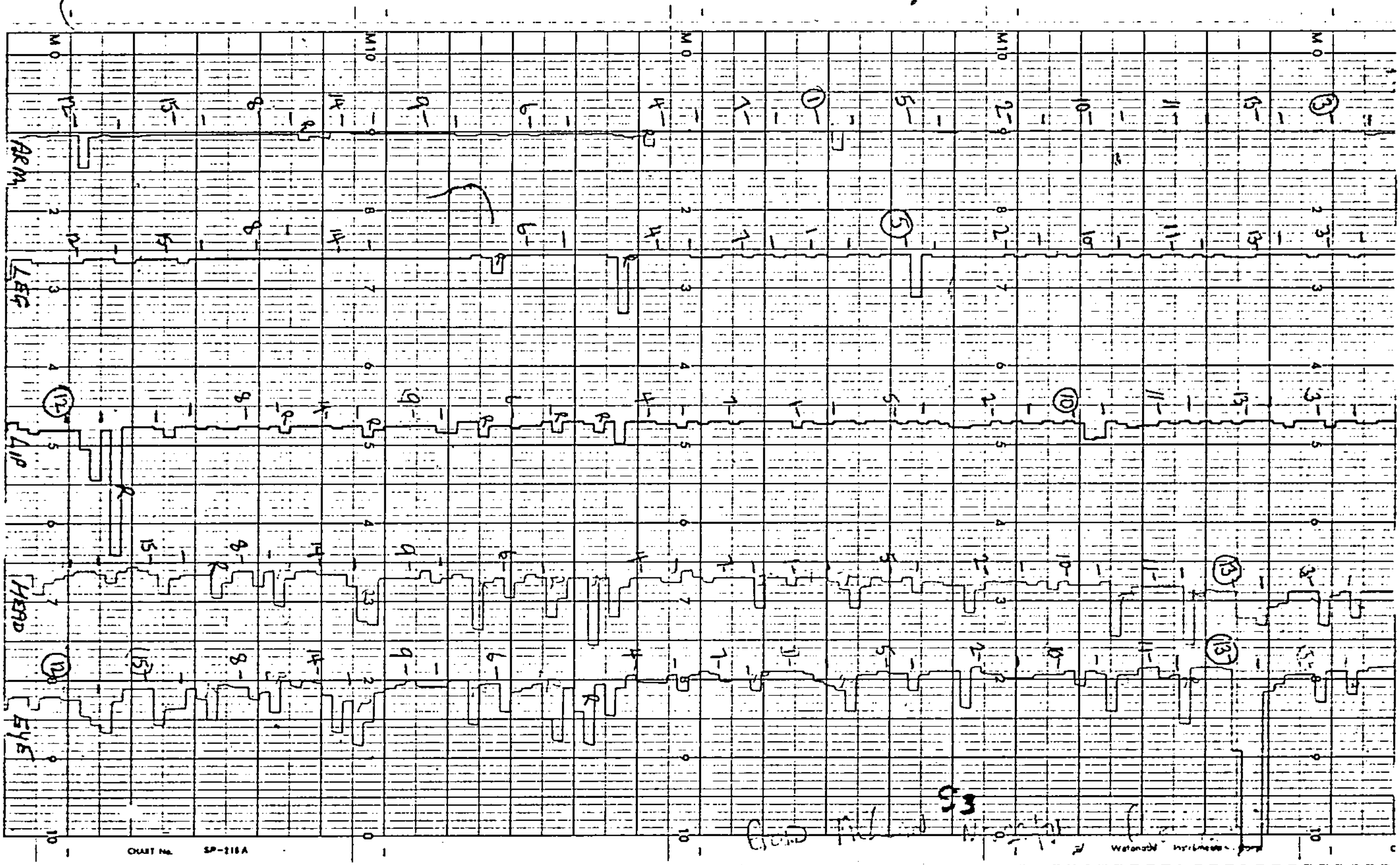

Figure 6. Example of Higher-amplitude EMG Record.
<u>Note</u>: Numerals signify coded task variables (see Table 1) and R = response during intertask interval.

Table 1

List of Image Task Variables

1. Imagine squeezing a tennis ball.
2. Imagine squeezing a girl's breast.
3. Imagine someone squeezing a lemon.
4. Imagine someone clenching his fist in rage.
5. Imagine tightening your thigh muscle.
6. Imagine kicking a small child.
7. Imagine someone bending his knee.
8. Imagine someone kicking a dog.
9. Imagine whistling a tune.
10. Imagine kissing someone.
11. Imagine someone chewing.
12. Imagine someone vomiting.
13. Imagine moving your eyes from side to side.
14. Imagine someone looking out of the corner of his eye.
15. Imagine wrinkling your forehead.

variables are 16 - 30, lip 31 - 45, forehead 46 - 60, eye 61 - 75. These groupings are coded for classification purposes: N = neutral, A = affective, S = self, O = other. Table 2 depicts the coding and numbering arrangement.

With the data so arranged, inspection of variables for comparative purposes was facilitated. For example, affective-neutral comparisons could be made across locales, or self-other comparisons, or locales could be compared over tasks. These and other comparisons were made and will be described.

Inspection of the raw data matrices revealed a preponderance of zero scores; that is, scores where there was no EMG amplitude change from baseline. In fact, zero scores obtained in every record, and in many were the most frequent score. Several records had amplitude changes of only 1 or 2 millimeters. As a general observation, recording from the body extremities (arm and leg) yielded lower amplitude EMG than from the bulbar area (lip, eye, forehead), with zero scores occurring in greater proportion in the former case.

Although frequent zero scores were not unexpected, the disproportionate number of them brought into question the normality of their distribution and the possible implications for statistical treatment. Accordingly, descriptive statistics were obtained on 10 randomly selected image-task variables and are presented in Table 3. It is

Table 2

Classification and Coding of Image Task Variables

Variable number and classification	Locale				
	Arm	Leg	Lip	Head	Eye
1 N, S	1	16	31	46	61
2 A, S	2	17	32	47	62
3 N, O	3	18	33	48	63
4 A, O	4	19	34	49	64
5 N, S	5	20	35	50	65
6 A, S	6	21	36	51	66
7 N, O	7	22	37	52	67
8 A, O	8	23	38	53	68
9 N, S	9	24	39	54	69
10 A, S	10	25	40	55	70
11 N, O	11	26	41	56	71
12 A, O	12	27	42	57	72
13 N, S	13	28	43	58	73
14 N, O	14	29	44	59	74
15 N, S	15	30	45	60	75

Note: For task corresponding to variable number, consult Table 1.

Coding key: N = neutral, A = affective, S = self-referent, O = other-referent. Example: Variable 33 is lip EMG to the neutral, other-referent image task "Imagine someone squeezing a lemon."

Table 3

Descriptive Statistics of 10 Randomly Selected Image Task Variables from 120 Valid Observations

Variable	Mean	Standard deviation	Maximum	Minimum	Skewness
9	.58	1.49	10.5	0.0	4.29
14	.54	1.64	13.0	0.0	5.36
22	1.61	4.50	38.5	0.0	5.97
28	.73	1.34	8.0	0.0	2.53
35	1.52	3.23	19.0	0.0	3.64
41	3.04	5.36	30.0	0.0	2.83
49	1.74	3.31	21.0	0.0	3.16
58	2.22	3.77	19.0	0.0	2.41
64	4.14	5.75	29.0	0.0	1.96
67	3.23	5.92	44.0	0.0	4.07

Note: Skewness = 0 when distribution is completely symmetrical. Positive values indicate clustering of most values to the left of the mean readily apparent from this table that scores were positively skewed in all selected cases.

The non-normality of the score distribution led to the next step, which was a check on the linearity of the correlations between variables. A sample of correlation scatter diagrams was obtained and is contained in Appendix 7. These diagrams graphically depict the non-linear (heteroscedastic) nature of the correlations. The use of the statistical procedure of factor analysis was therefore ruled out, as far as employing factor scores as independent variables was concerned. Nonetheless, it was decided to proceed with factor analysis in order to observe the patterning of the data and determine ways in which the EMG scores could be employed as dependent variables in subsequent tests of the psychological-physiological relationship.

Factor Analyses of EMG Variables

All the factor analyses to be presented were done at the University of Ottawa Computer Centre using the programs of Statistical Package for the Social Sciences (SPSS). In all cases, the principal factoring with iterations and oblique rotation method was used, since there were many measures on the same subject and the data were somewhat correlated (SPSS $\Delta = 0$).

Factor analyses were performed according to the following data breakdowns:

1. Total EMG variables (Table 4)
2. Self-Other (Tables 5 and 6)
3. Neutral-Affective (Tables 7 and 8)
4. Extremities (Arm, Leg) - Bulbar (Lip, Head, Eye) (Tables 9 and 10)
5. All five locales separately (Tables 11 - 15).

The tables include only those variables whose factor loadings are >.3 in the factor pattern matrix, and only those common factors extracted by Cattell's "scree" test. Appendix 8 contains the complete factor pattern matrices.

Results of Factor Analyses

What emerges on the factor analysis of Total:EMG, EMG:Self and EMG:Other, EMG:Neutral and EMG:Affective are body region common factors. Table 4 indicates that when the total matrix of variables is analyzed, those variables with the highest loadings on the first factor are forehead variables. Factor 2 is primarily an Arm factor, although two leg variables also have high loadings. Factor 3 is exclusively a Leg factor, and Factor 4 an Eye factor. Factor 5 high loadings are primarily on lip variables. The significant loadings on these factors appeared to be randomly related to the categories of self-referent and other-referent variables and to the neutral and affective variables as well. In addition, a specificity effect could not be determined; that is, the forehead task-specific variable did not load

Table 4

Factor Pattern Loadings of >.3 for EMG:Total with Eigenvalues and Percentage of Variance

	Variable	Factor 1	Variable	Factor 2	Variable	Factor 3	Variable	Factor 4	Variable	Factor 5
	8	.367	1	.382	18	.431	61	.501	33	.389
	46	.614	3	.686	19	.516	62	.342	34	.873
	49	.362	4	.371	23	.827	65	.731	35	.724
	51	.588	6	.592	24	.583	66	.480	37	.594
	52	.358	10	.705	25	.646	69	.301	38	.498
	53	.595	11	.580	28	.592	74	.751	41	.324
	57	.640	12	.338					43	.875
	59	.529	21	.845					44	.801
	60	.503	29	.818					45	.739
	61	.343							67	.563
	75	.388								
Eigenvalue		18.54		5.77		4.41		4.13		3.44
Percentage of variance		32.80		10.20		7.80		7.30		6.10
Cumulative percentage		32.80		43.00		50.80		58.10		64.20

Table 5

Factor Pattern Loadings of >.3 for EMG:Self with Eigenvalues and Percentage of Variance

	Variable	Factor 1	Variable	Factor 2	Variable	Factor 3
	40	.534	1	.330	61	.671
	46	.784	2	.501	62	.610
	51	.660	5	.607	65	.632
	60	.649	6	.687	66	.337
	61	.427	9	.809	69	.366
	37	.378	10	.391		
			13	.648		
			15	.687		
Eigenvalue		9.82		3.07		2.54
Percentage of variance		38.70		12.10		10.00
Cumulative percentage		38.70		50.80		60.90

Table 6

Factor Pattern Loadings of >.3 for EMG:Other with Eigenvalues and Percentage of Variance

Variable	Factor 1	Variable	Factor 2	Variable	Factor 3
8	.428	19	.345	33	.465
33	.336	22	.762	34	.817
48	.768	26	.935	37	.710
49	.646	27	.714	38	.670
52	.595			41	.469
53	.524			44	.782
56	.650			67	.582
57	.456				
59	.419				
Eigenvalue	9.25		3.08		2.73
Percentage of variance	39.20		13.00		11.60
Cumulative percentage	39.20		52.20		63.80

Table 7

Factor Pattern Loadings of >.3 for EMG:Neutral with Eigenvalues and Percentage of Variance

Variable	Factor 1	Variable	Factor 2	Variable	Factor 3	Variable	Factor 4
28	.315	1	.844	29	.320	16	.352
33	.390	3	.564	61	.557	22	.925
35	.715	7	.483	65	.790	24	.506
37	.602	13	.465	69	.313	26	.811
41	.510					29	
43	.901						
44	.752						
45	.769						
67	.459						
Eigenvalue	11.25		3.58		2.83		2.50
Percentage of variance	36.20		11.50		9.10		8.00
Cumulative percentage	36.20		47.70		56.80		64.90

Table 8

Factor Pattern Loadings of >.3 for EMG:Affective with Eigenvalues and Percentage of Variance

Variable	Factor 1	Variable	Factor 2	Variable	Factor 3
4	.700	2	.469	19	.800
8	.813	4	.416	23	.829
49	.494	10	.763	25	.708
53	.511	12	.326	27	.589
57	.535	21	.733		
Eigenvalue	8.01		2.48		1.14
Percentage of variance	41.60		12.90		11.70
Cumulative percentage	41.60		54.60		66.2

Table 9

Factor Pattern Loadings of >.3 for EMG:Extremities with Eigenvalues and Percentage of Variance

Variable	Factor 1	Variable	Factor 2	Variable	Factor 3	Variable	Factor 4
3	.620	19	.338	2	.579	19	.427
6	.531	23	.643	5	.405	22	.718
10	.439	24	.305	6	.538	26	.931
11	.619	25	.411	9	.695	27	.852
21	.827	28	.702	11	.407		
29	.835			13	.395		
				15	.627		
Eigenvalue	9.02		4.02		2.22		1.51
Percentage of variance	44.30		19.80		10.90		7.40
Cumulative percentage	44.30		64.10		75.00		82.50

Table 10

Factor Pattern Loadings of >.3 for EMG:Bulbar with Eigenvalues and Percentage of Variance

Variable	Factor 1	Variable	Factor 2	Variable	Factor 3
53	.460	61	.510	33	.342
56	.349	62	.371	34	.854
62	.491	64	.335	35	.746
68	.521	65	.733	37	.622
		66	.469	38	.490
				41	.339
				43	.915
				44	.795
				45	.715
				67	.588
Eigenvalue	14.09		3.63		3.32
Percentage of variance	45.70		11.80		10.80
Cumulative percentage	45.70		57.50		68.20

Table 11

Factor Pattern Loadings of >.3 on All Factors for EMG:Arm with Eigenvalues and Percentage of Variance

Variable	Factor 1	Variable	Factor 2	Variable	Factor 3
1	.917	2	.321	2	.581
3	.583	5	.694	3	.639
4	.683	7	.554	6	.527
7	.399	9	.787	11	.841
8	.694	13	.406		
10	.540	14	.551		
12	.386	15	.521		
13	.350				
Eigenvalue	6.67		1.19		1.05
Percentage of variance	74.80		13.40		11.80
Cumulative percentage	74.80		88.20		100.0

Table 12

Factor Pattern Loadings of $>.3$ on All Factors for EMG:Leg with Eigenvalues and Percentage of Variance

Variable	Factor 1	Variable	Factor 2	Variable	Factor 3	Variable	Factor 4
19	.745	22	.796	29	.814	16	.408
23	.805	26	.878			17	.452
25	.646	27	.616			18	.796
27	.512					30	.422
28	.515						
Eigenvalue	5.79		1.44		1.29		0.68
Percentage of variance	62.90		15.60		14.10		7.40
Cumulative percentage	62.90		78.50		92.60		100.00

Table 13

Factor Pattern Loadings of >.3 on All Factors for EMG:Lip with Eigenvalues and Percentage of Variance

Variable	Factor 1	Variable	Factor 2	Variable	Factor 3
33	.416	32	.660		
34	.790	36	.549		
35	.849	41	.453		
37	.730	42	.713		
38	.532				
43	.934				
44	.916				
45	.671				
Eigenvalue	6.46		0.71		1.18
Percentage of variance	77.20		8.50		14.20
Cumulative percentage	77.20		100.00		91.50

Note: Where column is blank, no variable loaded >.3 on that factor.

Table 14

Factor Pattern Loadings of >.3 on All Factors for EMG:Head with Eigenvalues and Percentage of Variance

Variable	Factor 1	Variable	Factor 2
47	.798		
48	.623		
49	.639		
40	.795		
52	.576		
53	.474		
54	.739		
55	.840		
56	.641		
57	.361		
58	.542		
Eigenvalue	7.53		1.21
Percentage of variance	86.20		13.80
Cumulative percentage	86.20		100.00

Note: Where column is blank, no variable loaded >.3 on that factor.

Table 15

Factor Pattern Loadings of >.3 on All Factors for EMG:Eye with Eigenvalues and Percentage of Variance

Variable	Factor 1	Variable	Factor 2	Variable	Factor 3	Variable	Factor 4
65	.364	62	.659			61	.419
74	.497	70	.622			66	.393
		71	.639			69	.300
						72	.422
						73	.790
						74	.491
						75	.645
Eigenvalue	6.13		0.89		0.67		0.58
Percentage of variance	73.90		10.8		8.20		7.10
Cumulative percentage	73.90		84.8		92.90		100.00

Note: Where column is blank, no variable loaded >.3 on that factor.

as highly as some of the other, nontask specific forehead variables. Specificity was not found in analyses of any of the factors emerging from any of the factor analyses.

When separate factor analyses were performed on the self-referent and other-referent variables (see Tables 5 and 6), the forehead locale again contributed the highest loadings on the first factor in both cases, but high loadings were also found for an eye and lip variable in the EMG:Self analysis and for a lip and arm variable in the EMG:Other analysis. Factor 2 was an Arm factor for EMG:Self and a Leg factor for EMG: Other. Factor 3 was an Eye factor in the former and primarily a Lip factor in the latter case.

Tables 7 and 8 indicate the neutral and affective factor analysis patterns. In the EMG:Neutral case, factor 1 was a Lip factor, with smaller loadings on an eye and a leg variable. Factor 2 was an Arm factor, factor 3 Lip, and factor 4 Leg. From the factor analysis of the affective variables, the first factor loaded significantly on both head and arm variables. Since all these variables were other-referent, this factor could be simply labelled as Head-Arm-Other. Of all analyses done, this was the only case in which any kind of a consistent pattern was detectable and is interpreted as a chance phenomenon.

Table 9 (EMG:Extremities) indicates a mixed first factor, with highest loadings from the leg component. Factors 2, 3, and 4 are Leg, Arm, and Leg, respectively. Factor analysis of the bulbar (lip, head, eye) region resulted in the extraction of three factors. Factor 1 was a mixed Head-Eye factor. Factor 2 was exclusively Eye, and Factor 3 primarily Lip. It should be noted in comparing factor analyses that analyzing in terms of body regions, as opposed to self-other or neutral-affective, yielded prime factors that accounted for considerably more of the variance. There was reason, therefore, to suppose that factor analyses of the five sets of locale variables separately would yield large general factors. As Tables 11 to 15 indicate, this proved to be the case. The EMG:Head analysis, for example, resulted in a first factor which accounted for 86.2% of the variance. It was the forehead variables that had the highest loadings on the first three factor analyses performed.

The conclusion drawn from the various factor analyses is simply that the EMG variables intercorrelated solely in terms of body region. Manipulating locale variables in terms of self vs. other-reference and neutral vs. affective quality had no effect. With the body factors clearly delineated, and having no empirical basis from which to pursue the self-other or neutral-affective differences, it was decided simply to employ body locales in subsequent analyses as dependent variables, summing raw scores over the 15 region-specific variables to get composite scores for each locale.

The Psychological Test Data

The psychological test data were arranged for use as independent variables. The data matrix was constituted as follows: scores on 12 POI scales, all 16PF scales, 2 EPI scales, 1 Cattell Culture Fair IQ score, and 1 score on the HABGT Psychopathology scale, for a total of 32 test variables. In order to reduce these data to more manageable proportions, the following procedures were implemented.

1. A principal component factor analysis with iterations and varimax rotation was done on the POI scales. Results of this analysis appear in Table 16. With 72.6% of the total variance accounted for by the first of three factors, the first factor was regarded as a general factor and estimated factor scores were derived from it. This was done by multiplying factor-score coefficients by the standard scores of the variables and summing over all variables for each subject. The resulting composite scale score became the POI variable in subsequent analyses.

