AN EXAMINATION OF THE RELATIONSHIP BETWEEN SCALP RECORDED STEADY POTENTIAL FLUCTUATIONS AND EVENT-RELATED POTENTIALS IN AN AUDITORY DISCRIMINATION TASK.

by

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An Examination of the Relationships Between Scalp Recorded Steady Potential Fluctuations And Event-Related Potentials in an Auditory Discrimination Task

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ABSTRACT

An experiment was carried out to investigate the relationships between steady potential level (SPL) fluctuations and event-related potentials (ERP: CNV, N1, P2, P3) in a CNV paradigm requiring an auditory discrimination. An "A-B-A" design was employed with the "B" condition differing only in that punishment (1 second of 95 db white noise) was administered for incorrect or delayed choice. Monopolar recordings of SPL, spontaneous brain electrical activity (EEG), eye movement (EOG), and cephalic galvanic skin potential activity (GSP) were obtained from 18 subjects (S). For each S single-trial ERP amplitude measures were correlated with each other and with SPL preceding that trial. Few consistent patterns of relationship were observed between SPL measured at Cz and any ERP measure; however N1, P2, P3 and the CNV measures all displayed significant patterns of interrelationships. Analysis of within-S condition differences revealed a great deal of variability. However, in Ss showing condition effects CNV amplitude was increased over the "B" condition. Pooled subject analysis of variance showed significant sex, condition, and electrode differences necessitating separate analyses for males and females. The females as a whole displayed larger amplitude CNVs and EPs in all conditions over all electrodes. For both groups the expected attentuation of CNV amplitude during the "B" condition was not observed and ,in fact, CNV amplitude was generally increased during this condition. The topographical distribution of the CNV obtained in this study demonstrated a frontally dominant early component and a more centrally dominant later component. These data are interpreted as support for the concept of the non-unitary CNV. The overall results are discussed in terms of the "ceiling hypothesis", the CNV and situational anxiety, sex differences and methodological problems in DC recording.

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INTRODUCTION

Interest in the extreme low end of the frequency spectrum of brain electrical activity began with the earliest recordings from exposed mammalian cortex in the late 19th century (Caton 1875, 1877, 1887; Beck 1891). These pioneer recordings utilized DC recording methodology which allowed the simultaneous observation of the "standing" cortical potential as well as the very slowly changing cortical "currents" and the faster "feeble" rhythmic oscillations of the spontaneously active brain. These "feeble currents" were nothing less than what was later to be called the electroencephalogram (after Berger 1929). However, the technological limitations of the recording systems led to a prevailing interest in the slower stimulus induced fluctuations which obscured the significance of the spontaneous rhythms. Nonetheless the primary importance of these early reports was the demonstration that the observed slow cortical "currents" were reactive to a variety of sensory and motor phenomena in that both stimulation (central as well as peripheral) and movement resulted in a slow negative shift. These slow changes were found to be somewhat localized to the specific neural tissue involved and appeared simultaneously with low voltage fast activity (Beck 1891). Both Caton and

Beck believed that these negative "currents" indexed the degree of cortical involvement (Brazier 1961) - a belief that is still widely accepted today (see review by Rebert 1976).

As already mentioned, this early interest in slow current variations was due in part to the technical limitations of the recording systems which were able to reliably record slow changes but could not follow faster frequencies or permit the observation of small current fluctuations. Technological advances in amplifier design subsequent to this period provided greater amplification and a higher frequency response at the expense of diminished low frequency capabilities. This was due to the fact that early amplifiers were inherently unstable necessitating the addition of low frequency (high-pass) filters to remove baseline drifting (Caspers 1974). The wide spread introduction of these capacitance coupled (AC) amplifiers insured that the bulk of research on brain electrical activity until the late 30's would ignore the very slow cortical changes which had attracted so much early attention. On a more positive note these advances in amplifier design led to recording instruments of sufficient sensitivity to allow Hans Berger (1929) to observe the rhythmical spontaneous activity of the human brain with electrodes placed on the scalp. Berger called the resulting recorded activity an electroencephalogram (EEG), following the pattern set by electrocardiography (EKG). Although Berger is correctly credited with the discovery of the human EEG, it was Adrian and Matthews (1934) who did the most to advance the cause of electroencephalography by providing public demonstrations of their findings. As soon as the EEG gained widespread credibility, electroencephalography became the primary tool for research into brain function. Since the EEG is most easily defined by its rhythmicity (.5 - 30 Hz): the ascendancy of EEG methodology was a trend that further diminished general interest in the very slow non-rhythmical brain changes first reported by Caton.

Despite these obstacles DC recording began to make a comeback in 1939 when Davis and his associates (1939a, b) attempted DC scalp recording from humans during sleep. Although these investigators were able to successfully record steady potential level (SPL) fluctuations, they were not able to demonstrate a consistent relation between the various stages of sleep and variations in SPL. At approximately the same time Libet and Gerard (1941) began a long and continuing series of investigations into the relationship between steady potential fields and neuronal activity. Simultaneously, the development of chopper stabilized amplifiers provided the technical means for Goldring and O'Leary (1950, 1951a, 1951b, 1953) and Kohler (1949, 1952, 1955a, b, 1957) to begin serious investigation of slow brain phenomena and their relationships to physiological and psychological processes.

These investigations opened the so-called modern era of DC recording (Caspers 1974) and since that time a steadily increasing number of reports investigating various slow brain phenomena have appeared. The list of potentials studied is so long that, for practical purposes, sub-groups of slow activities need be identified. Unfortunately there is no general agreement as to the criteria to be used for categorizing slow brain activity and classification schema abound. According to Rebert (1976) slow activities can be categorized as follows:

1) On the basis of a functional characteristic (resting versus reactive potential changes)
2) In terms of the mechanisms of generation (neuronal, glial, vascular and others)
3) In terms of the functional significance (relationships between slow potential change and neuronal activity)

4) On the basis of the temporal characteristics (frequency; rhythmiticity; duration)
5) In terms of the general cerebral organization
6) In relation to specific neurochemical systems
7) In terms of different neuronal arrangements (cortical dipole versus reticular)
8) In relation to overt eliciting factors (sensory stimulation, reinforcement, alteration of general arousal level, induced tissue damage, etc.)

As can be seen from the previous list of relevant dimensions, most slow brain activity can probably best be categorized on multiple dimensions as none of the dimensions are mutually exclusive. Unfortunately the information necessary to categorize any one slow brain reponse on many of the relevant dimensions is rarely, if ever, present in even the most elaborate studies using both intracerebral and intracellular recording. This problem is of course even more serious in human studies employing DC scalp recording due to the lack of certainty in even identifying the source of the recorded potential as neural. Because of the present lack of relevant information the definitional terms that are commonly used in the literature for categorizing slow brain activity (steady potential level, steady potential shift, slow potential and infra slow potential) are necessarily somewhat less than precise. However, despite this imprecision these terms will be defined and adopted throughout this thesis because they do classify slow brain activity on several relevant dimensions and allow this data to be indirectly related to a great body of research obtained with intracerebral recordings from primarily infra-human species.

Literature Review

Steady Potential Level (SPL)

The steady potential level (SPL) of any neuronal mass refers to the relatively constant potential difference that can be observed between almost any two points within the neural aggregate. Although SPLs have been recorded from many cortical and subcortical sites (Avromov 1965, 1966; Kawamura and Sawyer 1964; Wurtz 1965, 1966), the term SPL usually refers particularly to the potential difference across the cortical surface as measured against the depth of the brain, the ventricles, a cut cortical surface or a location on the frontal bone. The SPL as thus defined has also at times been labelled the cortical "standing" or "resting" potential; but these more phenomenological labels have since fallen out of favor.