The general factor that emerged in this analysis was highly loaded by scales having to do with feeling and its expression (numbers 5 and 6), with interpersonal contact (11 and 12), and with self-direction (2). As distinct from the more intellectual aspects of self-actualization measured by the POI, this factor appears to be primarily affective in nature and could be labelled "Feeling-

Table 16

Varimax Rotated Factor Matrix of POI Scales with Eigenvalues and Percentage of Variance

POI Scale	Factor 1	Factor 2	Factor 3
1 Time Competence	.189	.614	.192
2 Inner Directedness	.591	.757	.231
3 Self-actualizing Value	.427	.223	.730
4 Existentiality	.376	.581	.039
5 Feeling Reactivity	.773	.232	.064
6 Spontaneity	.545	.447	.228
7 Self-regard	.138	.507	.381
8 Self-acceptance	.220	.588	-.109
9 Nature of Man	-.163	.117	.563
10 Synergy	.077	-.047	.525
11 Acceptance of Aggression	.681	.245	.095
12 Capacity for Intimate Contact	.675	.462	.162
Eigenvalue	4.78	1.21	0.58
Percentage of variance	72.60	18.50	8.90
Cumulative percentage	72.60	91.10	100.00

Interpersonal Sensitivity." The second factor seems mainly one of self-perception and the third, intellectual awareness.

2. The 16 source variable scores of the 16PF were transformed into four second-order factor scores according to the formula given by the Institute of Personality and Ability Testing (1972). The original 16 raw scores were first transformed into sten scores and the second-order scores were derived from the sten scores. The four factors were:

Q_1 introversion vs. extraversion

Q_2 low anxiety vs. high anxiety

Q_3 tender-minded emotionality vs. tough poise

Q_4 subduedness vs. independence

3. Factor analysis was performed on the combined four 16PF second-order and two EPI scales, as anticipated in the previous chapter. The method was principal factoring with iterations and varimax rotation. Results of this analysis appear in Table 17. As expected, the 16PF anxiety scale and EPI Neuroticism scale are highly correlated and load heavily on the first factor. The EPI and 16PF introversion-extraversion scales are also highly correlated and are highly loaded on the second factor. It was, therefore decided to select the scale with the highest loadings on each factor for use in later analyses. These were the 16PF Anxiety and the EPI Extraversion scales.

Table 17

Varimax Rotated Factor Matrix of EPI and 16PF Second-order Scales with Eigenvalues and Percentage of Variance

	Scales	Factor 1	Factor 2
1	EPI Extraversion	-.024	.864
2	EPI Neuroticism	.820	-.047
3	16PF Extraversion	-.343	.633
4	16PF Anxiety	.887	-.155
5	16PF Tough Poise	-.419	.302
6	16PF Independence	-.651	.249
	Eigenvalue	2.57	0.93
	Percentage of variance	73.50	26.50
	Cumulative percentage	73.50	100.00

Utilizing the anticipated data reduction procedures, a final set of seven test variables was compiled, a POI score, three 16PF second-order scores (Anxiety, Tough Poise, and Independence), EPI Extraversion, HABGT Psychopathology, and the Culture Fair IQ. While these scales were originally selected on an a priori basis for their potential value in assessing the psychological maturity of the subjects, decisions remained as to their relative value in so doing. Therefore, a method of ranking and weighting the scales was employed. Ten practicing clinical psychologists who were familiar with the test scales were independently given a descriptive profile of a prototypical mature individual and asked to rank order and weight the scales according to their relevance or importance in measuring the construct. This profile was composed from various theoretical and empirical sources and appears in Appendix 9, along with instructions to the clinical judges. Table 18 indicates the ranks and weights assigned by the judges. It will be noted that the POI received the heaviest mean weighting by a considerable margin, followed by the 16PF Independence scale and so on. For purposes of compiling a composite maturity score from all weighted variables, the raw scores of each scale (factor scores in the case of the POI) were

Table 18

Ranks and Weights in Percentage by Clinical Judges of Independent Variable Test Scales

Judge	EPI Extraversion		16PF Anxiety		16PF Tough Poise		16PF Independence		POI		HABGT	
	Rank	Weight	Rank	Weight	Rank	Weight	Rank	Weight	Rank	Weight	Rank	Weight
1	4	10	3	15	5	5	2	15	1	50	6	5
2	1	20	5	10	3	20	2	20	4	20	6	10
3	5	10	4	10	3	15	2	25	1	35	6	5
4	3	15	4	10	5	7	2	25	1	40	6	3
5	5	10	4	15	1	30	2	18	3	17	6	10
6	5	9	3	20	2	25	1	30	4	15	6	1
8	5	10	4	15	2	20	1	25	3	20	6	10
9	3	15	5	10	4	10	2	20	1	40	6	5
10	3	10	2	25	6	5	5	5	1	50	4	5
Mean ranking	4.0		3.7		3.5		2.1		2.0		5.7	
Mean weight in percentage		11.6		14.5		14.7		20.3		32.7		6.2

transformed into standard scores. The resulting Z scores were then multiplied by the average rated weight of the scales and combined as follows: MAT = $32.7_Z + 20.3_Z + 14.7_Z - 14.5_Z - 11.6_Z - 6.2_Z$.

It will be seen that three of the scales are combined additively and three subtractively. Thus scores on the POI, 16PF Independence, and 16PF Tough Poise are summed and subtracted from them are scores on 16PF Anxiety, EPI Extraversion, and HABGT Psychopathology. While an argument could be made that extraversion is not necessarily inversely related to maturity, on the theoretical point that less extraversive individuals are more cortically aroused and cognitively active and less peripherally involved (Eysenck, 1967), it was judged that, except in extreme cases, lower extraversion scorers were likely the more mature individuals, EPI Extraversion was, therefore, deemed a subtractive factor in the equation.

Having arrived at a composite index of maturity (MAT), it then became possible to categorize and group subjects in terms of the magnitude of their composite MAT score, the higher scorers being the more mature. Three levels of this independent variable were devised: high, medium, and low. The two highest ranked and weighted scale variables, namely, the POI and 16PF Independence, were also independently divided into the same three levels according to the ordering of their scores.

Statistical Analyses of the Physiological-Psychological Relationship

The research question at this point was whether the criterion (EMG) measures were significantly related to the three independent variables. As an overall test of the relationships, a multivariate analysis of variance was first performed on the MAT variable and the five dependent variables. Three levels of MAT were tested: high, medium, and low, with contrasts made between both the extreme groups and the middle group. The dependent variables are represented in the analyses as follows: variable 1 = arm, variable 2 = leg, variable 3 = lip, variable 4 = head, variable 5 = eye. Tables 19 and 20 represent the results of multivariate analyses of variance and regression and tests of significance. As Table 20 indicates, there is no significance in the overall test of the null hypothesis of equal effects of levels of the independent variable. Hence, the null hypothesis is retained and it is concluded that there are no significant differences between categories of the independent variable in a multivariate analysis. The univariate analyses, which release control of the effects of the other dependent variables, are also nonsignificant, although there is a trend to significance for variable 5 (eye).

Table 19

Regression Analysis of MAT with IQ as Covariate for Test of Null Hypothesis of No Association between Dependent and Independent Variables (N = 120)

Variable	R Square	Multiple R	F	p less than
1	0.0006	0.0245	0.069	0.792
2	0.0229	0.1515	2.724	0.101
3	0.0096	0.0981	1.127	0.290
4	0.0040	0.0632	0.465	0.496
5	0.0001	0.0072	0.006	0.938

df hypothesis = 1
df error = 116
F for overall hypothesis of no association = 1.502, with df = 5 and 112, and $p < 0.194$.

Note: Tests of statistical power of F tests as follows:
Variables 1, 3, 4, 5 = .05
Variable 2 = .32

Table 20

Analyses of Variance of Three Levels of MAT for Test of Null Hypothesis of Equality of Mean Vectors (N = 120)

Variable	Mean Square	Univariate F	p less than
1	381.50	1.279	0.282
2	450.09	0.681	0.507
3	6490.65	1.893	0.155
4	2638.43	1.832	0.164
5	10541.09	2.652	0.074

df hypothesis = 2
df error = 116
F ratio for multivariate test of equality = 0.845, with df = 10 and 224, and $p > 0.585$.

A second multivariate analysis was performed, this time on a crossed design employing three levels of two factors, POI and 16PF Independence, with IQ as covariate. Table 21 contains the statistics for the regression analysis with IQ as covariate. Tables 22, 23, and 24 indicate the results of the multivariate and univariate analyses with the covariate removed, using the unbiased estimates of both independent variables. In all cases, the overall multivariate tests are nonsignificant. Univariate tests are also nonsignificant, with a very slight trend suggested on the leg variable in the case of the POI main effects and on the eye variable in the case of the 16PF Independence main effects. There is also a trend toward significance on the eye variable with the interaction test.

In view of the nonsignificant results obtained employing three levels of the independent variables, it was conjectured that by using extreme scores of the independent variables any differences that existed on the variable would be maximized. The MAT, POI, and 16PF Independence variables were, therefore, divided into two levels, with the levels comprised of the 22 highest and 22 lowest scores, respectively. MANOVAs were performed on these factors separately. Results appear in Tables 25, 26, and 27. All multivariate and univariate *F* ratios were nonsignificant. The only promising trends occurred in the analysis of the MAT factor, where *F* ratios

Table 21

Regression Analysis of POI with IQ as Covariate for Test of Null Hypothesis of No Association between Dependent and Independent Variables (N = 120)

Variable	R Square	Multiple R	F	p less than
1	0.0015	0.0384	0.1625	0.6877
2	0.0211	0.1453	2.3735	0.1263
3	0.0077	0.0879	0.8570	0.3567
4	0.0086	0.0925	0.9487	0.3322
5	0.0000	0.0069	0.0052	0.9428

df hypothesis = 1
df error = 110
F for overall hypothesis of no association = 1.644, with df = 5 and 106, and $p < 0.154$

Table 22

Analyses of Variance of Three Levels of POI for Test of Null Hypothesis of Equality of Mean Vectors (N = 120)

Variable	Mean Square	Univariate F	p less than
1	116.71	0.381	0.683
2	1128.96	1.695	0.188
3	1631.90	0.462	0.630
4	8.25	0.005	0.994
5	1088.18	0.275	0.759

df hypothesis = 2
df error =110
F for multivariate test of equality = 0.552, with df = 10 and 212; and $p < 0.851$.

Table 23

Analyses of Variance of Three Levels of 16PF Independence for Test of Null Hypothesis of Equality of Mean Vectors
(N = 120)

Variable	Mean Square	Univariate F	p less than
1	300.95	0.983	0.377
2	17.62	0.026	0.973
3	3832.25	1.086	0.341
4	673.03	0.441	0.644
5	7850.03	1.990	0.141

df hypothesis = 2
df error = 110
F for multivariate test of equality = 0.940, with df = 10 and 212, and $p < 0.497$.

Table 24

Analyses of Variance of POI X 16PF Independence Interaction for Test of Null Hypothesis of Equality of Mean Vectors (N = 120)

Variable	Mean Square	Univariate F	p less than
1	266.48	0.871	0.483
2	420.35	0.631	0.641
3	3438.95	0.975	0.424
4	826.54	0.542	0.705
5	8029.68	2.036	0.094

df hypothesis = 2
df error = 110
F for multivariate test of equality = 0.891, with df = 20 and 352.5, and $p < 0.598$.

Table 25

Analyses of Variance of Two Levels of MAT (Extreme Groups) for Test of Null Hypothesis of Equality of Mean Vectors (n = 44)

Variable	Mean Square	Univariate F	p less than
1	504.56	1.549	0.220
2	945.81	1.406	0.242
3	10211.41	3.532	0.067
4	160.36	0.467	0.497
5	8351.76	2.844	0.099

df hypothesis = 1
df error = 42
F for multivariate test of equality = 0.999, with df = 5 and 38, and $p < 0.431$.

Table 26

Analyses of Variance of Two Levels of POI (Extreme Groups) for Test of Null Hypothesis of Equality of Mean Vectors ($\underline{n}$ = 44)

Variable	Mean Square	Univariate $\underline{F}$	$\underline{p}$ less than
1	47.05	0.147	0.703
2	394.79	0.587	0.447
3	15.60	0.003	0.956
4	107.26	0.204	0.653
5	6514.82	2.075	0.157

df hypothesis = 1
df error = 42
F for multivariate test of equality = 0.776, with df = 5 and 38, and $p < 0.573$.

Table 27

Analysis of Variance of Two Levels of 16PF Independence (Extreme Groups) for Test of Null Hypothesis of Equality of Mean Vectors (n = 44)

Variable	Mean Square	Univariate F	p less than
1	748.68	2.178	0.147
2	116.18	0.149	0.701
3	7807.11	2.728	0.106
4	1262.60	1.609	0.211
5	6410.60	1.628	0.209

df hypothesis = 1
df error = 42
F for multivariate test of equality = 1.010, with df = 5 and 38, and $p < 0.425$.

for the lip and eye were at the < .1 comfidence level. Of the three variables tested by the extreme groups method, the MAT and 16PF variables showed more general trends to significance than did the POI.

A predominant feature of these analyses was the large within-cells error term which resulted in low F ratios. As can be seen by consulting the data printouts in Appendices 10 - 12, levels of the independent variables split in the predicted direction when observed means were considered, but the within-cell variation nullified the differences to some extent.

Using the procedures and tables outlined by Cohen (1977), the power of the statistical F tests in Tables 19 and 20 were calculated. An alpha of .05 was selected and the effect size (f^2) and noncentrality parameter (L) calculated for each of the dependent variables. As will be noted under Table 19, very low statistical power obtained on all contrasts, all being .05, with the exception of variable 2 (leg) where power was .32. These findings suggest that group differences may in fact exist, that there is not equality of mean vectors. In other words, there is not sufficient evidence for a rejection of the null hypothesis. Rather, the differences being sought were not detected with the design and statistical methods employed. This power estimate indicates the theory was far from being put to exhaustive test by this experiment.

CHAPTER IV

DISCUSSION

This chapter discusses the results of the exploratory study and makes suggestions for future research in the field.

General Overview of Results

As a general finding, there were statistically nonsignificant results on the test of the relationship between the composite maturity variable and the summated EMG local scores, and the POI and 16PF variables and the EMG scores. There is a trend to significance for a relationship between the maturity score and eye-movement in both the three-level (high, medium, low) MANOVA and the extreme group MANOVA ($p < .07$, $p < .09$), suggesting the possibility that the less mature subjects had more ocular activity when they imagined than the more mature subjects. In the absence of genuine statistical reliability, however, further interpretation of the relationship is not warranted. On the basis of the statistical analysis, the difference in myoactivity during movement imagery of a normal male population was not found to be related to measures of psychological maturity.

EMG Data

The main source of difficulty in the analysis of the psychological-physiological relationship was the nature of the raw EMG scores. As previously indicated (Chapter III), EMG scores on all the image-task variables were positively skewed, with many zero scores (no EMG) in many records and a few high scores in several. The intercorrelations of these variables was demonstrated to be nonlinear, which forced the abandonment of factor-scores as independent variables and led to the testing of the psychological-physiological relationship from the other direction, i.e., with EMG raw scores as dependent variables.

The five dependent variables turned out to be positively correlated in the MANOVAs, in some cases fairly significantly so, e.g., between arm and leg, leg and head, lip and eye, in the MAT MANOVA (see Appendix 11). At the same time, the within-groups variances, or error terms, in the various MANOVAs were quite large because of the range of scores on the locale variables. The result was a lowering of the F ratios and retention of the null hypotheses. Had the data been normally distributed as had been hoped, the anticipated relationships might have obtained.

Pre-experiment pilot investigation on normal college males had demonstrated occasional zero amplitude scores, so zero scores were not unanticipated in this survey. However, the extent of this feature of the data was surprising, resulting as it did in the skewed distributions. This writer is inclined to believe at this point that, in a normal sample of the size of the one employed in this study, positive skewness is an inherent feature of the phenomenon of imaginally induced muscle contraction. Therefore, the suggestion is made that in further studies what is needed is either an expanded sampling of the same population, or a survey of a more heterogeneous sample, including clinical populations, or both.

Greater heterogeneity of the sample may also have been obtained by increasing the number of older subjects. Practical constraints on subject recruiting had resulted in only a few subjects over the median age of 19.6 being included in the sample.

In speculating about other possible reasons for minimal EMG amplitude, it is worth analyzing the context of the EMG recording. Subjects were required to enter an unfamiliar situation and rather quickly adopt a mental and bodily set conducive to imagining, i.e., relaxation. It is possible and indeed probable that for certain subjects this ideal state was not achieved, or was achieved only partially, and that irrelevant cognitive or somatic events intruded to interfere with optimum recording. Future research in the area should recognize the importance of pretest relaxation and take steps to assure it, such as by having subjects in a prone position before and during recording, a condition that was not possible in this study. Aids to relaxation, such as progressive relaxation in training or hypnotic suggestion, could also be employed. In addition, a postsession check on the vividness and/or duration of the subjects' imagery could be obtained and perhaps should be done routinely in studies of this sort. Degree of vividness of imagery could be used as a screening device or may be an important variable in its own right in predicting change in EMG amplitude.

This study employed an artificial laboratory situation in which subjects responded to instructions to imagine movement activities. These activities were presumed by the author to be common events within the range of experience or at least capable of being conceptualized by adult subjects. An alternative to this approach could be one in which the EMG associated with the dreams of sleeping subjects is recorded. While creating certain design problems, such an approach would tap the idiosyncratic and presumably more meaningful imagery of subjects and obviate the difficulties inherent in imposing contrived image tasks.

The matter of recording sensitivity should also be considered. This study employed uniform amplification and recording procedures across subjects and instrument sensitivity was checked for each subject prior to recording. Where insensitivity may have resulted, however, was in the choice of body locales for electrode placement, with specific reference to placement on the extremities, where zero or minimal amplitude was most prevalent. For example, in the case of the arm, greater sensitivity may have been obtained using a finger electrode placement instead of the forearm flexor. Muscle groups of the leg other than the quadriceps, or different placings on the quadriceps may have detected EMG changes. The author is of the opinion that future research undertake extensive pretesting of body locales to assure choices of optimal sensitivity.

Psychological Data

In this study, degree of maturity of the individual was derived from existing psychological tests. These tests were believed, on theoretical grounds, to measure various aspects or components of "maturity." Whereas it was impractical in a normative, data-base study of this kind to employ instruments requiring individual administration and complex interpretation, it is conceivable that such instruments may have equal or better validity as measures of maturity. Dynamically oriented techniques such as the Rorschach would be one possibility, as would open-ended sentence completion questionnaires. Life-style maturity questionnaires or checklists could also be created and used for the same purpose. Future research involving indices of maturity could perhaps employ smaller samples on whom more sensitive, projective-type measures could be obtained.

From the standpoint of the test of the psychological-physiological relationship of this study, questions of the validity of the measures of the independent variables are academic, given the nonsignificant results that were found. It is interesting to note, however, that the composite maturity index (MAT) came closer to yielding significant results than did the two test scales (POI and 16PF) taken singly.

Whereas psychological test measures were used on this study as indices of maturity, the author wishes to suggest that there are other ways to attain the same end. One would be to categorize subjects on an age dimension, from mid- or late-adolescence to old age and test differences using these categories as independent variables. As a possible refinement, measures such as the POI (in this study the best single measure of maturity) could be obtained on subjects in each category, and within-categories as well as between-categories differences tested.

SUMMARY AND CONCLUSIONS

This study set out to explore the relationship between measures of psychological maturity and covert muscle activity during human movement imagery. The rationale for undertaking this investigation derived from several sources: the theories of human development that postulated decreasing motor involvement in the course of mental growth; the empirical evidence for a correlation between muscle tension and emotionality; evidence from the early motor theories of consciousness that localized motor reaction sometimes accompanied thinking; the electrophysiological data from Jacobson and others which showed myoactivity during imagining in some subjects. The thesis contended that myoactivity to imaginal stimuli ought to be of greater magnitude in less "mature" individuals, on the theoretical proposition that the more mature, integrated individual could carry out the mental task of imagining an activity with minimal concomitant involvement of the corresponding muscle group.

In order to explore this possibility, 120 male university students were studied in a repeated measures survey. Using surface electromyography, covert muscle activity was simultaneously recorded from five body regions (arm, leg, lip, head, eye) while subjects imagined a series of 15 human movement activities, some of which were self-reference, some other-referent, some neutral in content, some affective in content.