The existence of a cortical SPL was first reported by Caton (1875) and since that time it has been demonstrated that the surface of the mammalian cortex is approximately 15 millivolts (mV) positive with respect to cortical layers V - VI (Aldajova 1964) and 1 - 3 mV negative with respect to frontal bone (Fromm and Bond 1964). As can be seen from these two discrepant results the question of reference site is of crucial importance in determining absolute SPL values for either interindividual or interspecies comparisons. However, regardless of reference site the SPL as recorded with intracerebral electrodes has been shown not to vary by more than 500 microvolts or so in an hour (Goldring and O'Leary 1964).

Steady Potential Shifts

Although the SPL is correctly described as a non-rhythmic relatively constant millivolt level potential difference across the cortical surface, there are, nonetheless, microvolt level fluctuations in SPL which have been related to changes in metabolic state, arousal level, sensory stimulation, movement and information processing. These SPL changes have generally been labelled as steady or slow potential (SP) shifts (Rowland 1968). In the past these slow changes have also been called "baseline shifts" (Jasper 1936; Rowland and Goldstone 1962) due to the observation that the SPL is the baseline on which the spontaneous EEG "rides" (O'Leary and Goldring 1964) and therefore a change in SPL would be recorded as a change in baseline.

Two distinct classes of SP shifts can be identified empirically on the basis of their temporal and topographical characteristics. These two types of SP changes will be called "tonic" and "phasic" following Rebert's (1976) suggestion in his recent summary article. Tonic SP changes are those that occur over a relatively long period of time and seem to be somewhat uniform throughout the brain. In addition "tonic" SPs seem to be most clearly related to changes in the overall "state" of the organism and are most easily elicited by inducing gross structural or functional change in the neural tissue. "Tonic" SPs can be contrasted with "phasic" SPs in that the "phasic" SPs are of relatively short duration and usually show a topographical distribution. Additionally "phasic" SPs have been shown to be directly related to sensory input, motor output and the so-called "higher" psychological processes.

Tonic SPs

Most of the research on tonic SP fluctuations has investigated these slow non-rhythmic responses in relation to:

1) the sleep-wakefulness cycle, 2) the effect of various drugs, 3) changes in cerebral gas tensions and 4) induced tissue damage. Only the first two categories of research will be summarized here as both these areas of investigation have provided information relating "arousal" level to SPL in relatively intact organisms. The last two categories are more closely related to SPL change produced by functional or structural damage and, as such, are somewhat outside the focus of this thesis.

Numerous studies of SPL fluctuations during drowsiness, different stages of sleep, and abrupt or spontaneous arousal in both human and infra-human species have demonstrated a relatively high correlation between SPL change and level of arousal. There are of course exceptions to this general pattern of results. In fact, the first attempt at relating SPL to sleep stages (Davis et al. 1939a, b) was done with DC scalp recording from humans and met with little success. The authors reported that "no correlation could be detected between the stage of sleep and the DC potential differences or changes in DC potential observed between chest and head, scalp and mastoid, frontal and occipital regions, or right and left sides of the head." Despite this rather inauspicious start, later studies by

Caspers (1961b, 1963, 1965), Avramov (1965, 1966), Wurtz (1965), Tabushi et al. (1966), Starobinitz (1966, 1967), Marczynski et al. (1971) and others have demonstrated that the transition from wakefulness to slow wave sleep is accompanied by a marked change in SPL. Although most of these reports were based on data obtained from intra-cerebral recordings, it is of interest to note that the Starobinetz (1966, 1967) articles reported similar findings with data obtained from human scalp recordings.

In general the SPL changes with sleep onset have been reported as positive in polarity. However, Wurtz et al. (1964) and Wurtz (1965) found negative shifts produced under the same circumstances. This discrepancy is probably due to the choice of the reference site as the Wurtz studies employed an extracerebral reference whereas the others all used trans-cortical recording (Caspers 1974). During the transition from slow-wave sleep to "fast" or "rapid eye movement" (REM) sleep the SPL shifts in a direction opposite to the shift observed during the transition from wakefulness to sleep (Caspers 1961b, 1963; Kawamura and Sawyer 1964; Wurtz et al. 1964, 1967; Tabushi et al. 1966; Wurtz 1967). Therefore the majority of reports have described negative shifts during the onset of REM sleep. However Caspers (1963, 1965) reported a further shift in positivity with the onset of REM periods and unfortunately, this descrepancy cannot be ascribed to methodological differences. Arousal from sleep, regardless of whether it is sudden or gradual produces a negative SPL change of sufficient magnitude to restore the SPL to its pre-sleep level (Caspers and Schulze 1959; Caspers 1961b, 1963; Kawamura and Sawyer 1964; Tabushi et al. 1966). This shift is even more pronounced if movement occurs simultaneously with awakening.

In the awake animal increased activation has also been shown to be accompanied with surface-negative SPL shifts whose occurence often preceded the increased motor activity (Caspers 1961; Caspers and Schulze 1959). Furthermore electrical stimulation of the ascending reticular activating system (ARAS) which is effetive in producing electrographic and behavioural arousal also produces sustained negative SPL shifts (Arduini et al. 1956; Arduini 1958, 1961; Kanai and Katzman 1960).

In summary it appears that sufficient evidence has accumulated to maintain that increased cortical arousal, as indicated by changes in the spontaneous EEG, is related to the appearance of surface negative shifts in SPL. Conversely positive SPL fluctuations are associated with decreasing levels of arousal. The spatial dynamics of these changes are not so thoroughly documented; however, the majority of studies investigating topographical tonic SPL fluctuations have found a similar pattern throughout the brain (Wurtz 1965b, 1966b; Kawamura and Sawyer 1964; Kawamura and Pompuano 1969; Avramov 1965, 1966). These findings led Wurtz (1966b) to conclude that SPL changes observed with alterations of arousal level are due primarily to metabolic changes uniformly affecting the entire brain.

This conclusion is supported by the body of literature dealing with the relationship between SPL and the effect of various drugs. In general drugs that produce soporific and narcotic effects such as the barbiturates and other heterocyclic derivitives have been shown to produce positive SP shifts in both cortical and sub-cortical structures (Goldring et al. 1954a, b, 1959a; Tschirgi and Taylor 1958; Arduini 1962; Kawamura and Sawyer 1964; Starobinetz 1966, 1967; David et al. 1969). On the other hand central nervous system (CNS) stimulants such as strychnine, veratrine and caffeine have been shown to induce pronounced negative shifts (Libet and Gerard 1941; Goldring 1963). Additionally it has been demonstrated that adrenergic cortical activation produced a considerable negative SP shift (Vanasupa et al. 1959) whereas drugs that suppress adrenergic synaptic transmission (eg. chlorpromazine) induced surface positivity.

Phasic SPs

In addition to the relatively long lasting tonic changes in SPL due to alterations in the overall "state" of the organism, there have been countless descriptions of transient SPs that in general can be characterized as reflecting either stimulus registration or some type of information processing. Because of the short temporal duration of these reactive SPs they can generically be classified as "phasic."