In the second phase of the study, the 120 subjects were appraised as to their "maturity" status. To this end, existing psychological instruments were surveyed and five selected for use in the study: the Personal Orientation Inventory, the Cattell 16PF, the Eysenck Personality Inventory, the Hutt Adaptation of the Bender-Gestalt Test, and the Cattell Culture Fair Test of Intelligence. All were chosen on an a priori basis as measures of aspects of maturity. Data reduction procedures yielded six test-scale variables, each of which was rated by clinical judges as to validity as a measure of maturity. A composite maturity index was devised from weighted scale measures for use as the principal psychological variable in analyses of the physiological (EMG)-psychological relationship.

The EMG variables were positively skewed in their distributions and nonlinear in their intercorrelations. Factor analyses of the EMG data matrix were done to see what, if any, interpretable factors would emerge. Factors were found to load highly in clusters of body region variables, but not in terms of self-other or affective-neutral distinctions.

The nature of the EMG data (nonlinearity) precluded their use as independent variables. Instead, in view of the body region factor patterns observed to exist, these data were employed as dependent variables. Five dependent variables were created by summing all the scores of variables associated with each locale. Several multivariate analyses of variance were performed on these data. The first of these used three levels--high, medium, and low--of the maturity measure as the independent variable. High, medium, and low levels of the POI and 16PF Independence factor were also used in a crossed design. The hypothesis in all cases was that there would be significant differences between the levels, with high levels of the independent variable predicting low EMG scores. The multivariate and univariate *F* ratios were nonsignificant in each case, with a slight trend to significance for the eye locale of the test of the maturity factor. An attempt was then made to maximize differences on the independent variables by testing extreme groups of the distributions. Two-factor MANOVAs were performed using extreme groups for the maturity, POI, and 16PF variables separately. Again, tests of the relationship were nonsignificant, with slight trends to significance noticed on the maturity and 16PF factors.

The nonsignificance of the tests of the relationships was interpreted as due to the noncontinuous nature of the EMG score distribution and heterogeneity of the variance of the scores, which resulted in large error terms in the *F* ratios. It was contended, however, that, considering the observed means of the dependent variables in the various MANOVAs, differences did exist in the anticipated direction, despite the failure to attain statistical validation for the reasons already mentioned. It was also suggested that increasing the number and/or kind of subjects might normalize the distribution of scores and homogenize the variances.

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APPENDIX 1

INSTRUCTIONS TO SUBJECTS

APPENDIX 1

INSTRUCTIONS TO SUBJECTS

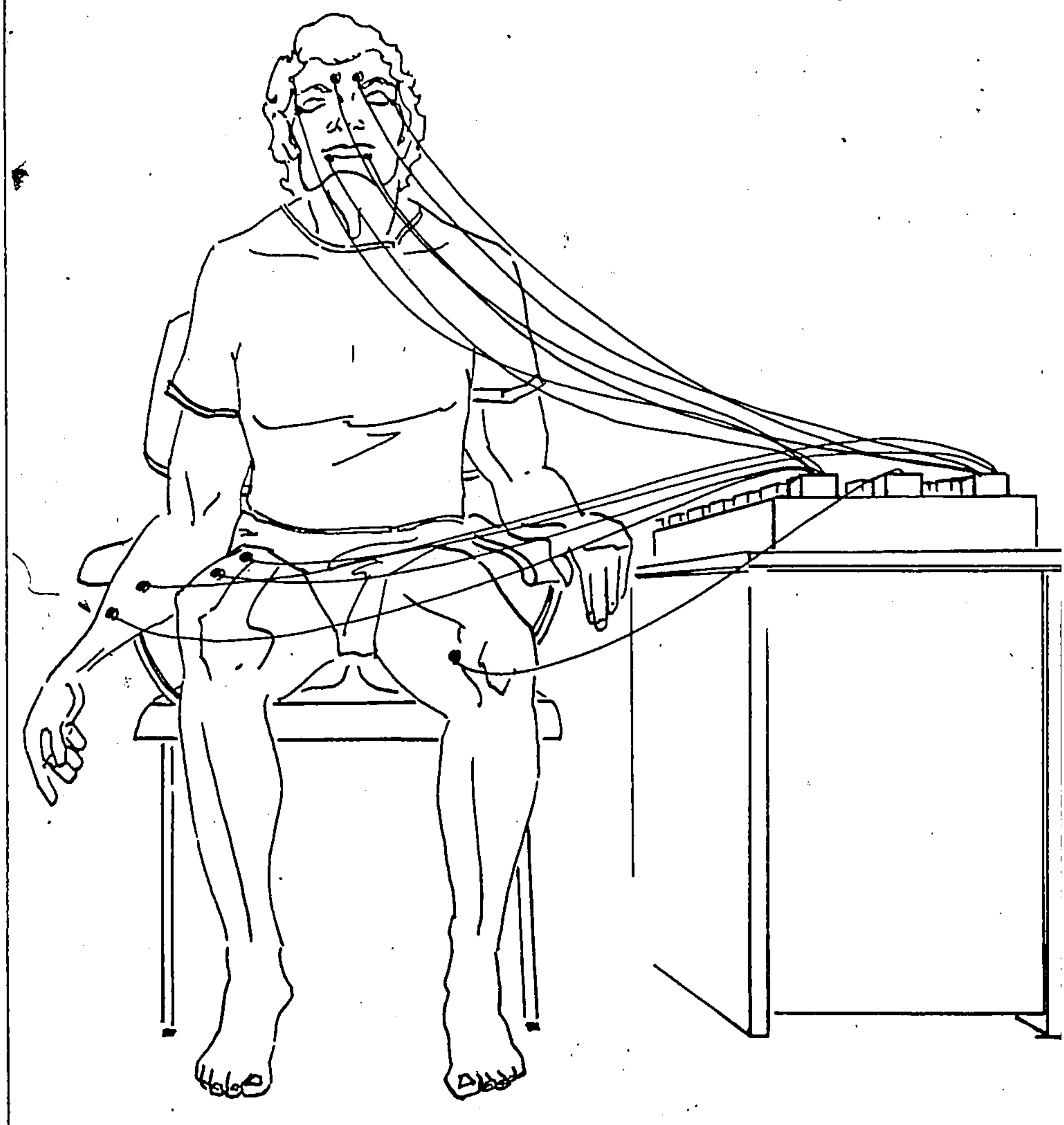
This research involves having you imagine certain things. What I will be doing is putting these surface electrodes onto various parts of your body--your arm, leg, lip, forehead, and at the corner of your eye. This is a harmless, painless, and widely used procedure. Once you are "wired up" and relaxed, I will be giving you some instructions over the intercom from my position in the other room. I will be asking you to imagine various things. When you hear me say, "Imagine such-and-such," you are to do just that. Try to sustain that image for about a 10-second period. After 10 seconds, I will give you the instruction, "Relax," which means you are to stop imagining, let your mind go blank, just relax. After a half a minute or so, you will receive the next image instruction, followed after 10 seconds by "Relax," and so on, until all the images have been completed. I will inform you when the session is over.

APPENDIX 2

FIGURE OF FULLY PREPARED SUBJECT

APPENDIX 2

FIGURE OF FULLY PREPARED SUBJECT



APPENDIX 3

RELAXATION INSTRUCTIONS

APPENDIX 3

RELAXATION INSTRUCTIONS

At this point you have absolutely nothing to do or think about. You can relax completely . . . . . Keep your eyes closed . . . . . Take fairly deep breaths, exhaling slowly each time as you relax more and more . . . . . Let your arm go limp as a rag. Let your legs relax completely . . . . . Let your whole body sink into the chair . . . . . Put your head back and let your neck and face muscles relax . . . . . Just relax . . . . . There is nothing to do but relax.

APPENDIX 4

RESULTS OF t TESTS OF DIFFERENCES BETWEEN NEUTRAL AND AFFECTIVE IMAGE PAIRS ON SEMANTIC DIFFERENTIAL RATINGS

APPENDIX 4

RESULTS OF t TESTS OF DIFFERENCES BETWEEN NEUTRAL AND AFFECTIVE IMAGE PAIRS ON SEMANTIC DIFFERENTIAL RATINGS

According to Osgood, Suci, and Tannenbaum (1957), descriptive semantic differential measures in the case of replications over different individuals can be analyzed with the usual statistical tests of significance. SD scale scores on six neutral-affective pairs of image tasks were tested for significant differences using *t* tests. Results are as follows ($N = 20$, $df = 38$):

Image task pair	*t*	*p*
1. Squeezing a tennis ball vs. Squeezing a girl's breast	-8.87	<.001
2. Squeezing a lemon vs. Clenching a fist in rage	-4.01	<.001
3. Tightening your thigh muscle vs. Kicking a small child	-3.46	<.001
4. Bending your knee vs. Kicking a dog	-4.10	<.001
5. Whistling a tune vs. Kissing someone	-4.80	<.001
6. Chewing vs. Vomiting	-2.46	<.01

APPENDIX 5

SEMANTIC DIFFERENTIAL SCALES USED TO MEASURE NEUTRAL AND AFFECTIVE IMAGES

APPENDIX 5

SEMANTIC DIFFERENTIAL SCALES USED TO MEASURE NEUTRAL AND AFFECTIVE IMAGES

CONCEPT ______________________________

good ____:____:____:____:____:____:____: bad

worthless ____:____:____:____:____:____:____: valuable

nice ____:____:____:____:____:____:____: awful

distasteful ____:____:____:____:____:____:____: tasteful

beautiful ____:____:____:____:____:____:____: ugly

dirty ____:____:____:____:____:____:____: clean

pleasant ____:____:____:____:____:____:____: unpleasant

profane ____:____:____:____:____:____:____: sacred

fair ____:____:____:____:____:____:____: unfair

APPENDIX 6

QUESTIONNAIRES, PROFILE, AND SCORING FORMS OF THE FIVE INSTRUMENTS COMPRISING THE TEST BATTERY

PREVIOUSLY COPYRIGHTED MATERIAL
IN APPENDIX 6, LEAVES 121 to 127
NOT MICROFILMED.

121 - Personal Orientation Inventory by Everett L. Shostrom, Ph.D.

122 - Profile Sheet for the personal Orientation Inventory.

123 - Eysenck Personality Inventory.

MAY BE OBTAINED FROM:
Educational and Industrial Testing Service
Box 7234 San Diego
California 92107

124 - The Hutt Adaptation of the Bender-Gestalt Test

MAY BE OBTAINED FROM:
Grune & Stratton, Inc., N.Y.

125 - Test of "g"; Culture Fair
Scale 3, Form A

126 - 16 PF

127 - 16 PF Test Profile

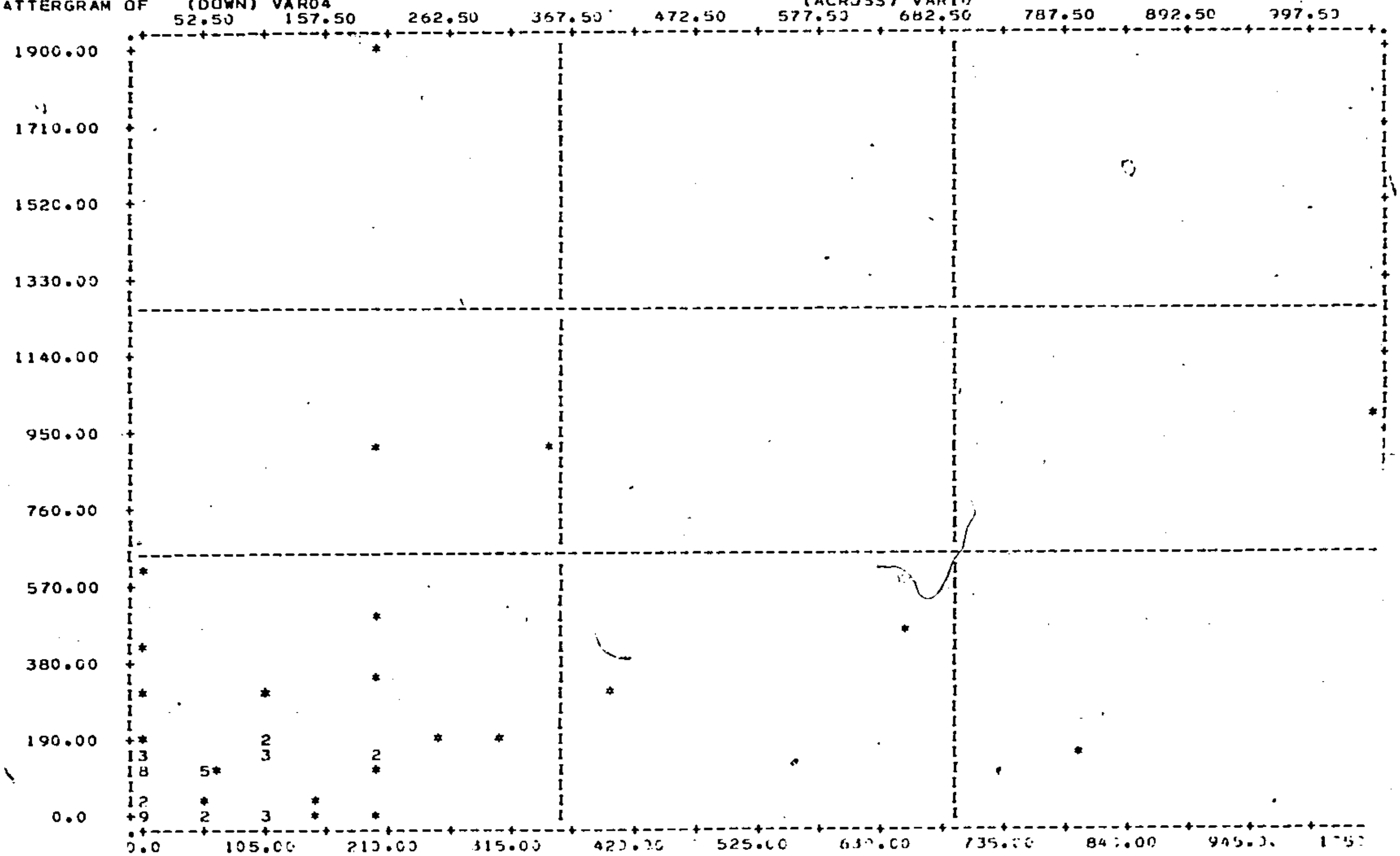
MAY BE OBTAINED FROM:

Institute for Personality and Ability Testing
1602 Coronado Drive
Champain, Illinois

APPENDIX 7

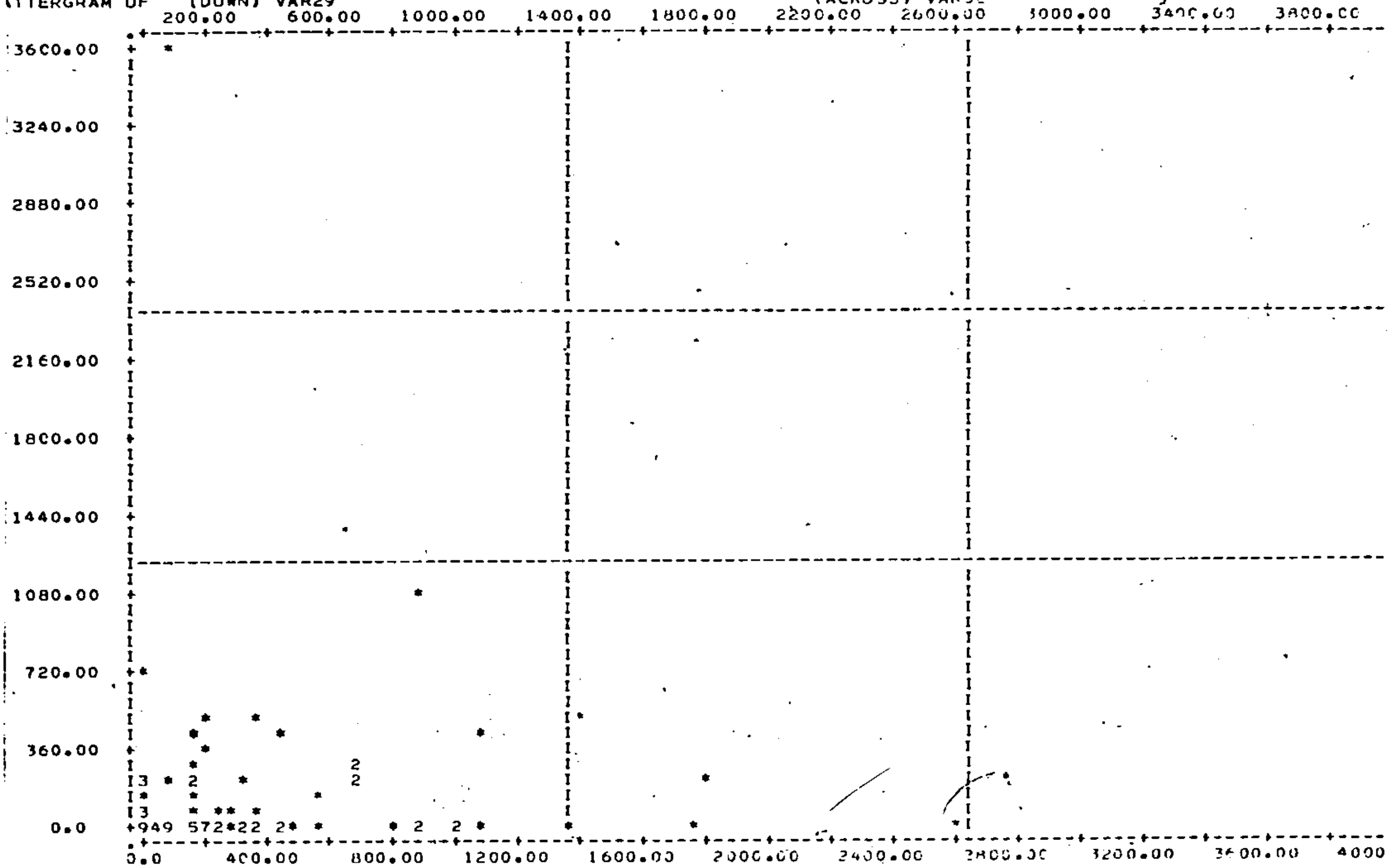
RANDOM SAMPLE OF CORRELATION SCATTERGRAMS DEPICTING NONLINEAR RELATIONSHIPS

_6 EMG (CREATION DATE = 11/02/77) CORRGRAPHIC
ATTERGRAM OF (DOWN) VAR04 (ACROSS) VAR10



LE EMG (CREATION DATE = 11/03/77) CORRGRAPHIC

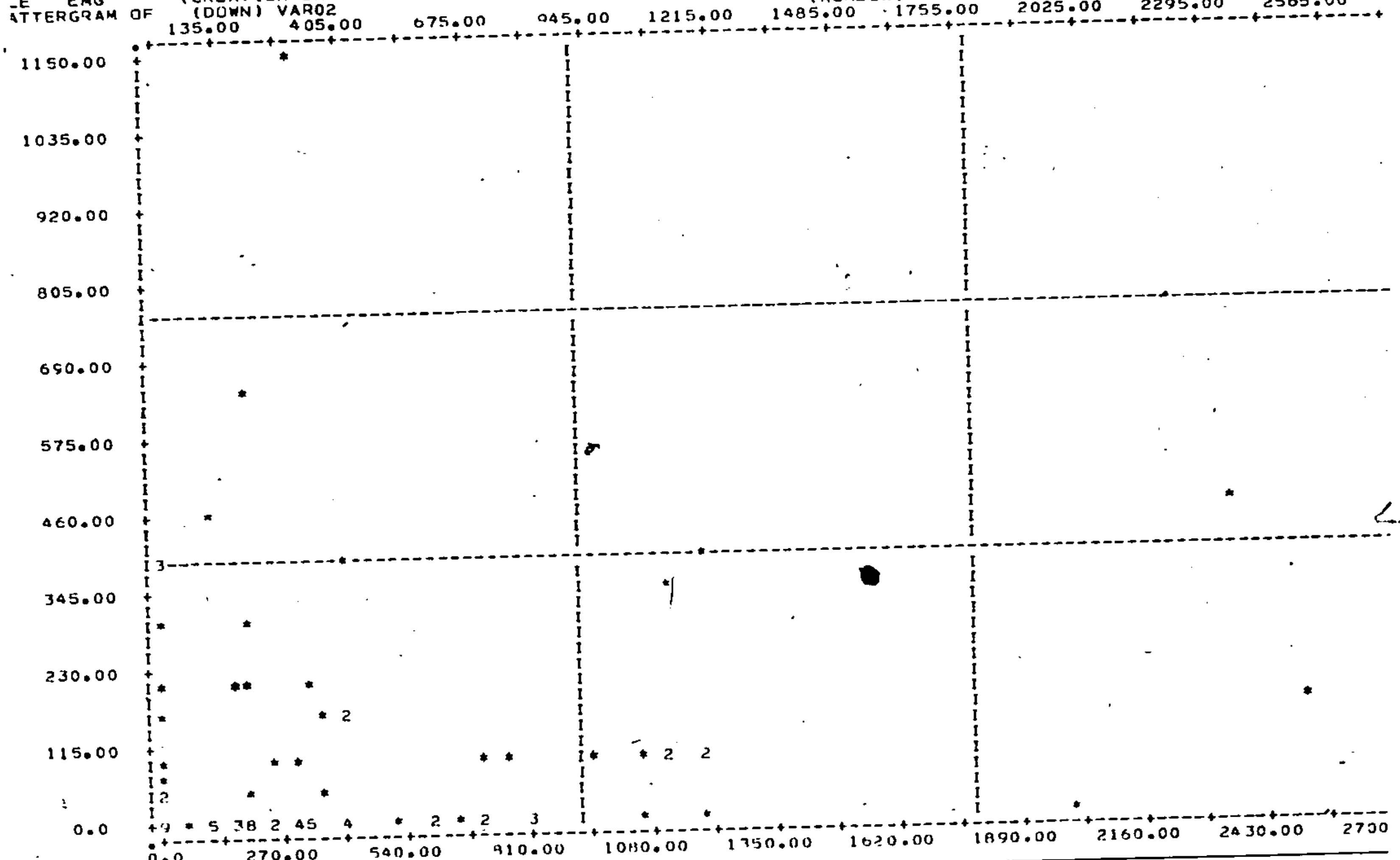
SCATTERGRAM OF (DOWN) VAR29 (ACROSS) VAR32