The first report of phasic SP changes came from Caton's (1875) earliest recordings from exposed cortex which clearly showed negative current change in relation to the presentation of visual and auditory stimuli. Subsequent research has clearly confirmed this early report by demonstrating that "if DC recording is used, virtually every stimulus-bound cortical activity is seen to be accompanied by a change in cortical steady potential" (Caspers 1974). Unfortunately much of this work is difficult to integrate because the polarity and duration of stimulus-bound SPL changes vary with the recording technique, the kind of stimulation, kind and depth of anesthesia and state of alertness in unanesthetized preparations. Despite these many sources of extraneous variation there are several consistent findings that can be discussed. The first is that any external stimulation - visual, auditory, tactile or gustatory - produces a multitude of SP shifts in both cortical and subcortical structures (Rowland 1968; Goldring and O'Leary 1951a, b; Rebert 1973a). It has been shown that there are both "local" and "diffuse" SP changes reflecting respectively, the direct sensory registration and its consequences (general arousal, reinforcement, information processing). The "local" SP changes are recorded maximally from the area of cortical representation for the particular stimulus modality (Gumnit 1960, 1961; Lickey and Fox 1966; Caspers 1963; Kohler 1957) or from the appropriate thalamic nuclei (Vastola 1955; Rebert 1973a). These "local" SP changes have almost always been reported as negative in polarity. This pattern of results defines what Lickey and Fox (1966) call the "primary negative rule." Recordings from human subjects have generally provided confirming evidence. Kohler and Held (1949) and Kohler and Wegener (1955b) were the first to demonstrate SP changes to complex visual and auditory stimuli in intact humans. These authors maintained that the recorded SPs were the "isomorphic cortical representation of the percept." The polarity of these SP changes was first reported (1949) as positive but this finding was due to the use of the vertex as the reference. A later study (1955b) employing an active vertex electrode referred to the neck produced the expected surface negative SPs. More recently a study by David et al. (1969) demonstrated scalp recorded negative SP changes to tones and light of varying intensity and duration. They found that the duration of the negative shift was equal to the stimulus duration. Furthermore the recorded SPs to light were maximal at the occiput whereas the tone-induced SPs were maximal at the vertex. Keidel (1971a, b) argued that these SPs reflect "local" SP changes related to the stimulus properties. However, this conclusion was contested by Jarvilehto and Fruhstorfer (1973) who demonstrated that identical SPs were recorded to random 1 second tone bursts and to random 1 second "silent" periods set against an otherwise continuous tone background. These authors maintained that the SPs recorded in this situation were analagous to the contingent negative variation (CNV) described by Walter et al. (1964). An equally plausible explanation is that these SPs are the "diffuse" components of the stimulus-induced slow activity reflecting a more general process such as orientation or arousal.

One of the consistent results obtained in the human (Kohler and Wegener 1955), in the chronic implanted cat (Rowland and Goldstone 1963; Gumnit 1961), in the acute flaxedilized cat (Lichey and Fox 1966) and in the rat (Rowland 1968) is the fairly rapid decrease in SP amplitude due to simple repitition of the eliciting stimulus. This SP habituation effect is observed only with nonreinforcing stimuli (Rowland 1968). If reinforcing stimuli are used the SP amplitude and polarity is determined by the "drive state" of the organism (Rowland 1963, 1968; Rowland and Goldstone 1963). The reinforcing stimuli investigated in this series of studies were food, perineal stimulation in the estrous cat and rat, peripheral electric shock and both positively and negatively reinforcing hypothalamic stimulation.

Similar reinforcement effects were reported by Marczynski (1969, 1971a, 1976) in recording from implanted cats. These studies demonstrated a positive SP shift, the reward contingent positive variation (RCPV), accompanying reinforcement. RCPV was found to depend on the quality of reinforcement as the SP shift was greatly reduced when water was substituted for milk. Steinmetz and Rebert (1972) also observed SP shifts that varied with the quality of reward. These SPs were negative in polarity and observed in the frontal areas following consumption. No comparable SPs were observed at the subcortical electrodes. However, Irvin and Rebert (1970) reported SP changes to reinforcing stimuli from such widespread subcortical areas as the lateral hypothalamus, medial amygdala and midbrain reticular formation.