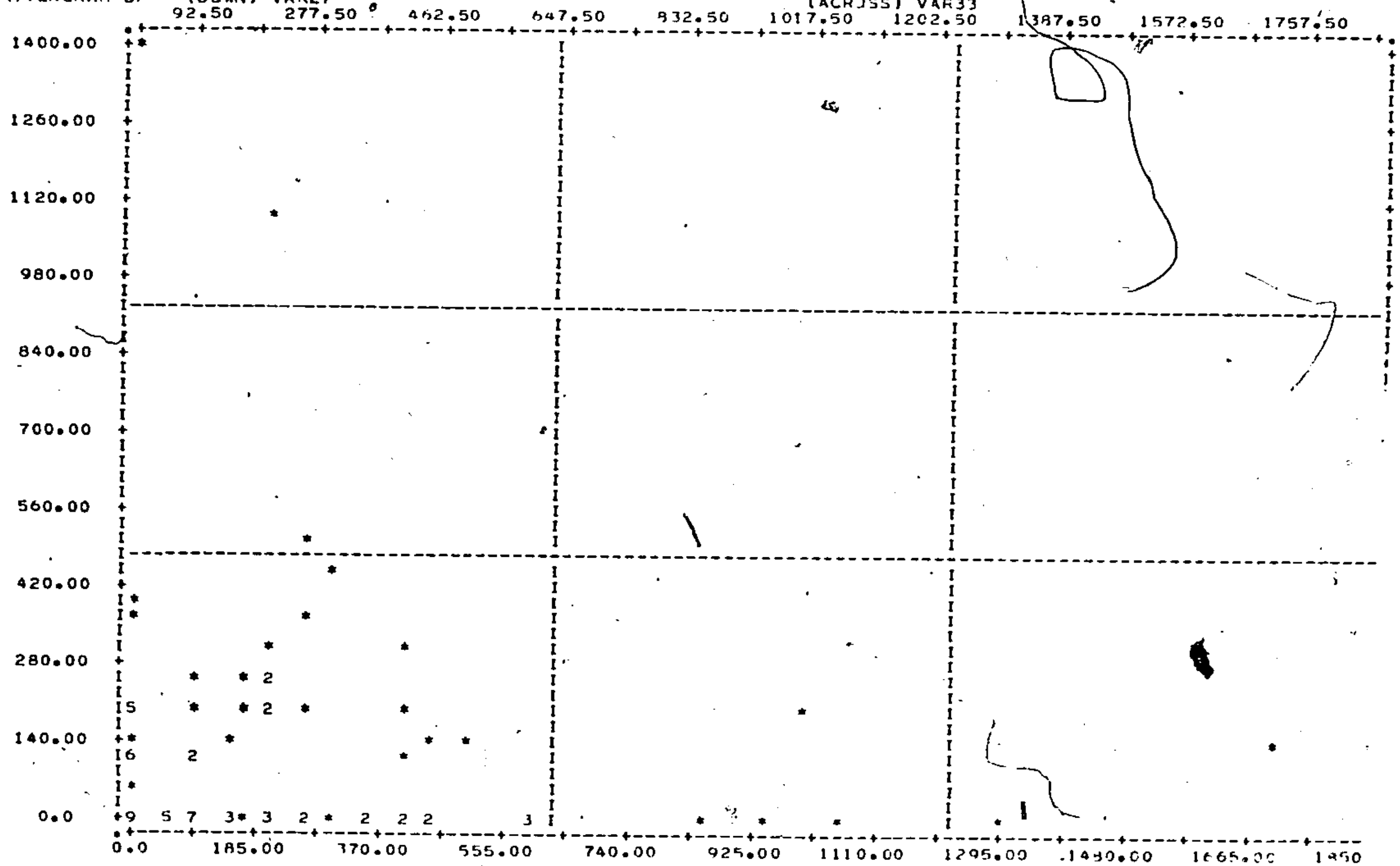
S LINEARITY

-E ENG (CREATION DATE = 11/03/77) CORRGRAPHIC

ATTERGRAM OF (DOWN) VAR02 (ACROSS) VAR65



LE ENG (CREATION DATE = 11/03/77) CORRGRAPHIC
ATTERGRAM OF (DOWN) VAR27 (ACROSS) VAR33



APPENDIX 8

FACTOR PATTERN MATRICES OF ALL FACTOR ANALYSES DONE ON EMG VARIABLES

FILE EMG (CREATION DATE = 10/27/77) DATA REDUCTION

AFTER ROTATION WITH KAISER NORMALIZATION

Total 328

FACTOR PATTERN

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8	FACTOR 9	FACTOR 10
VAR01	0.03466	0.38290	-0.09072	0.08743	-0.01019	-0.02855	0.12361	0.06918	0.21960	0.13935
VAR02	-0.02331	0.25537	0.01374	0.11892	-0.11412	0.01519	0.49009	-0.09012	0.10020	-0.15989
VAR03	0.00370	0.66698	-0.01611	0.05952	-0.15093	0.02435	0.02714	0.03919	0.22777	-0.28007
VAR04	0.23683	0.37164	0.06983	-0.06258	-0.07462	0.21058	0.31591	0.11080	0.34032	-0.00364
VAR05	-0.14654	0.00165	0.08843	-0.02595	-0.02146	0.17624	[illegible]	-0.24710	-0.06530	-0.03493
VAR06	0.03033	0.59298	-0.04531	0.03226	0.03443	-0.04122	[illegible]	0.00257	-0.09641	-0.09975
VAR07	0.19541	-0.37484	0.01057	0.02876	0.01097	-0.02369	[illegible]	-0.09667	0.06674	-0.03014
VAR08	0.36742	0.17559	0.08419	0.00689	-0.00495	-0.06258	[illegible]	0.12025	0.22783	-0.09293
VAR09	0.03633	-0.01024	-0.00232	0.04597	0.10232	0.00039	0.72419	0.09672	-0.07109	0.11069
VAR10	-0.14467	0.70504	0.00955	-0.00823	0.09577	0.10154	0.23350	0.01360	0.00345	0.11769
VAR11	0.19628	0.58079	-0.05106	0.06877	-0.02521	-0.14116	0.21565	-0.05581	0.13559	-0.14976
VAR12	0.14409	0.33574	-0.06215	-0.01035	0.02703	0.00004	0.13473	0.10248	-0.23687	-0.20642
VAR13	0.15210	0.25577	0.08419	0.02154	0.06618	-0.11737	[illegible]	0.09580	0.02973	-0.21172
VAR14	0.14058	0.06865	0.12807	0.10193	0.03758	-0.11462	[illegible]	-0.67621	-0.01533	0.15308
VAR15	0.02791	0.07945	-0.08215	-0.11327	0.03344	-0.08326	[illegible]	-0.05990	0.06675	-0.15227
VAR16	-0.05352	-0.01821	0.13622	0.09725	-0.07234	-0.02672	0.22103	-0.01922	0.03067	-0.03485
VAR17	0.05529	0.05475	0.20497	0.03053	-0.14546	0.02972	-0.01177	-0.27716	0.09157	-0.18121
VAR18	0.03657	0.17901	0.43133	-0.01393	-0.08344	0.05544	-0.05568	-0.37064	0.04879	-0.12957
VAR19	0.11053	-0.04209	0.51615	0.05835	0.03520	-0.06408	0.10868	-0.07550	-0.02596	-0.14253
VAR20	0.00553	0.06472	0.25020	-0.10408	-0.04017	0.06750	-0.06415	0.04014	0.19666	0.00770
VAR21	-0.03781	0.64501	0.11748	0.05285	-0.00121	0.13836	-0.16617	-0.14760	-0.02584	0.05582
VAR22	-0.01133	0.11743	0.09514	-0.08308	0.02725	-0.04374	-0.06293	0.04336	0.05737	0.05979
VAR23	-0.03878	-0.01380	0.82730	-0.01969	0.00147	0.02030	-0.00539	-0.01198	0.08415	0.05561
VAR24	-0.02612	0.05819	0.58392	-0.10884	0.09575	0.03222	-0.01710	0.06826	0.02430	0.05649
VAR25	-0.03142	0.05699	0.54699	0.07414	0.11291	0.15351	0.02207	0.05304	-0.10659	0.05974
VAR26	0.03465	0.16027	-0.15378	-0.07810	-0.06489	0.00771	-0.19274	-0.06350	0.00279	-0.00052
VAR27	-0.09510	-0.19363	0.06701	0.09073	-0.03427	0.01705	0.14007	0.07307	-0.05478	0.03493
VAR28	0.06660	0.11548	0.59270	0.02475	0.23447	-0.11223	-0.05249	-0.28225	-0.05595	-0.09411
VAR29	-0.01079	0.81859	0.12384	0.07477	0.04066	-0.09973	-0.15785	-0.07439	-0.06427	0.07563
VAR30	-0.07940	0.04527	-0.02269	-0.09086	0.15932	0.01842	0.09656	-0.80941	0.13563	-0.04603
VAR31	0.08865	-0.09894	-0.09391	0.11849	0.15830	0.20772	0.13996	0.00702	0.12233	-0.41125
VAR32	-0.08170	-0.02396	-0.00353	-0.05771	0.01753	0.02667	0.04518	-0.00124	-0.04873	-0.28340
VAR33	-0.07434	0.03486	0.13114	0.13631	0.39914	0.03513	-0.08590	-0.11152	0.33447	-0.26194
VAR34	0.05225	0.06586	0.01422	-0.05974	0.87396	0.15356	0.05357	0.01616	0.01178	-0.14637
VAR35	0.04116	-0.03723	0.03289	0.14486	0.72519	-0.03644	0.04163	0.02452	-0.17971	0.00146
VAR36	-0.03591	-0.00170	-0.03535	-0.01140	0.13021	0.01355	-0.07393	-0.32132	-0.23068	-0.13508
VAR37	0.16131	0.02143	0.25136	-0.06414	0.59450	0.07557	0.04525	-0.00515	-0.12292	-0.05828
VAR38	0.00084	-0.08141	0.21980	-0.05535	0.47852	0.05502	0.05862	-0.06626	0.06895	-0.21299
VAR39	0.01519	0.01200	0.08000	-0.02786	0.09569	0.81570	-0.01693	0.06618	0.07439	-0.07428
VAR40	0.24552	0.00651	0.05187	0.05937	0.17479	0.50037	0.08963	0.10258	-0.01388	-0.15676
VAR41	-0.04664	0.04134	-0.05487	0.04093	0.32420	0.13353	-0.19883	0.03460	0.12338	-0.40561

FILE EMG (CREATION DATE = 10/27/77) DATA REDUCTION

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8	FACTOR 9	FACTOR 10
VAR42	0.08012	-0.02309	-0.06132	0.08648	0.13047	0.05358	0.00561	-0.03751	-0.17620	-0.20564
VAR43	0.00024	0.03484	0.05117	-0.03751	0.87512	0.01730	0.00603	-0.01632	-0.02780	0.00112
VAR44	-0.05369	-0.09025	-0.00526	0.21579	0.80176	0.08406	-0.03566	-0.14370	0.05951	0.05923
VAR45	0.03213	0.01146	-0.04779	-0.09071	0.73961	-0.07042	0.04002	-0.10611	0.00250	-0.09540
VAR46	0.61428	0.05397	-0.09275	0.01388	-0.01217	0.26158	-0.04175	-0.15399	0.01144	0.07036
VAR47	0.11751	0.00529	0.11626	0.05846	0.03382	-0.06331	0.05550	-0.14743	-0.14140	-0.29458
VAR48	0.12175	0.03180	-0.05626	0.01840	-0.08020	0.01560	-0.02709	-0.22063	0.36384	-0.10981
VAR49	0.36213	-0.04860	0.00132	-0.03867	0.11954	-0.04278	0.06026	-0.22951	0.17272	-0.25111
VAR50	0.20275	-0.19194	0.15648	0.16030	0.02032	-0.08273	0.10922	0.07514	0.05991	-0.08810
VAR51	0.55355	0.03653	0.17550	0.27748	-0.02733	0.19620	-0.01144	-0.22375	-0.18426	-0.14015
VAR52	0.35387	-0.05375	-0.02957	-0.22744	0.11243	-0.06266	0.03245	-0.21215	0.25805	-0.09042
VAR53	0.59522	-0.13279	0.03483	0.01303	-0.03274	0.02683	-0.03935	-0.15913	0.01581	-0.11627
VAR54	0.19250	-0.05661	-0.01193	-0.04507	0.20504	-0.04237	0.14164	-0.03401	-0.30513	-0.05892
VAR55	0.07301	0.02036	0.02530	-0.04722	0.16269	-0.05852	-0.06152	-0.16947	-0.19811	-0.19749
VAR56	0.23591	0.09234	0.04822	-0.10966	0.01550	0.16557	-0.04591	0.13363	0.13873	-0.17221
VAR57	0.64023	-0.02305	0.20263	-0.04451	0.10633	0.03274	0.02153	0.15266	0.01229	0.01912
VAR58	0.02712	-0.07359	-0.03627	0.04267	0.03890	-0.04683	0.12353	-0.09629	-0.02484	-0.07161
VAR59	0.52938	-0.06894	0.01711	0.21326	0.06016	0.38672	-0.01464	-0.12096	-0.18790	0.10052
VAR60	0.50364	0.06433	-0.09165	-0.13197	0.03962	0.30949	0.00357	-0.18413	0.04965	0.00434
VAR61	0.34395	0.18501	-0.10272	0.50121	0.17214	0.00349	0.00566	0.07892	0.01637	-0.00660
VAR62	-0.05549	0.22061	-0.05958	0.34248	0.01253	-0.00015	-0.10920	0.04885	-0.09403	-0.30394
VAR63	-0.02848	-0.09902	0.01575	0.11579	-0.05566	0.05699	0.01248	-0.09046	0.66427	0.04481
VAR64	0.23232	0.16569	-0.03767	0.27514	0.06587	-0.05351	-0.10837	-0.11114	0.31096	-0.01485
VAR65	-0.05488	0.18287	-0.00569	0.73130	0.12018	-0.25292	-0.02569	0.11126	0.12224	0.03443
VAR66	0.15447	0.04767	-0.00539	0.48007	-0.13991	0.02238	-0.02490	-0.14509	-0.08523	-0.16639
VAR67	0.01677	0.06132	-0.12735	0.13816	0.56314	-0.03462	-0.08146	-0.12369	0.22725	0.02660
VAR68	0.23190	0.02260	0.07997	0.19595	0.13705	-0.18624	0.00246	-0.02045	0.06349	-0.22345
VAR69	-0.16665	0.14745	-0.10375	0.30158	0.02673	0.29664	-0.03711	-0.07524	0.11259	0.07332
VAR70	-0.05597	0.03663	0.16580	0.25941	-0.17468	0.02436	-0.04155	-0.07503	0.00184	-0.08091
VAR71	0.05397	0.01270	0.04928	0.01025	-0.02219	0.05816	0.08956	0.03496	0.07398	0.02464
VAR72	0.01149	-0.11556	0.01047	-0.00085	0.12920	-0.17396	-0.04580	0.12993	0.22112	-0.08405
VAR73	-0.05567	-0.02822	0.03137	0.22903	0.00999	0.13730	0.15090	0.04161	0.07436	0.12139
VAR74	-0.03665	-0.15441	0.01703	0.75111	-0.00023	0.31717	0.07597	-0.08551	0.05837	0.04268
VAR75	0.38829	0.06649	0.01113	0.11740	[illegible]16009	0.03148	-0.03891	0.03300	0.07911	-0.06442

FILE EMG (CREATION DATE = 10/27/77) DATA REDUCTION

	FACTOR 11	FACTOR 12	FACTOR 13	FACTOR 14	FACTOR 15	FACTOR 16	FACTOR 17	FACTOR 18	FACTOR 19
VAR01	-0.00066	-0.00361	-0.01871	-0.02207	-0.06112	0.25365	0.09194	0.56634	-0.07422
VAR02	-0.02841	0.00162	0.01772	0.10028	0.12430	-0.06583	-0.23933	-0.31688	0.06892
VAR03	0.06611	0.03760	-0.05007	-0.06893	-0.11024	0.03973	-0.00781	0.13430	-0.12420
VAR04	0.01924	-0.22850	-0.19383	0.09022	0.11732	0.19194	0.00681	0.22644	-0.13399
VAR05	-0.00878	-0.10070	0.07215	-0.06724	-0.07704	0.05364	0.16219	0.21274	0.06244
VAR06	0.10790	-0.02946	0.06898	-0.01662	0.00543	-0.07161	-0.03049	0.03427	-0.05429
VAR07	0.00893	0.17642	-0.12846	0.06402	0.01760	-0.02925	-0.02080	0.51687	-0.11390
VAR08	0.02134	-0.11300	-0.03852	0.07055	0.01609	0.20761	-0.01649	0.32678	0.12629
VAR09	-0.00030	0.16706	0.05473	0.09663	0.13028	0.02035	-0.11429	0.05994	0.05115
VAR10	0.05767	0.01522	0.04006	-0.05910	-0.02661	0.12043	0.25985	0.16649	0.11061
VAR11	0.08007	0.00316	-0.02656	0.06702	-0.04524	0.02235	-0.36445	-0.25684	-0.11842
VAR12	0.01820	-0.00161	0.32023	-0.01482	0.13863	0.07050	-0.06713	0.24598	0.25478
VAR13	0.05574	0.04579	-0.09388	0.06411	-0.03442	-0.15525	-0.20899	0.33299	-0.08135
VAR14	-0.02547	-0.24795	0.06094	0.02117	0.06875	-0.16522	-0.12531	0.09563	-0.00684
VAR15	0.01273	0.04899	0.08977	0.03302	-0.07571	0.00161	-0.05901	-0.01667	-0.10117
VAR16	0.13857	0.43721	-0.05149	-0.07945	0.07086	-0.01356	0.10714	0.05661	0.02729
VAR17	0.04459	0.17256	-0.07009	-0.14201	0.34046	0.07177	0.06911	-0.10146	-0.15206
VAR18	0.04036	0.31474	0.09863	-0.10004	-0.06232	0.11315	-0.04779	-0.11998	-0.06628
VAR19	-0.43241	-0.13743	-0.03773	-0.18541	0.04425	0.14371	0.15564	-0.14362	-0.01692
VAR20	0.00737	-0.04385	0.39668	-0.10920	0.36510	0.09420	0.00348	0.05373	-0.07267
VAR21	0.09740	-0.08461	-0.00665	0.06730	0.23412	-0.07308	0.00037	0.01965	0.07559
VAR22	0.735[illegible]	0.22151	0.00635	-0.02229	-0.06764	-0.05726	-0.03623	0.56053	-0.05972
VAR23	0.16423	-0.03975	0.04302	0.09750	0.05071	-0.06189	-0.06599	0.05319	0.01938
VAR24	0.04978	0.57293	0.04978	0.06888	-0.04548	0.01506	-0.07860	0.02213	0.02133
VAR25	0.11273	0.13178	-0.08182	0.05684	0.18843	0.25341	0.05653	-0.19884	0.01611
VAR26	0.98855	0.06530	0.05378	-0.02080	-0.03836	-0.05314	-0.10924	-0.03669	0.00043
VAR27	0.57374	-0.24353	-0.04653	0.04783	0.04345	0.02107	0.09129	-0.03342	0.00629
VAR28	0.10026	-0.11003	0.07876	0.05647	-0.13746	-0.20917	-0.02782	0.13731	0.02784
VAR29	0.17127	0.15193	-0.00935	0.03301	0.01698	-0.01372	-0.02599	0.01521	0.05099
VAR30	0.07295	0.09720	-0.07144	0.03338	0.05156	0.12112	0.09226	-0.06003	0.04675
VAR31	0.09115	0.23008	0.07028	-0.06250	0.11010	-0.18182	0.00252	0.06563	0.05554
VAR32	-0.00774	0.01355	-0.04213	0.02738	0.01777	0.03159	0.01744	-0.05337	-0.07064
VAR33	0.01336	-0.00808	-0.02634	-0.10442	-0.05879	0.27591	-0.20108	-0.01682	-0.03033
VAR34	0.00740	-0.14172	-0.00257	-0.01343	-0.03005	-0.02620	0.12083	-0.14203	-0.04166
VAR35	0.00643	0.03393	0.07953	0.01222	0.09765	0.16508	-0.09303	0.04942	0.03182
VAR36	0.01917	-0.00898	0.10679	0.48707	-0.09194	0.12125	0.16181	0.05599	-0.20285
VAR37	0.05270	0.18625	-0.01311	0.05688	-0.00374	-0.10564	0.01058	0.11175	0.19265
VAR38	0.01803	-0.07351	-0.16310	0.14961	-0.10741	-0.09640	-0.04071	0.121[illegible]	0.02452
VAR39	-0.00391	-0.09248	-0.01919	0.11388	0.29941	-0.12031	-0.04365	0.03469	0.04521
VAR40	0.01034	0.03892	0.15834	-0.05993	-0.19669	0.07995	0.15247	-0.15649	0.25[illegible]05
VAR41	0.00382	-0.03307	0.01932	0.13682	-0.16038	0.05176	-0.19037	0.06414	-0.19558
VAR42	0.04657	-0.06631	0.08806	0.29356	0.13533	0.10388	-0.08547	0.12819	-0.62226
VAR43	-0.01282	-0.04777	0.05349	0.01455	-0.06235	-0.02022	0.05009	0.01426	0.02068
VAR44	0.03854	0.18592	-0.08937	-0.06204	-0.00017	0.12773	-0.12175	0.08076	0.05944
VAR45	-0.01294	0.02692	0.26935	-0.04029	0.16064	0.01294	-0.00228	0.02458	-0.25869
VAR46	0.04034	0.24240	-0.01097	0.03598	-0.17404	0.07194	0.08773	-0.04275	0.02924

EMG FACTORS

FILE EMG (CREATION DATE = 10/27/77) DATA REDUCTION

	FACTOR 11	FACTOR 12	FACTOR 13	FACTOR 14	FACTOR 15	FACTOR 16	FACTOR 17	FACTOR 18	FACTOR 19
VAR47	0.05347	-0.03434	0.02227	0.00023	0.29873	0.31424	0.11580	0.00513	0.31004
VAR48	-0.00914	0.03496	0.20394	0.01640	0.02727	0.53111	-0.04370	0.07640	0.13651
VAR49	0.08074	0.02408	-0.03712	0.02439	0.03487	0.34262	0.20447	0.07632	0.18598
VAR50	0.06773	-0.02636	-0.09027	0.16921	0.13568	0.48694	-0.14087	0.16949	0.04837
VAR51	-0.01138	-0.10876	0.12386	-0.19235	-0.07750	-0.02323	0.14175	0.10651	-0.02286
VAR52	0.07118	0.20289	-0.01655	0.21864	-0.06399	0.20157	0.04121	0.06662	0.20115
VAR53	0.01431	-0.14437	0.13832	0.11288	0.05758	0.05960	-0.07994	0.22096	0.24946
VAR54	0.09297	0.24161	0.05965	0.25521	0.23842	0.13842	-0.12546	0.17966	0.25773
VAR55	0.05034	0.11589	0.04381	0.01760	0.13978	0.42186	-0.00587	-0.03889	0.38945
VAR56	0.03115	-0.08086	0.07420	0.23908	0.00853	0.33538	-0.08816	-0.01991	0.32210
VAR57	0.10059	0.05327	0.05863	0.14330	0.08981	0.17937	0.04263	0.02850	-0.08549
VAR58	0.09050	0.01343	0.51532	0.06838	-0.08093	0.15993	-0.12023	0.17619	0.25075
VAR59	0.06311	0.06264	0.16726	-0.07565	-0.16848	0.18845	-0.08846	0.01228	0.07462
VAR60	0.05389	-0.00290	0.26886	0.04457	0.02991	0.15041	0.00596	0.09550	-0.03039
VAR61	0.04155	0.17100	-0.01236	0.06127	-0.04926	0.07112	0.13989	-0.24295	0.07355
VAR62	0.05210	-0.05728	0.14448	0.20874	0.05338	-0.02880	0.08802	0.25358	0.22497
VAR63	0.03742	0.08927	0.23650	0.12427	0.11124	-0.06818	0.06741	0.03462	0.05655
VAR64	0.04465	0.02628	-0.16256	0.14216	0.07509	-0.14746	0.23953	0.10908	0.05027
VAR65	0.04250	-0.04092	0.09723	0.05955	0.08765	0.11544	0.04204	0.06269	-0.02411
VAR66	0.01534	0.06222	0.05222	0.16983	-0.00442	-0.07271	0.36764	-0.01648	-0.10301
VAR67	0.03919	0.07224	0.00285	0.20818	-0.03952	-0.14798	0.25015	-0.17952	0.15035
VAR68	-0.03046	-0.09910	0.26091	0.13597	0.10401	-0.25282	0.08949	0.14395	0.32663
VAR69	0.02614	0.12191	0.03046	0.27139	0.49878	-0.08546	-0.07154	0.01812	0.01562
VAR70	-0.03381	-0.00247	0.09093	0.45320	-0.26855	0.08332	0.04385	0.01173	-0.09195
VAR71	0.05343	-0.01198	-0.03584	0.82228	0.05061	-0.02860	-0.01540	-0.00174	-0.02917
VAR72	0.00662	-0.04803	0.38278	0.42246	0.11434	0.01285	0.34832	-0.11398	-0.07294
VAR73	0.03862	-0.00371	0.70382	0.11223	-0.07089	-0.05792	0.08149	-0.09715	-0.05334
VAR74	0.05529	0.02656	0.16603	0.02755	0.00996	-0.09339	-0.06504	0.02319	-0.03871
VAR75	0.02893	-0.00020	0.47588	-0.10313	0.09955	-0.07312	0.03096	-0.07650	-0.04809

FACTOR CORRELATIONS

FILE EMG (CREATION DATE = 10/27/77) DATA REDUCTION

VARIABLE	COMMUNALITY	FACTOR	EIGENVALUE	PCT OF VAR	CUM PCT
VAR01	0.78799	1	18.54030	32.8	32.8
VAR02	0.60470	2	5.77731	10.2	43.0
VAR03	0.85253	3	4.41136	7.8	50.8
VAR04	0.91603	4	4.13799	7.3	58.1
VAR05	0.71240	5	3.44551	6.1	64.2
VAR06	0.78582	6	2.49051	4.4	68.6
VAR07	0.76223	7	2.33375	4.1	72.8
VAR08	0.85636	8	1.99524	3.5	75.3
VAR09	0.79759	9	1.97124	3.5	79.8
VAR10	0.80804	10	1.72275	3.0	82.8
VAR11	0.88638	11	1.71382	3.0	85.9
VAR12	0.73274	12	1.38383	2.4	88.3
VAR13	0.78627	13	1.27572	2.3	90.6
VAR14	0.81564	14	1.02141	1.8	92.4
VAR15	0.49965	15	0.98022	1.7	94.1
VAR16	0.40851	16	0.90472	1.6	95.7
VAR17	0.52518	17	0.88215	1.6	97.3
VAR18	0.76805	18	0.78858	1.4	98.7
VAR19	0.83249	19	0.75410	1.3	100.0
VAR20	0.50596				
VAR21	0.92397				
VAR22	0.71893				
VAR23	0.83156				
VAR24	0.83650				
VAR25	0.84397				
VAR26	0.99047				
VAR27	0.80936				
VAR28	0.83505				
VAR29	0.87654				
VAR30	0.88809				
VAR31	0.56539				
VAR32	0.78162				
VAR33	0.70787				
VAR34	0.93018				
VAR35	0.73989				
VAR36	0.68053				
VAR37	0.75659				
VAR38	0.57608				
VAR39	0.86442				
VAR40	0.75849				
VAR41	0.59356				
VAR42	0.72409				
VAR43	0.79938				
VAR44	0.88030				
VAR45	0.82831				
VAR46	0.72150				
VAR47	0.74322				

FILE EMG (CREATION DATE = 10/19/77) DATA REDUCTION

AFTER ROTATION WITH KAISER NORMALIZATION

FACTOR PATTERN

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8	FACTOR 9	FACTOR 10
VAR01	0.17162	0.33061	0.08943	-0.13884	0.02317	-0.07225	0.00222	-0.43427	-0.03403	-0.31844
VAR02	-0.12401	0.50172	0.16788	0.09756	0.11689	-0.11489	-0.04807	0.22411	0.09359	-0.05554
VAR05	0.08825	0.60757	-0.28011	0.09457	0.00928	-0.04865	0.20311	-0.06212	0.04984	-0.04982
VAR06	0.03758	0.68783	0.12313	-0.08441	-0.02687	0.05700	-0.03247	0.07821	0.00199	-0.45565
VAR09	-0.05045	0.80955	0.04853	0.18814	0.09321	0.07054	-0.07339	-0.17448	0.04933	0.25367
VAR10	0.09181	0.39179	0.09264	0.05959	0.05951	0.00887	0.01368	-0.21772	-0.02780	-0.55778
VAR13	0.00716	0.64868	0.00954	-0.01788	0.00336	0.15555	0.06298	-0.04076	-0.11834	-0.16245
VAR15	0.04464	0.68764	-0.06555	-0.04974	-0.03312	0.04565	-0.02932	0.13522	0.05581	0.03145
VAR16	0.03551	0.26523	0.15969	0.51254	-0.02802	-0.09384	0.00463	0.00136	-0.02118	0.13690
VAR17	0.08754	0.00948	0.04325	0.40688	0.03539	-0.12394	-0.13417	0.36978	0.03091	-0.16681
VAR20	-0.00444	-0.08757	-0.09909	0.13041	0.17718	-0.02391	-0.23867	-0.01422	0.44256	-0.19947
VAR21	-0.02171	0.05881	-0.19463	0.14490	0.17223	-0.00306	0.03243	0.02615	0.00927	-0.72148
VAR24	0.01957	-0.00221	-0.07421	0.68839	0.08417	0.14894	-0.00790	-0.07559	-0.00454	0.09679
VAR25	-0.01160	-0.17801	-0.05090	0.72525	0.16643	0.08179	0.05640	-0.00089	0.04947	-0.15383
VAR28	-0.01374	0.02293	-0.18672	0.40948	-0.18279	0.35824	0.37779	0.02522	0.08191	-0.28818
VAR30	0.17825	0.14021	-0.10124	0.28206	-0.10912	0.03698	0.14555	0.27642	-0.04697	-0.14217
VAR31	0.17405	0.22135	0.11606	-0.03313	0.29424	0.17193	0.02424	0.26098	0.01279	0.11610
VAR32	-0.01235	0.15827	-0.05359	-0.12761	0.13469	0.11529	0.15770	0.53582	-0.09223	0.01518
VAR35	-0.00935	-0.00761	0.14089	0.08374	0.03442	0.71677	-0.01715	-0.07629	-0.02347	0.05856
VAR36	0.05314	0.01912	-0.06026	-0.07525	0.05418	0.20180	0.52136	0.21648	0.03656	0.02129
VAR39	0.13394	-0.07203	-0.17768	0.04611	0.91795	0.03552	0.03285	0.00611	0.02799	-0.01880
VAR40	0.53455	0.02535	-0.07036	0.01411	0.35350	0.21579	0.11275	0.08846	0.06383	0.13350
VAR43	0.00487	-0.01862	0.01427	0.04807	0.02153	0.89133	0.03947	-0.05318	-0.06455	-0.00155
VAR45	0.01699	0.08704	0.02392	-0.04153	0.03426	0.80238	-0.14018	0.16405	0.17260	-0.01454
VAR46	0.78441	-0.02654	0.07126	0.06050	0.04380	-0.03840	0.00505	-0.08475	-0.08031	0.03755
VAR47	0.07540	-0.03373	0.07555	0.06305	-0.01223	-0.02469	0.08522	0.26139	0.04556	-0.16078
VAR50	0.07910	0.04688	-0.00710	0.05187	0.05827	0.05704	0.03574	-0.09467	-0.01597	0.09731
VAR51	0.66011	0.00284	-0.01913	0.05923	-0.02900	0.01500	0.22446	0.05957	0.13406	-0.12574
VAR54	0.02170	0.14803	0.03591	0.10615	0.09058	0.16932	0.02251	-0.05042	-0.00445	0.11849
VAR55	0.11331	-0.13474	0.01013	0.13024	-0.08382	0.07101	0.00117	0.14842	-0.04325	-0.04155
VAR58	0.01057	0.16263	-0.04835	-0.13256	-0.09808	0.07267	0.15831	-0.03432	0.45570	0.05987
VAR60	0.64993	0.07289	-0.12286	-0.08796	0.11605	0.04373	-0.08236	-0.02132	0.21469	-0.09261
VAR61	0.42705	-0.03193	0.67195	0.06987	-0.03499	0.11308	0.04760	0.03416	0.00065	0.03329
VAR62	-0.04555	0.02000	0.31045	-0.19089	0.15339	0.06967	0.35988	-0.01270	0.03929	-0.23914
VAR65	-0.12096	-0.05220	0.63203	-0.04998	-0.03222	0.12934	0.22433	-0.09627	0.16977	-0.15396
VAR66	0.29502	-0.04585	0.33748	0.09577	0.06160	-0.12190	0.49459	0.14406	0.13404	-0.00287
VAR69	-0.17076	0.01542	0.36682	0.12216	0.47919	-0.00966	0.03943	0.03675	0.10221	-0.11294
VAR70	0.03588	-0.02508	0.13122	0.04354	0.04258	-0.09274	0.52491	-0.05931	0.06651	0.00177
VAR73	0.02426	0.06852	0.11088	0.00258	0.08193	0.01196	0.23953	-0.07805	0.80523	0.13581
VAR75	0.37831	-0.02703	0.19366	-0.04979	0.00792	0.23674	-0.13544	0.08397	0.50173	-0.05657

FILE ENG (CREATION DATE = 10/19/77) DATA REDUCTION

VARIABLE	COMMUNALITY	FACTOR	EIGENVALUE	PCT OF VAR	CUM PCT
VAR01	0.57714	1	9.82575	38.7	38.7
VAR02	0.43271	2	3.06901	12.1	50.8
VAR05	0.53929	3	2.54165	10.0	60.9
VAR06	0.82904	4	1.96135	7.7	68.6
VAR09	0.81936	5	1.69860	6.7	75.3
VAR10	0.67603	6	1.45095	5.7	81.0
VAR13	0.61709	7	1.23125	4.9	85.9
VAR15	0.48678	8	1.08160	4.3	90.1
VAR16	0.39029	9	0.93765	3.7	93.8
VAR17	0.46166	10	0.84738	3.3	97.2
VAR20	0.42951	11	0.71498	2.8	100.0
VAR21	0.76376				
VAR24	0.55674				
VAR25	0.74176				
VAR28	0.69478				
VAR30	0.45139				
VAR31	0.47503				
VAR32	0.50696				
VAR35	0.70820				
VAR36	0.52134				
VAR39	0.91862				
VAR40	0.67546				
VAR43	0.77899				
VAR45	0.79196				
VAR46	0.66318				
VAR47	0.71263				
VAR50	0.52552				
VAR51	0.73279				
VAR54	0.67317				
VAR55	0.71084				
VAR58	0.58216				
VAR60	0.75895				
VAR61	0.74456				
VAR62	0.61102				
VAR65	0.66829				
VAR66	0.69158				
VAR69	0.56733				
VAR70	0.35125				
VAR73	0.83883				
VAR75	0.68372				

FILE EMG (CREATION DATE = 10/19/77) DATA REDUCTION

AFTER ROTATION WITH KAISER NORMALIZATION

FACTOR PATTERN

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8	FACTOR 9	FACTOR 10
VAR03	0.01539	0.05227	-0.09414	0.83453	0.06582	0.13717	0.01810	0.04714	0.11238	-0.02856
VAR04	0.26655	0.02495	-0.14851	0.38465	0.09986	0.51275	-0.01446	0.16703	0.25672	-0.03808
VAR07	0.04098	0.02081	0.07360	0.01886	-0.06051	0.78504	0.03434	-0.06603	0.05681	-0.01560
VAR08	0.42830	0.02017	-0.06450	0.17565	0.06503	0.53202	-0.02936	0.16229	0.04095	0.23197
VAR11	-0.00594	0.03995	0.01007	0.76737	-0.04491	0.09186	0.03345	-0.03663	0.11023	0.05331
VAR12	0.17895	-0.01135	-0.01825	0.31775	-0.09887	0.01263	0.01235	-0.01153	0.08996	0.62223
VAR14	-0.16559	-0.13139	0.10516	0.15959	0.01624	0.41221	-0.26605	-0.19457	-0.15732	0.11032
VAR18	0.19917	0.04660	0.07213	0.29891	-0.09394	-0.12747	-0.50902	-0.23337	-0.11495	-0.14665
VAR19	0.10235	0.34530	0.06206	-0.01405	-0.07253	-0.00533	-0.61658	-0.04962	0.01508	0.02800
VAR22	0.02045	0.76287	0.07946	0.13306	-0.04863	0.05083	-0.06620	0.02387	-0.08519	-0.10295
VAR23	-0.05512	0.13859	0.03387	-0.05955	0.10644	0.02468	-0.78273	0.05212	0.02681	0.03412
VAR26	0.06822	0.93508	-0.01180	0.21041	-0.04371	-0.13047	0.05059	-0.07029	-0.03726	-0.02115
VAR27	-0.12613	0.71475	-0.09737	-0.17860	0.13002	0.05652	-0.22515	0.03402	0.15038	0.04435
VAR29	-0.10316	0.21120	0.05033	0.73610	0.01382	-0.09194	-0.13994	0.00142	-0.20235	0.19928
VAR33	0.33655	-0.10115	0.46505	0.23695	0.09453	-0.05971	-0.24183	0.05409	0.14779	-0.27020
VAR34	0.01090	0.00098	0.81799	-0.00268	0.01462	-0.06824	0.02504	-0.02900	0.15595	0.07095
VAR37	0.01241	0.11196	0.71075	-0.06146	-0.13388	0.12495	-0.15695	-0.07184	-0.05158	0.23023
VAR38	-0.06551	-0.04998	0.57017	-0.05426	0.04538	0.17667	-0.21926	0.19103	0.13642	0.05802
VAR41	0.11572	-0.02428	0.46206	0.17786	0.01920	-0.13349	0.12048	-0.06452	0.36852	-0.09395
VAR42	-0.09087	0.00492	0.16465	0.06988	0.03813	0.08233	-0.01082	-0.16653	0.63444	0.02073
VAR44	0.10145	0.02305	0.78218	-0.04952	-0.04766	0.06626	-0.02863	-0.15232	-0.07729	-0.09469
VAR48	0.76846	-0.08352	-0.05630	0.14882	0.17492	-0.03864	-0.09876	-0.03086	-0.01838	-0.05345
VAR49	0.64629	0.08388	0.15427	-0.09943	0.08515	0.25670	-0.06705	-0.08125	-0.18912	0.02462
VAR52	0.59559	0.07842	0.24788	-0.03853	0.11032	0.23844	-0.00889	0.04774	-0.16167	0.02353
VAR53	0.52410	-0.07354	-0.00515	-0.12658	0.03915	0.16725	-0.10093	-0.22369	0.03131	0.45197
VAR56	0.65023	0.04383	0.06349	0.06493	0.08732	-0.08755	0.00884	0.06508	0.11359	0.24005
VAR57	0.45607	0.15700	0.04775	-0.08303	0.03051	0.19824	0.05499	-0.14774	0.23315	0.18349
VAR59	0.41911	0.08028	0.05688	-0.12090	-0.22723	0.03510	-0.01639	-0.67190	0.11529	0.15894
VAR63	0.19241	-0.03294	-0.12211	0.06509	0.66626	0.03603	-0.11158	-0.11305	-0.03532	-0.18686
VAR64	0.08133	0.08673	0.07346	0.16837	0.46304	0.13335	0.08022	-0.11203	-0.16285	0.00854
VAR67	-0.04295	0.10388	0.58223	0.02388	0.50070	-0.10191	0.22315	-0.14671	-0.20850	0.00918
VAR68	0.02980	-0.06391	0.17879	0.04852	0.39286	0.04939	-0.03583	-0.10441	-0.14561	0.55828
VAR71	-0.00318	0.09053	0.06197	0.01616	0.44385	0.13953	0.01992	0.02986	0.25417	0.15060
VAR72	0.11063	-0.00239	0.03986	-0.14970	0.67390	-0.20900	-0.06228	0.04740	0.17320	0.18686
VAR74	-0.19289	0.00347	-0.01130	0.03348	0.32812	0.04633	-0.06252	-0.64324	0.17000	-0.02469