The first evidence that SPs could themselves be conditioned was provided by Morrell (1960). In this study an auditory signal was paired with low-frequency brain stimulation in a classical conditioning paradigm. After a number of trials the presentation of the previously ineffective auditory stimulus began to elicit SPs similar to those produced by the brain stimulation. Similar demonstrations of this same phenomena were provided by Rowland (1961, 1967, 1968) and Rowland and Goldstone (1963) who were able to demonstrate conditioned SPs by pairing "neutral" stimuli with reinforcing stimuli in a classical paradigm. These investigators found that after a number of pairings the presentation of the neutral stimulus began to elicit SPs resembling the shifts produced by the presentation of the reinforcing stimulus alone. These conditioned shifts developed more rapidly with electrical shock than with food as the reinforcer. Operant conditioning of SP responses has been demonstrated by Pirch and Osterholm (1974) in rats, by Rosen et al (1974) in monkeys and by Cohen (1974) in man.

SP shifts accompanying learning have primarily been studied during classical conditioning paradigms using shock as the unconditioned stimulus (UCS). Recent studies have demonstrated the appearance of a multitude of cortical and subcortical SP changes during conditioning in rabbits, cats, dogs, pigeons and monkeys (Chiorini 1969; Pinto-Hamuy et al. 1969; Pirch and Barnes 1972; Skinner 1971). It is difficult to make general statements about this data as these SPs display both spatial and temporal patterns that appear to be at least partly dependent upon the species and the particular paradigm employed. For example Chiorini (1969) observed negative SPs from the feline somatosensory and motor cortices that developed gradually over the conditioning trials and then diminished with both overtraining and extinction. On training trials the SP was largest over the cortex contralateral to the applied UCS. This lateralization was not observed during either pre-training habituation or extinction. Similar reports of negative SPs accompanying conditioning can be found for the rat (Pirch and Barnes 1972), pigeon (Durkovic and Cohen 1968) and cat (Skinner 1971). On the other hand Pinto-Hamuy _et al_. (1969) recorded positive SPs from both sensory and motor cortex in the rabbit. These SPs developed early in the training session and then subsided when the animals performance had stabilized. A mixture of positive and negative SP shifts was reported by Rebert and Irwin (1969) and Irwin and Rebert (1970) in studies investigating both classical appetitive and aversive conditioning in cats. These authors reported an interaction between type of conditioning, motivation level and the electrode location. In the earlier study (1969) negative SPs were not observed in the motor cortex during acquisition. However, in the second study (1970) it was demonstrated that, with the same paradigm cortical SPs could be recorded if extremely motivating stimuli were used. This influence of motivational factors was also observed for SP shifts recorded from the lateral hypothalamus, amygdala and reticular formation. Negative shifts were obtained from ventralis posteromedialis that increased over training sessions until the conditioned response (CR) stabilized, at which point the SPs began to decrease. These shifts were observed in both conditioning groups and did not appear to be influenced by the level of motivation. The further observation that the SPs accompanying aversive conditioning and the SPs accompanying appetitive conditioning had a different topographical distribution adds an additional level of complexity to an already complex question (Irwin and Rebert 1970). This data and reports by others (Skinner 1971; Borda 1970) suggests that there are a number of different SPs and, of course, an equal number of SP generators reflecting different aspects of the situation. The notion that there is a uniform SP correlate of conditioning is no longer tenable.

The Contingent Negative Variation (CNV)