FACTOR CORRELATIONS

FILE EMG (CREATION DATE = 10/19/77) DATA REDUCTION

VARIABLE	COMMUNALITY
VAR03	0.80273
VAR04	0.76754
VAR07	0.66382
VAR08	0.84525
VAR11	0.66417
VAR12	0.60451
VAR14	0.46209
VAR18	0.61535
VAR19	0.70079
VAR22	0.69317
VAR23	0.71285
VAR26	0.97184
VAR27	0.68593
VAR29	0.73648
VAR33	0.67343
VAR34	0.75325
VAR37	0.76107
VAR38	0.61747
VAR41	0.50389
VAR42	0.53223
VAR44	0.72639
VAR48	0.73793
VAR49	0.74591
VAR52	0.66984
VAR5	0.82632
VAR56	0.62851
VAR57	0.57634
VAR59	0.82413
VAR63	0.57358
VAR64	0.43900
VAR67	0.76378
VAR68	0.69143
VAR71	0.41739
VAR72	0.62144
VAR74	0.62481

FACTOR	EIGENVALUE	PCT OF VAR	CUM PCT
1	9.25783	39.2	39.2
2	3.08387	13.0	52.2
3	2.73017	11.6	63.3
4	1.83490	7.8	71.5
5	1.67209	7.1	78.6
6	1.24693	5.3	83.9
7	1.15021	4.9	88.8
8	1.00008	4.2	93.0
9	0.94756	4.0	97.0
10	0.71125	3.0	100.0

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FILE EMG (CREATION DATE = 10/19/77) , DATA REDUCTION

AFTER ROTATION WITH KAISER NORMALIZATION

FACTOR PATTERN

Neutral 56.2%

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8	FACTOR 9	FACTOR 10
VAR01	0.02092	0.36439	0.05489	-0.00563	-0.05434	-0.02216	0.24741	-0.00077	-0.06928	0.02668
VAR03	-0.09421	[illegible]	0.11754	0.15564	0.10437	-0.52528	-0.37591	-0.04365	0.04443	-0.04206
VAR05	-0.04180	0.24749	-0.10024	-0.11319	0.05433	0.19328	-0.41295	-0.03031	0.05929	0.10420
VAR07	0.06975	0.48361	-0.07431	0.00292	-0.10471	0.23743	-0.10206	-0.03615	0.05476	-0.12040
VAR09	-0.00014	0.18707	0.04944	-0.01001	-0.15407	0.19077	-0.15092	0.03237	0.17031	-0.00247
VAR11	-0.07776	0.11379	0.14279	0.12027	-0.07589	-0.70115	-0.14128	-0.03436	0.01031	-0.07567
VAR13	0.15777	0.46544	0.02117	0.00701	-0.10005	-0.15925	-0.18113	0.06487	0.06004	-0.10220
VAR14	0.03044	0.11070	0.02928	-0.17137	0.06709	-0.02223	-0.80019	-0.01173	-0.02455	0.04723
VAR15	0.00704	-0.00448	-0.08601	-0.00127	0.01216	-0.16352	-0.03677	0.02391	-0.05416	0.08749
VAR16	-0.04801	0.14152	0.10344	0.35967	0.03041	0.20474	-0.00759	-0.07416	0.17778	-0.09602
VAR18	-0.04837	-0.16070	-0.01685	0.39140	-0.05369	-0.15677	-0.47172	-0.14739	0.12439	0.01146
VAR20	-0.00307	0.15504	-0.13255	0.08326	-0.12965	-0.00786	-0.04766	0.07654	0.23252	0.43533
VAR22	0.04154	0.05569	-0.05381	0.72641	0.04434	0.04755	0.06957	0.04452	-0.05460	0.05657
VAR24	0.11466	-0.11512	-0.03810	0.50712	-0.15374	0.15206	-0.10707	0.01205	0.22770	-0.09286
VAR26	-0.06518	-0.03452	-0.00512	0.31177	-0.00295	-0.14601	0.02456	-0.07665	-0.08728	0.09254
VAR28	0.71519	0.00477	-0.01052	0.25277	-0.03944	-0.01566	-0.57536	0.03140	-0.01530	0.09536
VAR29	-0.74249	0.00592	0.32258	0.41152	-0.00242	-0.33274	-0.25705	-0.00947	0.32065	-0.10059
VAR30	0.04957	-0.10529	-0.05644	-0.01935	-0.06485	-0.06840	-0.72515	-0.12335	-0.01497	-0.12927
VAR31	0.21404	-0.04423	0.03353	0.05205	-0.02975	-0.03538	0.06476	-0.13185	0.29734	0.02912
VAR33	0.70074	-0.02020	0.00941	-0.05034	-0.24103	-0.29016	-0.06211	0.05184	0.04155	0.02145
VAR35	0.71042	-0.01041	0.14600	-0.03849	-0.21311	0.07510	-0.02987	-0.03549	-0.00174	0.01763
VAR37	0.55210	0.00573	-0.02598	0.23712	-0.08460	0.14683	-0.13407	-0.15564	0.10577	-0.07219
VAR39	[illegible]	-0.01515	-0.15199	-0.05759	0.02081	-0.01595	0.05511	-0.18688	0.03194	0.06692
VAR41	[illegible]	0.05809	-0.10090	-0.04231	-0.01563	-0.31990	0.17599	-0.03404	0.14700	0.02137
VAR43	[illegible]	0.04455	-0.02440	0.00187	0.04237	0.04432	-0.08655	-0.00519	-0.03043	0.02342
VAR44	[illegible]	-0.07402	0.20495	-0.01494	-0.05321	0.10555	-0.04417	-0.11577	0.04735	-0.17035
VAR45	[illegible]	-0.01278	-0.07131	-0.01147	0.02676	-0.08043	-0.06034	0.06236	0.01914	0.24477
VAR46	[illegible]	0.04341	-0.01297	0.05075	0.01407	0.01322	-0.01160	-0.88509	0.01476	-0.09486
VAR48	[illegible]	0.10550	0.03503	-0.06764	-0.05212	-0.12588	-0.03379	-0.14031	-0.00705	0.19257
VAR50	[illegible]	0.15519	0.08825	-0.05651	-0.73404	0.06459	0.00312	-0.01398	0.00427	-0.04445
VAR52	0.09791	0.04724	-0.15511	0.12326	-0.42564	0.06040	-0.07775	-0.70749	-0.17136	-0.08550
VAR54	[illegible]	-0.05913	0.07594	0.14767	-0.01961	0.18041	-0.10013	-0.04219	0.10021	-0.07772
VAR55	[illegible]	-0.01052	-0.09703	0.03490	-0.08361	-0.19190	0.09724	-0.16346	0.09265	0.11732
VAR58	[illegible]	0.00576	0.12474	0.02817	-0.36051	0.12339	-0.08044	-0.00148	-0.16525	0.42158
VAR59	[illegible]	-0.00775	0.10347	-0.04112	-0.12961	0.06477	-0.07043	-0.78713	0.10779	0.14030
VAR60	0.04744	[illegible]	-0.16401	-0.02057	-0.15773	-0.06059	-0.08372	-0.40553	0.10564	0.29693
VAR61	0.04913	-0.05004	0.65714	0.06014	-0.01053	-0.13169	0.07265	-0.42061	-0.00463	-0.01328
VAR63	-0.13477	0.14402	0.12604	0.01694	-0.04315	0.07607	-0.06282	0.03950	0.20037	0.21052
VAR65	0.09353	0.17585	0.72163	-0.00050	-0.10076	-0.06634	0.07042	0.13254	-0.05655	0.15589
VAR67	0.45695	-0.06161	0.19974	0.09640	0.10381	0.02393	-0.13113	-0.28345	-0.01033	-0.04148
VAR69	-0.05610	-0.00369	0.31723	0.02599	-0.03953	-0.03147	-0.04351	0.09021	0.57675	0.02506

FILE EMG (CREATION DATE = 10/19/77) DATA REDUCTION

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8	FACTOR 9	FACTOR 10
VAR71	-0.02580	0.03060	0.08748	0.06384	-0.31754	-0.02163	-0.06501	0.05356	0.27376	-0.04147
VAR73	-0.01757	-0.09983	0.27917	0.05103	0.08383	0.10316	0.01575	-0.05337	0.04455	0.66526
VAR74	-0.00454	-0.04277	0.84354	-0.00000	0.17045	0.10259	-0.05600	-0.19168	0.36592	0.22594
VAR75	0.20236	-0.06117	0.07673	0.08301	-0.01443	-0.12193	0.01785	-0.27038	0.05112	0.53777

	FACTOR 11	FACTOR 12	FACTOR 13
VAR01	0.35852	0.01676	0.06071
VAR03	-0.20235	0.09904	-0.09831
VAR05	-0.07144	0.01317	-0.35035
VAR07	0.04451	-0.03564	-0.39241
VAR09	-0.16153	-0.07462	-0.52575
VAR11	-0.06766	-0.05407	-0.33454
VAR13	-0.13701	-0.12643	-0.37136
VAR14	-0.00117	-0.14778	-0.06284
VAR15	0.02495	0.01983	-0.79615
VAR16	-0.00795	0.22738	-0.21352
VAR18	-0.10844	0.40182	0.03846
VAR20	-0.02205	0.17255	0.14550
VAR22	0.25086	0.00575	-0.01123
VAR24	-0.14027	0.31254	-0.00143
VAR26	0.35395	-0.10989	0.03630
VAR28	-0.37462	-0.04359	0.08999
VAR29	-0.12819	-0.02300	0.14839
VAR30	0.22856	0.21750	-0.06737
VAR31	0.09858	0.04951	-0.34417
VAR33	0.12425	0.42461	-0.05406
VAR35	-0.12240	-0.00950	-0.00929
VAR37	-0.04731	-0.07155	-0.03047
VAR39	-0.05079	-0.02169	0.04522
VAR41	0.17532	0.02612	-0.04267
VAR43	0.04173	-0.05709	0.07356
VAR44	0.02346	0.22397	-0.01064
VAR45	0.03990	0.02415	-0.14784
VAR46	0.06913	0.03810	0.00838
VAR49	0.22015	0.31444	0.00494
VAR50	-0.03780	0.35406	-0.02523
VAR52	0.36747	0.05784	-0.12148
VAR54	-0.15242	-0.20915	-0.15770
VAR56	0.04213	-0.08906	0.03546
VAR58	-0.01847	-0.04103	-0.15098
VAR59	-0.23351	-0.23335	0.07727
VAR60	0.05328	-0.05937	-0.02586

FILE EMG (CREATION DATE = 10/19/77) DATA REDUCTION

VARIABLE	COMMUNALITY	FACTOR	EIGENVALUE	PCT OF VAR	CUM PCT
VAR01	0.73836	1	11.25758	36.2	36.2
VAR03	0.80278	2	3.58011	11.5	47.7
VAR05	0.57190	3	2.83681	9.1	56.8
VAR07	0.71346	4	2.50334	8.0	64.8
VAR09	0.66436	5	2.01675	6.5	71.7
VAR11	0.81837	6	1.77636	5.7	77.4
VAR13	0.75521	7	1.35450	4.4	81.7
VAR14	0.71475	8	1.24443	4.0	85.7
VAR15	0.83977	9	1.21609	3.9	89.7
VAR16	0.37725	10	1.01374	3.3	92.9
VAR18	0.75028	11	0.77643	2.5	95.4
VAR20	0.41371	12	0.72943	2.3	97.8
VAR22	0.79649	13	0.69500	2.2	100.0
VAR24	0.59841				
VAR26	0.48339				
VAR28	0.59197				
VAR29	0.73271				
VAR30	0.81745				
VAR31	0.46496				
VAR33	0.56908				
VAR35	0.70716				
VAR37	0.70847				
VAR39	0.77609				
VAR41	0.47501				
VAR43	0.81325				
VAR44	0.84146				
VAR45	0.74516				
VAR46	0.80452				
VAR48	0.76084				
VAR50	0.66302				
VAR52	0.79521				
VAR54	0.74447				
VAR55	0.68251				
VAR58	0.32063				
VAR59	0.65812				
VAR60	0.79320				
VAR61	0.65317				
VAR63	0.61464				
VAR65	0.79993				
VAR67	0.75182				
VAR69	0.58745				
VAR71	0.49500				
VAR73	0.66622				
VAR74	0.74003				
VAR75	0.52512				

SNG FACTORS   10/19/77   PAGE   35

FILE   SNG   (CREATION DATE = 10/19/77)   DATA REDUCTION

AFTER ROTATION WITH KAISER NORMALIZATION

FACTOR PATTERN   Affective   41.6%

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8	FACTOR 9
VAR02	0.04461	0.44368	-0.02430	0.27061	0.01001	0.12692	-0.03530	-0.06489	0.07782
VAR04	0.72082	0.41967	0.02320	0.10969	0.08732	-0.13743	0.00674	-0.03451	-0.03760
VAR06	0.13712	0.72243	0.01948	0.14541	0.04073	-0.04138	0.23658	0.13246	0.00102
VAR08	0.41342	0.21455	0.02394	0.01540	-0.03744	0.08293	-0.01473	0.11075	0.08634
VAR10	[illegible]	0.76774	0.00359	-0.17216	-0.01067	-0.04622	0.07459	0.09038	-0.06179
VAR12	0.17657	0.32640	-0.24366	0.05750	-0.01872	0.17705	-0.01140	0.67274	-0.10154
VAR17	0.00268	0.13592	0.22119	0.18053	0.07992	0.29730	-0.17104	-0.14907	-0.10761
VAR19	0.04867	0.00255	0.85093	0.00491	0.07643	0.17417	0.71915	-0.02918	-0.10063
VAR21	-0.07321	0.73160	0.14496	-0.11168	-0.11057	0.01810	0.01257	0.01983	-0.08644
VAR23	0.03760	0.01735	0.83673	-0.05506	-0.03474	-0.00977	0.04878	-0.02171	0.13627
VAR25	-0.12423	0.10341	0.72415	-0.04520	0.10167	0.18766	0.04376	-0.07145	-0.14839
VAR27	0.01757	-0.01104	0.55720	0.01346	-0.10626	-0.12230	-0.03310	0.07239	0.07375
VAR32	-0.06445	0.04171	-0.07593	0.55589	-0.05845	0.30498	0.20464	0.01726	0.01781
VAR34	-0.10362	0.10676	-0.00621	-0.01494	0.03374	0.05134	0.44444	-0.00230	-0.19036
VAR35	-0.02702	-0.04470	-0.02164	0.74443	-0.38971	0.12034	0.17043	-0.00093	-0.14631
VAR38	0.00348	-0.00785	0.13657	0.13759	-0.04090	0.02575	0.51448	-0.02733	0.11013
VAR40	0.03137	-0.01453	0.03855	0.19675	0.08777	-0.15350	0.25863	-0.00749	-0.62837
VAR42	0.12202	-0.02377	0.04120	0.64635	-0.11451	-0.23068	0.11187	0.07059	-0.14490
VAR47	0.10279	0.05592	0.17575	0.09447	-0.08494	0.72556	0.00419	0.04196	0.07067
VAR49	0.46477	-0.06421	0.02766	-0.13430	-0.12440	0.50166	0.15040	-0.13900	-0.11515
VAR51	0.14721	0.04665	0.00861	-0.05676	-0.07423	0.16292	-0.00252	0.13049	-0.70763
VAR53	0.21105	-0.23490	0.02207	-0.03408	-0.18187	0.31314	-0.00234	0.31919	-0.20391
VAR55	0.21446	-0.04608	0.02494	-0.04930	0.02601	0.71659	0.14767	0.14430	-0.05047
VAR57	0.47564	-0.16911	0.67590	0.04898	-0.00087	0.09735	0.06093	0.15775	-0.33760
VAR62	-0.07250	0.24176	0.01552	0.04702	-0.63422	0.12372	-0.03349	0.37319	0.01257
VAR64	0.27411	0.19607	-0.03796	-0.20248	-0.55512	-0.02024	0.07034	-0.25076	-0.05370
VAR65	-0.13703	0.15600	-0.03897	0.04120	-0.57284	0.04051	-0.12486	-0.19006	-0.52228
VAR69	0.08677	0.09329	-0.03564	-0.11832	-0.52658	0.23531	0.18906	0.24591	0.01872
VAR70	-0.01927	-0.01310	0.12448	0.11103	-0.50132	-0.02706	-0.05740	0.00937	-0.03122
VAR72	0.06045	-0.20561	0.05473	0.07792	-0.55823	-0.03659	0.17005	0.02695	0.00523

FACTOR CORRELATIONS

EMG FACTORS

FILE EMG (CREATION DATE = 10/19/77) DATA REDUCTION

VARIABLE	COMMUNALITY
VAR02	0.32797
VAR04	0.77364
VAR06	0.72170
VAR08	0.67711
VAR10	0.67453
VAR12	0.78551
VAR17	0.35376
VAR19	0.80226
VAR21	0.[illegible]4452
VAR23	0.73206
VAR25	0.70011
VAR27	0.34197
VAR32	0.56028
VAR34	0.85771
VAR35	0.49639
VAR38	0.49501
VAR40	0.60794
VAR42	0.63567
VAR47	0.75724
VAR49	0.77361
VAR51	0.76109
VAR53	0.81251
VAR55	0.96133
VAR57	0.92237
VAR62	0.77736
VAR64	0.56615
VAR66	0.76064
VAR69	0.63152
VAR70	0.20946
VAR72	0.43945

FACTOR	EIGENVALUE	PCT OF VAR	CUM PCT
1	9.01160	41.6	41.6
2	2.68409	12.[illegible]	54.6
3	2.24372	11.7	66.3
4	1.73570	9.0	75.2
5	1.58266	7.2	82.5
6	1.13914	5.9	88.4
7	0.95824	4.4	92.8
8	0.70564	3.7	96.5
9	0.67276	3.5	100.0

FILE EMG (CREATION DATE = 11/03/77) DATA REDUCTION

AFTER ROTATION WITH KAISER NORMALIZATION

FACTOR PATTERN

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8
VAR01	0.10595	-0.14515	-0.20325	0.00651	-0.97125	0.00577	-0.03455	0.02370
VAR02	0.29716	-0.10081	0.57706	-0.02982	0.13082	0.02009	-0.06116	0.13659
VAR03	0.62015	-0.14055	0.10310	0.04353	-0.34473	0.07408	-0.01604	0.02694
VAR04	0.18837	-0.00293	0.17971	0.01257	-0.63563	-0.06205	0.02149	0.16255
VAR05	-0.19884	0.12786	0.40593	-0.00557	-0.28116	-0.07813	-0.30632	0.04959
VAR06	0.53165	0.12274	0.53850	0.07731	-0.09681	-0.06843	0.03709	-0.08375
VAR07	-0.23135	0.05834	0.25493	-0.00634	-0.58536	0.17641	-0.20665	-0.17901
VAR08	0.01795	0.10570	0.15778	0.02667	-0.69979	-0.02075	-0.01637	0.05192
VAR09	-0.14928	0.04822	0.69557	-0.00555	-0.20844	0.11427	-0.04718	0.00937
VAR10	0.43925	0.04143	0.08530	0.05215	-0.42205	0.00063	-0.02055	0.08279
VAR11	0.41963	-0.13062	0.40799	0.05330	0.01952	0.04255	-0.08585	-0.04307
VAR12	0.22330	0.13234	0.20757	0.00679	-0.33723	-0.03076	0.11679	0.04744
VAR13	0.21551	0.18202	0.39551	0.02447	-0.35204	0.10749	-0.04713	-0.25422
VAR14	0.05087	0.16743	0.14052	-0.02835	-0.09257	-0.18548	-0.71131	-0.09966
VAR15	-0.01798	-0.02548	0.62707	0.00891	-0.07457	0.04051	-0.08417	-0.10813
VAR16	-0.37235	-0.05544	0.19508	0.14110	-0.07858	0.42526	-0.03942	0.09045
VAR17	0.03730	-0.12612	0.04300	0.04564	0.06167	0.18501	-0.33892	0.47416
VAR18	0.17853	0.07166	-0.05093	0.01435	0.10780	0.44375	-0.43268	0.23755
VAR19	-0.05164	0.33564	0.05424	0.42759	0.03249	-0.00210	-0.19362	0.37370
VAR20	0.03242	0.08693	-0.03568	0.00317	-0.16794	0.02598	0.03957	0.42724
VAR21	0.82723	0.15230	-0.10104	0.05199	-0.07850	-0.08701	-0.09331	0.16538
VAR22	0.09442	-0.01913	-0.06652	0.71836	-0.07599	0.36659	0.05385	-0.13345
VAR23	0.01683	0.64379	-0.03402	0.13735	0.03247	0.20861	-0.02226	0.21702
VAR24	0.01796	0.30512	-0.00361	-0.01222	0.03086	0.81938	0.06663	0.06355
VAR25	0.04664	0.41133	0.04343	0.10544	0.10706	0.32132	0.04085	0.47280
VAR26	0.22175	-0.16211	-0.11515	0.93146	0.02916	0.08952	-0.05703	-0.09169
VAR27	-0.10306	0.15970	0.09418	0.85291	0.01770	-0.24687	0.04165	0.11228
VAR28	0.14939	0.70259	-0.07727	0.06862	0.02612	0.10357	-0.37438	-0.17588
VAR29	0.83557	0.10487	-0.14469	0.12476	-0.07810	0.13575	-0.08464	-0.03134
VAR30	0.03072	-0.01833	-0.03474	0.02588	0.01192	0.06399	-0.79995	0.08377

FACTOR CORRELATIONS

EMG FACTORS

FILE EMG (CREATION DATE = 11/03/77) DATA REDUCTION

VARIABLE	COMMUNALITY
VAR01	0.85928
VAR02	0.48776
VAR03	0.73102
VAR04	0.67792
VAR05	0.54257
VAR06	0.80620
VAR07	0.57792
VAR08	0.67606
VAR09	0.58011
VAR10	0.58952
VAR11	0.71116
VAR12	0.34669
VAR13	0.71583
VAR14	0.67846
VAR15	0.48817
VAR16	0.33218
VAR17	0.48694
VAR18	0.73136
VAR19	0.74809
VAR20	0.24778
VAR21	0.85014
VAR22	0.78337
VAR23	0.74654
VAR24	0.85643
VAR25	0.77999
VAR26	0.96981
VAR27	0.77234
VAR28	0.81971
VAR29	0.87455
VAR30	0.68901

FACTOR	EIGENVALUE	PCT OF VAR	CUM PCT
1	9.02653	44.3	44.3
2	4.02366	19.8	64.1
3	2.22458	10.9	75.0
4	1.51484	7.4	82.5
5	1.16795	5.7	88.2
6	0.94454	4.6	92.9
7	0.76508	3.8	96.6
8	0.69045	3.4	100.0

EMG FACTORS 11/03/77

FILE EMG (CREATION DATE = 11/03/77) DATA REDUCTION

AFTER ROTATION WITH KAISER NORMALIZATION

45.7 % variance

FACTOR PATTERN

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8	FACTOR 9	FACTOR 10
VAR31	-0.04170	-0.01056	0.10655	-0.05515	0.36995	0.10978	0.11430	0.41043	-0.11721	-0.19035
VAR32	0.07297	-0.32759	-0.02381	0.11237	0.84602	0.00784	-0.05924	0.01259	0.05455	0.00786
VAR33	-0.04414	0.20731	0.34270	0.03091	0.29008	0.47380	-0.10852	0.06271	-0.11355	0.27431
VAR34	0.05117	-0.00656	0.65402	-0.09182	0.15820	-0.01338	0.05003	0.02606	-0.01506	-0.01888
VAR35	0.13496	0.12238	0.74069	-0.01030	-0.10336	-0.12398	0.01103	0.02173	0.01483	0.15314
VAR36	-0.14615	0.05269	0.14133	-0.09093	0.26931	-0.10769	0.18479	-0.12624	0.54429	0.00325
VAR37	-0.03283	-0.08147	0.62280	-0.14576	0.05739	-0.10820	-0.03066	0.13071	0.03758	-0.16761
VAR38	-0.10532	-0.08993	0.49044	0.03074	0.25929	0.04961	-0.08628	0.04392	0.15080	-0.08036
VAR39	-0.03922	-0.17152	0.03094	-0.20459	0.09626	-0.01229	0.01866	0.73889	0.01459	0.02346
VAR40	-0.17283	-0.04429	0.13458	-0.34622	0.29434	-0.00837	0.23689	0.19436	0.00053	0.12653
VAR41	0.12031	0.01405	0.33959	-0.00781	0.32323	0.08185	-0.07506	0.06001	0.17291	0.23277
VAR42	0.03038	0.00779	0.12148	-0.07883	0.24641	-0.12942	0.00717	0.09515	0.41100	0.35883
VAR43	0.06002	-0.03032	0.91550	-0.01240	-0.02710	-0.03536	0.05722	-0.27034	0.02121	-0.01095
VAR44	-0.20849	0.20931	0.79584	-0.04270	-0.06862	0.12404	-0.07496	0.13690	-0.08938	0.06022
VAR45	0.09705	-0.08083	0.71533	0.04438	0.13019	0.01828	0.22369	0.02269	-0.03306	0.11688
VAR46	-0.05834	0.01425	0.02350	-0.82149	-0.08269	0.14538	-0.09722	0.03437	0.08865	-0.11110
VAR47	0.14271	0.10449	-0.01040	-0.05250	0.22004	0.06484	0.01136	0.03103	-0.04137	-0.05948
VAR48	0.09594	0.09629	-0.13323	-0.18084	0.11023	0.60283	0.11612	-0.06269	-0.02026	0.21098
VAR49	0.07753	0.03220	0.07985	-0.35748	0.08134	0.37474	0.00256	-0.15397	0.01913	-0.09145
VAR50	0.04140	0.01144	0.03605	-0.07726	0.03144	0.23569	-0.05739	0.01184	0.19149	0.24742
VAR51	0.16193	0.21770	-0.01366	-0.70173	0.21515	-0.17992	0.11759	-0.00974	-0.11228	-0.07487
VAR52	0.03053	-0.16094	0.14600	-0.32033	0.01584	0.45875	-0.03076	-0.12100	0.21580	-0.14209
VAR53	0.35032	-0.09535	-0.02045	-0.42474	0.01403	0.10285	0.01555	-0.00306	0.27314	-0.01723
VAR54	0.11871	-0.09567	0.18677	-0.04152	-0.04006	-0.14994	0.01002	0.16925	0.16893	-0.04526
VAR55	0.07234	0.05584	0.12227	-0.07349	0.12071	0.07324	-0.02865	-0.04767	-0.07186	0.02883
VAR56	0.34993	-0.10523	-0.03852	-0.19082	0.08794	0.26189	-0.03767	0.07424	0.10773	0.14448
VAR57	0.22925	-0.12601	0.09136	-0.47105	-0.08504	0.11703	0.04267	0.04936	0.15949	0.09658
VAR58	0.10064	-0.00651	0.04225	-0.02375	-0.01633	0.10139	0.47986	-0.06684	0.00884	0.05832
VAR59	0.01351	0.11258	0.07728	-0.78446	-0.10925	-0.09814	0.09368	0.11629	-0.00977	0.14209
VAR60	0.26932	-0.17118	0.02358	-0.62773	0.01844	0.15350	0.11586	0.12995	0.04095	0.11955
VAR61	0.03857	0.51046	0.15816	-0.36021	-0.04141	0.06223	-0.00725	0.05114	0.05599	-0.09304
VAR62	0.49196	0.17131	-0.00735	0.03359	0.15865	-0.11857	-0.03735	0.15609	0.17137	-0.05546
VAR63	0.02763	0.04771	-0.07435	0.03502	-0.07249	0.54180	0.23047	0.27261	0.05541	-0.14451
VAR64	0.19994	0.33585	0.05929	-0.14106	0.00918	0.26365	-0.14407	0.07026	0.13074	-0.27653
VAR65	0.11744	0.73376	0.06315	0.16430	-0.05302	0.11524	0.14143	0.01391	0.06021	0.04932
VAR66	-0.05700	0.46947	-0.14960	-0.28319	0.23722	-0.10442	0.19427	0.06218	0.22245	-0.24649
VAR67	0.08240	0.19288	0.58825	-0.00828	-0.07062	0.19373	0.02028	0.00023	0.14645	-0.32170
VAR68	0.52166	0.13421	0.16800	0.03990	0.11215	-0.03492	0.18444	-0.02127	0.02982	-0.23829
VAR69	0.13270	0.23400	-0.02809	0.18179	-0.12068	0.07753	0.00223	0.67821	0.12324	0.02981
VAR70	0.02000	0.27524	-0.11513	-0.07961	0.04116	0.01935	0.05381	-0.03516	0.46019	0.02475
VAR71	0.09220	-0.04470	-0.00251	0.06256	-0.07899	0.06179	-0.02076	0.20249	0.77523	-0.05240
	0.34646	0.51750								

FILE EMG (CREATION DATE = 11/03/77) DATA REDUCTION

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8	FACTOR 9	FACTOR 10
VAR74	0.48550	0.57720	0.24689	-0.15955	-0.11268	-0.06478	0.11745	0.23184	-0.00919	0.13018
VAR75	0.62257	0.19615	0.01922	-0.22237	-0.08941	-0.00470	0.17535	-0.15172	-0.13412	-0.09937

	FACTOR 11
VAR31	0.17713
VAR32	0.03314
VAR33	-0.05554
VAR34	-0.05560
VAR35	-0.13782
VAR36	0.22280
VAR37	0.12783
VAR38	0.13299
VAR39	0.01761
VAR40	0.07623
VAR41	-0.19585
VAR42	-0.12704
VAR43	-0.05067
VAR44	0.11118
VAR45	-0.06299
VAR46	0.07779
VAR47	0.09419
VAR48	0.00785
VAR49	0.10845
VAR50	0.02773
VAR51	-0.04402
VAR52	0.15017
VAR53	-0.19639
VAR54	0.10843
VAR55	0.10144
VAR56	-0.18230
VAR57	-0.11431
VAR58	0.14008
VAR59	-0.02238
VAR60	-0.15983
VAR61	-0.01744
VAR62	-0.27895
VAR63	0.10705
VAR64	-0.07430
VAR65	-0.07491
VAR66	0.17149
VAR67	0.02763
VAR68	-0.12955

EMG FACTORS

FILE EMG (CREATION DATE = 11/03/77) DATA REDUCTION

VARIABLE	COMMUNALITY
VAR31	0.55519
VAR32	0.74795
VAR33	0.59355
VAR34	0.87725
VAR35	0.75939
VAR36	0.62717
VAR37	0.69685
VAR38	0.49130
VAR39	0.67334
VAR40	0.74433
VAR41	0.49974
VAR42	0.56466
VAR43	0.81738
VAR44	0.85765
VAR45	0.72539
VAR46	0.73983
VAR47	0.64395
VAR48	0.74548
VAR49	0.71184
VAR50	0.60112
VAR51	0.61895
VAR52	0.78014
VAR53	0.77839
VAR54	0.76839
VAR55	0.65442
VAR56	0.58176
VAR57	0.58605
VAR58	0.57591
VAR59	0.65812
VAR60	0.78930
VAR61	0.60264
VAR62	0.67319
VAR63	0.46653
VAR64	0.52630
VAR65	0.72707
VAR66	0.73091
VAR67	0.68105
VAR68	0.72871
VAR69	0.66499
VAR70	0.33046
VAR71	0.71858
VAR72	0.57228
VAR73	0.83662
VAR74	0.76716
VAR7[illegible]	0.60600

FACTOR	EIGENVALUE	PCT OF VAR	CUM PCT
1	14.09073	45.7	45.7
2	3.63694	11.8	57.5
3	3.32128	10.8	68.2
4	2.26939	7.4	75.6
5	1.55425	5.0	80.6
6	1.33343	4.3	85.0
7	1.14654	3.7	88.7
8	1.09887	3.6	92.2
9	0.94438	3.1	95.3
10	0.76668	2.5	97.8
11	0.68268	2.2	100.0

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11/09/77

EMG FACTORS

FILE EMG (CREATION DATE = 11/09/77) DATA REDUCTION

AFTER ROTATION WITH KAISER NORMALIZATION

FACTOR PATTERN

	FACTOR 1	FACTOR 2	FACTOR 3
VAR01	0.91707	-0.04364	-0.09357
VAR02	-0.14089	0.32188	0.58149
VAR03	0.58310	-0.26447	0.63906
VAR04	0.68365	0.11274	0.14889
VAR05	0.11746	0.69483	-0.09345
VAR06	0.24554	0.28686	0.52778
VAR07	0.39977	0.55407	-0.16259
VAR08	0.69452	0.28757	-0.08831
VAR09	0.03809	0.78796	0.04050
VAR10	0.54072	0.05448	0.26814
VAR11	0.11353	0.02512	0.84106
VAR12	0.38641	0.17171	0.10630
VAR13	0.35057	0.40691	0.25482
VAR14	-0.03195	0.55170	0.10088
VAR15	0.00614	0.52100	0.23474

S-N Squeezing tennis ball
O-A Someone kicking a dog
O-A Someone clenching her fist in rage
O-N Someone squeezing a lemon

FACTOR CORRELATIONS

	FACTOR 1	FACTOR 2	FACTOR 3
FACTOR 1	1.00000	0.46225	0.37570
FACTOR 2	0.46225	-1.00000	0.36085
FACTOR 3	0.37570	0.36085	1.00000

FACTOR STRUCTURE

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EMG FACTORS 11/09/77

FILE EMG (CREATION DATE = 11/09/77) DATA REDUCTION

AFTER ROTATION WITH KAISER NORMALIZATION

FACTOR PATTERN

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4
VAR16	0.01953	0.17282	-0.01410	0.40835
VAR17	0.15373	-0.04433	0.08203	0.45260
VAR18	0.09491	-0.00512	0.08394	0.79606
VAR19	0.74538	0.18963	-0.03053	0.08489
VAR20	0.31016	-0.06041	0.07877	0.05108
VAR21	0.10595	-0.01167	1.00761	-0.12945
VAR22	-0.03942	0.79621	0.05270	0.29142
VAR23	0.80565	-0.00295	-0.00951	0.09046
VAR24	0.18955	0.11535	-0.09320	0.65564
VAR25	0.64681	-0.00033	-0.00356	0.28393
VAR26	-0.05047	0.87888	0.22583	0.09390
VAR27	0.51280	0.61363	-0.03297	-0.31531
VAR28	0.51545	-0.01928	0.13795	0.17831
VAR29	-0.07793	0.16957	0.81455	0.12837
VAR30	0.11916	-0.06711	0.13464	0.42240

FACTOR CORRELATIONS

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4
FACTOR 1	1.00000	0.33296	0.32006	0.52633
FACTOR 2	0.33296	1.00000	0.19119	0.17814
FACTOR 3	0.32006	0.19119	1.00000	0.38265
FACTOR 4	0.52633	0.17814	0.38265	1.00000

FACTOR STRUCTURE

Log

Factor 1
Someone kicking a dog
Someone clenching his fist
Kissing someone
moving up eyes ...

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11/09/77

EMG FACTORS

FILE EMG (CREATION DATE = 11/09/77) DATA REDUCTION

AFTER ROTATION WITH KAISER NORMALIZATION

FACTOR PATTERN Lip

	FACTOR 1	FACTOR 2	FACTOR 3
VAR31	0.14826	0.13585	-0.46745
VAR32	-0.03007	0.66081	-0.06658
VAR33	0.41691	0.22605	-0.06528
VAR34	0.79002	0.07865	-0.11261
VAR35	0.84972	0.00308	0.09359
VAR36	0.11281	0.54971	0.00861
VAR37	0.73004	-0.04706	-0.10914
VAR38	0.53260	0.18907	-0.00783
VAR39	-0.01409	-0.11918	-0.84877
VAR40	-0.00397	0.22166	-0.60771
VAR41	0.24514	0.45331	-0.05205
VAR42	-0.05182	0.71334	-0.02761
VAR43	0.93475	-0.04719	0.06752
VAR44	0.91628	-0.17041	-0.07940
VAR45	0.67186	0.20344	-0.01705

Factor 1

Moving up lips side to side
Someone looking corner of eye
Flattening things muscle
Someone clenching fists in anger

FACTOR CORRELATIONS

	FACTOR 1	FACTOR 2	FACTOR 3
FACTOR 1	1.00000	0.52464	-0.45529
FACTOR 2	0.52464	1.00000	-0.45817
FACTOR 3	-0.45529	-0.45817	1.00000

FACTOR STRUCTURE

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EMG FACTORS 11/09/77

FILE EMG (CREATION DATE = 11/09/77) DATA REDUCTION

AFTER ROTATION WITH KAISER NORMALIZATION

FACTOR PATTERN Head

	FACTOR 1	FACTOR 2
VAR46	-0.09546	-0.86385
VAR47	0.79837	0.07228
VAR48	0.62399	-0.12041
VAR49	0.63999	-0.22763
VAR50	0.79508	0.09333
VAR51	0.02830	-0.75307
VAR52	0.57604	-0.23686
VAR53	0.47456	-0.45577
VAR54	0.73918	0.02297
VAR55	0.84061	0.12649
VAR56	0.64152	-0.10321
VAR57	0.36156	-0.44658
VAR58	0.54273	-0.08180
VAR59	0.01956	-0.85089
VAR60	0.14757	-0.75933

Factor 1

Kissing someone
Squeezing breast
Tightening thigh muscle
Whistling a tune

FACTOR CORRELATIONS

	FACTOR 1	FACTOR 2
FACTOR 1	1.00000	-0.61596
FACTOR 2	-0.61596	1.00000

FACTOR STRUCTURE

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11/09/77

EMG FACTORS

FILE EMG (CREATION DATE = 11/09/77) DATA REDUCTION

AFTER ROTATION WITH KAISER NORMALIZATION

FACTOR PATTERN Eye

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4
VAR61	0.21022	-0.18683	-0.51617	0.41096
VAR62	0.23194	0.65982	-0.10170	0.00019
VAR63	-0.31410	0.15626	-0.49914	0.14595
VAR64	-0.07859	-0.00556	-0.91061	-0.03431
VAR65	0.36400	0.15718	-0.47128	0.10874
VAR66	0.26517	0.18026	-0.22232	0.39340
VAR67	-0.11970	0.08306	-0.60943	0.10201
VAR68	0.15587	0.08654	-0.63889	-0.07361
VAR69	0.03481	0.26127	-0.08306	0.30082
VAR70	0.02651	0.62270	0.03128	0.03228
VAR71	-0.19770	0.63997	-0.05842	-0.00776
VAR72	-0.32620	0.26067	-0.14501	0.42274
VAR73	0.05917	0.05395	0.10254	0.79046
VAR74	0.49779	0.19198	-0.11743	0.49187
VAR75	-0.10648	-0.03734	-0.11480	0.64579

FACTOR CORRELATIONS

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4
FACTOR 1	1.00000	0.01591	-0.12397	0.13207
FACTOR 2	0.01591	1.00000	-0.53646	0.48397
FACTOR 3	-0.12397	-0.53646	1.00000	-0.60843
FACTOR 4	0.13207	0.48397	-0.60843	1.00000

FACTOR STRUCTURE

Someone looking out of corner ° Tightening of the muscle

APPENDIX 9

INSTRUCTIONS TO CLINICAL JUDGES FOR RANKING AND WEIGHTING TEST SCALES AS RELEVANCE TO MATURITY

APPENDIX 9

INSTRUCTIONS TO CLINICAL JUDGES FOR RANKING AND WEIGHTING TEST SCALES AS RELEVANCE TO MATURITY

The research I am conducting entails, among other things, the measuring of individuals in terms of their "psychological maturity." In the literature, this term and others like it are abundant but are so multidimensional as to resist operational definition and direct measurement. What I am endeavoring is the formation of a composite index of this higher-order trait using existing psychological tests.

Enclosed is a profile of the psychologically mature individual derived from existing theoretical and empirical sources. I would like you to consider the profile carefully and then do the following:

1. Rank the following tests or test scales as to their relevance, importance, or contribution to the measurement of psychological maturity as here outlined:

Rank

____ The Eysenck Personality Inventory Extraversion scale ( ).

____ The Cattell 16PF 2nd order Anxiety scale ( ).

____ The 16PF 2nd order Tough Poise scale ( ).

____ The 16PF 2nd order Independence scale ( ).

____ The Personal Orientation Inventory (Shostrom) ( ).

____ The Hutt Adaptation of the Bender-Gestalt test ( ).

2. In the bracket following the test or test scale, assign a weight to your rankings in percentage terms. Thus, for example, you may deem scale or test X four times more appropriate than scale or test Y, so X would be weighted as 40% Y, as 10%, etc. Your weightings should total 100%.

If there are any questions regarding this procedure, please call me at 237-5660, local 173, or evenings at 225-2903. I thank you most sincerely for your cooperation.

Bill McElheran

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The mature individual is highly differentiated in the sense that higher-order mental functions, such as abstract ability, reason, values, and philosophies of life subsume, incorporate, and integrate lower genetic functions of sensation and affect. The behavior of such an individual is less likely to be impulsive and drive-determined, but more under the control and direction of cognitive structures. Thought is differentiated from action. Such individuals are characteristically reflective, considerate of consequences of their actions and usually exercise sound judgment.

The mature individual increasing incorporates reality-given (allocentric) schemas into his self-organization and is less need-dominated (autocentric) in his perceptions and representations of the world. He therefore possesses superior social adaptive and coping skills. He is increasingly more autonomous in the sense that he is less under the control of contemporary situational and motivational forces and less governed by historical and irrational unconscious influences. Hence he is more self-determined than past- or other-determined. He also possesses a high degree of self-awareness and insight and is capable of high levels of empathy, interpersonal sensitivity and love. While he is not necessarily free from conflict, the integrity of his personality maintains itself in the face of emotional stress and life problems.

The mature person is characterized as well by self-consistency over time, with a secure and enduring sense of personal identity. Furthermore, he has strongly persistent directly motives which assist in organizing goal-directed activity over time. He is also likely to be open to experience, flexible, and continually seeking of new information, knowledge, and challenge.

APPENDIX 10

DATA PRINTOUT OF CODED PSYCHOLOGICAL VARIABLES AND EMG RAW SCORES

Note: Levels of independent variable coded as follows: High = 1, Medium = 2, Low = 3.

APPENDIX 10

	MAT	16PF	POI	VAR1	VAR2	VAR3	VAR4	VAR5
60100	2	3	3	0	9630	0	1230	6260
61100	3	3	3	4350	0	0	0	6350
62100	3	2	2	0	150	0	2200	6260
63100	1	1	1	3050	3450	0	700	5950
64100	1	1	1	300	0	700	450	14100
65100	2	2	1	0	900	1800	1350	6260
66100	2	3	1	1200	1150	3700	6200	7300
67100	1	1	2	350	12350	9800	2050	4000
68100	1	1	1	0	0	200	4500	9350
69100	1	1	2	0	0	100	150	550
70100	3	3	1	950	50	4100	0	4200
71100	3	1	3	1250	2400	20250	3000	19250
72100	1	1	1	450	1700	1250	6850	2350
73100	2	2	3	0	2400	1150	0	2750
74100	1	1	2	0	0	1250	300	1200
75100	3	3	3	0	0	8100	3550	5800
76100	1	2	1	0	0	1250	250	1900
77100	3	3	2	0	0	1700	100	2950
78100	3	3	3	0	1400	3200	550	9500
79100	3	3	2	1200	2450	4800	0	8000
80100	2	1	3	1750	10950	7700	10250	6800
81100	1	1	1	600	700	950	800	1900
82100	3	2	3	200	3150	4300	4950	6260
83100	2	3	2	400	1050	13250	2300	5400
84100	3	3	3	750	0	22750	3500	19750
85100	1	1	1	1200	500	3700	2650	7700
86100	2	1	2	350	900	3200	3550	2750
87100	2	2	2	100	1750	1500	4450	6050
88100	1	1	2	0	1650	2600	2750	2450
89100	3	3	3	1600	1450	2100	5500	18950
90100	1	1	2	0	0	1700	0	0
91100	2	3	2	300	1700	750	200	100
92100	2	2	3	0	0	0	0	600
93100	2	2	1	7100	1000	7450	16550	13400
94100	2	3	2	200	500	3450	150	750
95100	3	3	2	900	3350	22600	16050	20650
96100	3	3	2	0	0	6750	0	600
97100	2	2	3	350	8650	3700	5300	7300
98100	2	1	1	250	3100	2950	4200	23850
99100	3	2	3	550	1950	6350	3150	11050
100100	3	3	3	2900	4100	11950	2620	6260
101100	3	3	3	200	1750	500	900	1500
102100	3	3	1	500	3200	5800	8850	9700
103100	2	2	3	400	1850	4190	2000	10100
104100	2	2	3	1900	4700	3350	4700	27200
105100	2	2	2	10400	4200	18950	14300	9500
106100	2	2	3	1250	700	2500	2620	2250
107100	1	2	1	300	850	4050	1350	15150
108100	1	1	1	950	3200	3900	1250	5000
109100	1	2	1	450	2600	34150	5650	16550
110100	3	3	3	3400	10700	9900	5350	6950
111100	2	2	2	1950	5100	11000	1800	11450
112100	1	1	1	100	800	4190	4050	4450
113100	3	3	2	4900	2250	1750	4700	10900
114100	1	1	1	5300	2100	19550	3700	6450
115100	2	3	2	1950	2250	10500	3750	6250
116100	1	1	1	100	3000	13450	3450	1900
117100	3	3	3	2250	1500	5600	4500	5250
118100	2	2	2	250	1300	18800	2250	23400
119100	2	3	2	1750	1150	1600	2800	3050
120100	1	3	2	1250	2150	0	3950	6500

APPENDIX 10

	MAT	16PF	PO1	VAR1	VAR2	VAR3	VAR4	VAR5
1100	1	1	1	1850	100	150	300	4900
2100	2	1	3	500	2550	4650	2100	8200
3100	2	1	3	1800	1750	3550	5700	14400
4100	1	1	1	0	1100	1650	1700	1400
5100	2	2	3	0	0	1500	0	0
6100	1	3	1	1800	150	1600	350	9400
7100	1	2	1	0	0	0	0	4100
8100	2	2	2	3250	7200	8850	8500	12500
9100	3	3	1	200	2750	7200	6000	12500
10100	2	2	3	4400	0	450	50	7600
11100	3	1	2	2350	3050	7800	15550	11500
12100	3	3	2	550	0	3150	250	3550
13100	1	1	1	150	1300	600	1050	1150
14100	2	2	2	200	1000	6850	2050	22050
15100	1	2	2	50	3800	1600	1600	16750
16100	3	3	3	600	3200	3150	1700	5600
17100	1	1	1	350	1650	4190	2750	10100
18100	1	1	1	2600	5600	7000	5600	3700
19100	2	2	1	450	750	1700	1600	2100
20100	3	3	3	9500	13250	2950	3850	18700
21100	3	2	3	2900	4600	21650	24500	22950
22100	2	2	1	800	2650	12550	2650	20750
23100	3	3	3	1400	1800	5300	5150	6000
24100	3	2	3	0	0	600	450	2900
25100	1	1	2	0	0	2550	300	6450
26100	2	2	2	400	0	500	1650	2850
27100	1	1	2	0	0	1000	150	650
28100	3	3	3	50	0	850	100	1350
29100	3	2	3	0	150	1300	0	850
30100	3	3	3	0	0	6700	0	300
31100	1	1	1	0	0	800	700	1450
32100	1	1	1	0	100	50	100	1150
33100	3	3	2	0	0	2550	50	350
34100	3	3	3	0	0	450	200	3050
35100	2	2	3	0	0	150	300	1900
36100	2	2	1	0	0	200	450	800
37100	2	1	3	970	0	900	250	250
38100	2	2	1	0	0	150	0	200
39100	3	3	3	0	50	800	0	200
40100	2	1	2	0	0	2700	1750	9450
41100	3	3	3	100	0	3600	100	2650
42100	1	1	1	0	0	550	150	1350
43100	1	2	1	0	0	850	400	1000
44100	3	3	2	0	500	150	200	100
45100	2	1	2	100	0	250	0	3650
46100	1	2	2	700	0	150	450	950
47100	1	1	1	50	0	50	1650	1000
48100	2	1	3	0	0	2250	300	3300
49100	2	2	3	0	0	1800	600	300
50100	1	1	1	0	0	250	1650	2400
51100	1	1	1	1350	0	400	300	1350
52100	1	1	1	0	0	900	950	1150
53100	1	1	1	700	1200	100	200	3500
54100	3	3	1	650	900	1650	3450	18750
55100	2	2	2	300	1600	6200	1750	4600
56100	2	2	1	550	2400	2700	2950	3200
57100	2	3	2	3050	950	100	1050	8400
58100	3	3	2	0	2150	4000	1200	550
59100	3	2	3	0	300	1470	580	6260

APPENDIX 11

DATA PRINTOUTS OF DESCRIPTIVE STATISTICS FROM MANOVA ON THREE LEVELS OF THREE PSYCHOLOGICAL VARIABLES (MAT, 16PF, POI)

POOR COPY

MANCOVA: INDEP. VARIABLE IS MATURATION FIVE DEPENDENT VARIABLES AND IQ AS COVARIATE

OBSERVED CELL MEANS --- ROWS ARE CELLS-COLUMNS ARE VARIABLES

	1 VAR1	2 VAR2	3 VAR3	4 VAR4	5 VAR5	6 IQ
1	6.1538	12.8846	32.6231	16.7179	46.5000	115.1282
2	11.5762	20.4238	42.7357	29.4405	73.6357	111.6429
3	11.3333	18.6026	55.8513	34.0513	76.4718	106.3077

OBSERVED CELL STD DEVS--ROWS ARE CELLS-COLUMNS VARIABLES

	1 VAR1	2 VAR2	3 VAR3	4 VAR4	5 VAR5	6 IQ
1	10.75942	22.80421	64.35837	18.10307	46.16560	20.94637
2	20.27614	26.86118	48.26573	36.63402	71.33025	12.00990
3	18.75195	27.65463	62.51834	51.35980	67.17029	14.81337

POOR COPY

SAMPLE CORRELATION MATRIX

		1 VAR1	2 VAR2	3 VAR3	4 VAR4	5 VAR5	6 IQ
1	VAR1	1.000000					
2	VAR2	0.400835	1.000000				
3	VAR3	0.267806	0.295306	1.000000			
4	VAR4	0.459756	0.387748	0.528606	1.000000		
5	VAR5	0.291820	0.313425	0.508157	0.484395	1.000000	
6	IQ	0.024539	-0.151476	0.098122	-0.063208	0.007240	1.000000

	VARIABLE	VARIANCE	STANDARD DEVIATION
1	VAR1	295.873779	17.2010
2	VAR2	670.129883	25.8869
3	VAR3	3431.055176	58.5752
4	VAR4	1433.460449	37.8611
5	VAR5	3940.567627	62.7739
6	IQ	264.335205	16.2584

D.F.= 117.

ERROR TERM FOR ANALYSIS OF VARIANCE(WTHIN CELS)

POOR COPY

MANCOVA: INDEP. VARIABLE IS MATURATION — FIVE DEPENDENT VARIABLES AND IQ AS COVARIATE

MATRIX OF CORRELATIONS WITH COVARIATES ELIMINATED

		1 VAR1	2 VAR2	3 VAR3	4 VAR4	5 VAR5
1	VAR1	1.000000				
2	VAR2	0.409398	1.000000			
3	VAR3	0.266766	0.315382	1.000000		
4	VAR4	0.462371	0.383355	0.538478	1.000000	
5	VAR5	0.291738	0.318202	0.509921	0.485837	1.000000

VARIABLE		VARIANCE	STANDARD DEVIATION
1	VAR1	298.244385	17.2698
2	VAR2	660.397949	25.6982
3	VAR3	3427.312988	58.5433
4	VAR4	1440.041260	37.9479
5	VAR5	3974.329102	63.0423

D.F.= 116.

ERROR TERM FOR ANALYSIS OF COVARIANCE(WTHIN CELS)

1 COVARIATES HAVE BEEN ELIMINATED

POOR COPY

OBSERVED COMBINED MEANS

1 (PF)

Group					
Level 1, N 41. ANS $\bar{X}$	VAR1= 7.017 IQ = 116.6	VAR2= 15.95	VAR3= 34.09	VAR4= 23.87	VAR5= 51.82
Level 2, N 38. ANS $\bar{X}$	VAR1= 10.05 IQ = 110.8	VAR2= 16.85	VAR3= 50.18	VAR4= 31.64	VAR5= 80.01
Level 3, N 40. ANS $\bar{X}$	VAR1= 12.21 IQ = 105.6	VAR2= 19.37	VAR3= 47.26	VAR4= 25.10	VAR5= 66.09

2 (POI)

Group					
Level 1, N 42. ANS $\bar{X}$	VAR1= 8.167 IQ = 114.4	VAR2= 11.70	VAR3= 37.72	VAR4= 25.65	VAR5= 63.06
Level 2, N 38. ANS $\bar{X}$	VAR1= 9.789 IQ = 110.4	VAR2= 16.97	VAR3= 48.54	VAR4= 27.45	VAR5= 62.40
Level 3, N 40. ANS $\bar{X}$	VAR1= 11.33 IQ = 108.1	VAR2= 23.73	VAR3= 45.41	VAR4= 27.40	VAR5= 71.72

MANCOVA: INDEP. VARIABLES ARE 16 PF AND POI(CROSSED)   FIVE DEPENDENT VARIABLES AND IQ AS COVARIATE

SAMPLE CORRELATION MATRIX

		1 VAR1	2 VAR2	3 VAR3	4 VAR4	5 VAP5	6 IQ
1	VAR1	1.000000					
2	VAR2	0.398127	1.000000				
3	VAR3	0.259084	0.293019	1.000000			
4	VAR4	0.485718	0.407122	0.543697	1.000000		
5	VAR5	0.293781	0.318316	0.508644	0.490703	1.000000	
6	IQ	0.038405	-0.145331	0.087922	-0.092473	0.006856	1.000000

VARIABLE		VARIANCE	STANDARD DEVIATION
1	VAR1	303.624268	17.4248
2	VAR2	673.921875	25.9600
3	VAR3	3521.369141	59.3411
4	VAR4	1523.145264	39.0275
5	VAR5	3908.520020	62.5182
6	IQ	267.453369	16.3540

D.F.= 111.

ERROR TERM FOR ANALYSIS OF VARIANCE(WTHIN CELS)

APPENDIX 12

DATA PRINTOUTS OF EXTREME GROUP DESCRIPTIVE STATISTICS FOR THREE PSYCHOLOGICAL VARIABLES

EXTREME GROUPS MANOVA FACTOR IS MATURITY

OBSERVED CELL MEANS --- ROWS ARE CELLS-COLUMNS ARE VARIABLES

	1 VAR1	2 VAR2	3 VAR3	4 VAR4	5 VAR5
1	6.70455	9.95455	28.10909	15.86364	44.61363
2	13.47727	19.22726	58.57727	19.68179	72.16817

OBSERVED CELL STD DEVS--ROWS ARE CELLS-COLUMNS VARIABLES

	1 VAR1	2 VAR2	3 VAR3	4 VAR4	5 VAR5
1	12.77988	11.42669	47.49220	16.11282	41.71643
2	22.08936	34.84686	59.38316	20.63789	64.28802

EXTREME GROUPS MANOVA FACTOR IS MATURITY

SAMPLE CORRELATION MATRIX

		1 VAR1	2 VAR2	3 VAR3	4 VAR4	5 VAR5
1	VAR1	1.000000				
2	VAR2	0.738385	1.000000			
3	VAR3	0.180689	0.166194	1.000000		
4	VAR4	0.341099	0.475937	0.427165	1.000000	
5	VAR5	0.394580	0.334158	0.405291	0.408687	1.000000

VARIABLE		VARIANCE	STANDARD DEVIATION
1	VAR1	325.632324	18.0453
2	VAR2	672.436523	25.9314
3	VAR3	2890.934326	53.7674
4	VAR4	342.772949	18.5141
5	VAR5	2936.604248	54.1904

D.F.= 42.

ERROR TERM FOR ANALYSIS OF VARIANCE(WTHIN CELS)

EXTREME GROUPS MANOVA FACTOR IS 16 P-F

OBSERVED CELL MEANS --- ROWS ARE CELLS-COLUMNS ARE VARIABLES

	1 VAR1	2 VAR2	3 VAR3	4 VAR4	5 VAR5
1	7.50000	14.52273	29.26817	18.36363	61.45454
2	15.75000	17.77272	55.90909	29.07727	85.59544

OBSERVED CELL STD DEVS--ROWS ARE CELLS-COLUMNS VARIABLES

	1 VAR1	2 VAR2	3 VAR3	4 VAR4	5 VAR5
1	12.91640	27.01872	43.32895	16.69487	57.60022
2	22.81538	28.69035	62.00514	35.92317	67.48148

EXTREME GROUPS MANOVA FACTOR IS 16 P-F

SAMPLE CORRELATION MATRIX

		1 VAR1	2 VAR2	3 VAR3	4 VAR4	5 VAP5
1	VAR1	1.000000				
2	VAR2	0.534297	1.000000			
3	VAR3	0.062858	0.203398	1.000000		
4	VAR4	0.130332	0.254645	0.557198	1.000000	
5	VAR5	0.271354	0.278431	0.305642	0.612146	1.000000

VARIABLE		VARIANCE	STANDARD DEVIATION
1	VAR1	343.687012	18.5388
2	VAR2	776.573975	27.8671
3	VAR3	2861.012451	53.4884
4	VAR4	784.596436	28.0107
5	VAR5	3935.766357	62.7357

D.F.= 42.

ERROR TERM FOR ANALYSIS OF VARIANCE(WTHIN CELS)

EXTREME GROUPS MANOVA FACTOR IS PCI

OBSERVED CELL MEANS --- ROWS ARE CELLS-COLUMNS ARE VARIABLES

	1 VAR1	2 VAR2	3 VAR3	4 VAR4	5 VAR5
1	10.27273	14.65909	48.34090	26.20454	56.27272
2	12.34091	20.64998	49.53181	23.08180	80.60905

OBSERVED CELL STD DEVS--ROWS ARE CELLS-COLUMNS VARIABLES

	1 VAR1	2 VAR2	3 VAR3	4 VAR4	5 VAR5
1	12.83200	15.75813	80.87665	25.00984	47.66472
2	21.78104	33.09540	61.33292	20.60187	63.29413

EXTREME GROUPS MANOVA FACTOR IS POI

SAMPLE CORRELATION MATFIX

		1 VAR1	2 VAR2	3 VAR3	4 VAR4	5 VAR5
1	VAR1	1.000000				
2	VAR2	0.586155	1.000000			
3	VAR3	0.111669	0.112880	1.000000		
4	VAR4	0.186354	0.338513	0.416726	1.000000	
5	VAR5	0.338002	0.285535	0.508619	0.408643	1.000000

VARIABLE		VARIANCE	STANDARD DEVIATION
1	VAR1	319.536865	17.8756
2	VAR2	671.812256	25.9193
3	VAR3	5151.375000	71.7731
4	VAR4	524.964600	22.9121
5	VAR5	3139.032471	56.0271

D.F.= 42.

ERROR TERM FOR ANALYSIS OF VARIANCE(WTHIN CELS)