The CNV is a particular type of phasic negative SP first observed by Walter et al. (1964) in scalp recording from humans. This SP was seen to develop in the interval between two stimuli (S1 and S2) as soon as the subject had formed an association between these two events. In this classic study the subjects were first presented with a random series of clicks (S1) and flashes (S2). The two stimuli were then paired repeatedly and then, finally, the stimuli were again paired and the subject was required to make a motor response to the onset of S2. This last condition, a fixed foreperiod reaction time task, is what has come to be called _the_ CNV paradigm. Walter _et al_. (1964) found that when S1 and S2 were presented separately the vertex recordings displayed only typical evoked potentials (EPs) to the occurence of each of the stimuli. Pairing of S1 and S2 resulted in minor immediate change to the EP components, although habituation by continuous repitition rapidly decreased the amplitude of the recorded potentials. The addition of the motor response requirement resulted in the development of a slow vertex-negative shift in the interstimulus interval that reached peak amplitude just prior to S2. This slow shift was labelled the CNV and was ascribed the function of "cortical primer;" preparing the subject for a quick and efficient response. Later Walter (1964b, 1968) believed the CNV to be the electrophysiological representation of a conditioned association between discrete events. Evidence to support this claim was provided by the demonstration that the complete withdrawal of S2 (extinction) resulted in a progressive and finally total decrement of CNV amplitude. In partial extinction, where S2 only followed S1 part of the time, the CNV amplitude was found to be directly related to the probability of S2's occurence (probability dilution). However, if the S1-S2 pairing was maintained, consistent CNVs could be recorded over an indefinite number of trials as long as the subject was attentive and responding (Walter 1964a). Data more consistent with the animal literature were obtained in a classical eyelid conditioning paradigm (Walter 1964a). In this situation no operant response was required and consequently the CNV reached maximum amplitude after about 20 trials and then declined rapidly. The decrease in CNV amplitude occured at approximately the same time that the response had become well established. After 60 trials very little negativity could be observed and the CR was appearing regularly.

Although the discrepant results for the classical and instrumental procedures were merely noted in this early report, subsequent investigations have extensively examined the role of the instrumental motor response in the CNV paradigm (see review by Tecce 1972). This concern was prompted in part by the nearly simultaneous discovery by Kornhuber and Deecke (1965) of the "Bereitschaftspotential" or readiness potential (RP), a surface negative slow potential observed prior to volitional movement. The RP data led some investigators to conclude that the CNV and RP were identical phenomena (Vaughan 1969). This assertion provided the "raison d'etre" for numerous studies demonstrating that the CNV could be obtained in situations that did not require an overt response (Cohen and Walter 1966; Cohen 1973; Donchin et al. 1972; Picton and Low 1971). The independence between the RP and the CNV were most clearly demonstrated when S2 was novel (Gullickson 1970), nociceptive (Irwin et al. 1966) or signaled the start of an arithmetic task (Donchin et al. 1972). Further evidence for the independence of CNV and RP came from observed amplitude and topographical differences (McCallum 1976) as well as from recent studies by Loveless and Sanford (1974a, b, 1975), Weerts and Lang (1973) and Klorman and Bensten (1975, 1976) showing biphasic CNVs with a long interstimulus interval (ISI) paradigm. These latter authors argue that the biphasic CNV recorded under these conditions demonstrates that the CNV recorded with the usual 1-1.5 second ISI is actually the summation of at least two different SPs, each of which can be experimentally manipulated independent of the other. The "early" SP is frontally dominant and appears to relate to orientation, as change in the S1 parameters can selectively influence this component. The "later" SP is centrally dominant, maximal at S2 onset and seems to primarily reflect preparation to respond (Weerts and Lang 1973). These findings of a non-unitary CNV rule out any simple equation of CNV and RP even though the "later" CNV component may reflect RP and CNV processes.

In addition to providing evidence that the CNV and RP are not identical phenomena, the previously cited body of data, which suggests that there is no unitary CNV, provides a *necessary* rationale for understanding and integrating many of the conflicting reports concerning the CNV and its relation to particular psychological "constructs". This necessity arose in the years subsequent to the classic study (Walter *et al*. 1964) as these researchers and others began intensive investigation into the psychological relevance of the CNV. According to Walter (1965a) and his co-workers in Bristol the CNV was primarily related to "expectancy" and, to a lesser degree, "attention" (McCallum 1968). Evidence to support Walter's assertion that the CNV was the cortical correlate of expectancy came both from the data showing decrements in CNV amplitude due to probability dilution and from the numerous studies indicating the seeming independence of the CNV from the particular stimuli used or response required. A contemporaneous series of studies by Low *et al*. (1965, 1966a, b) repeated and greatly extended much of Walter's early work. However, on the basis of their findings, these investigators concluded that the CNV was more directly related to "conation" - the intent to respond - than to expectancy *per se*. Another conflicting viewpoint was put forward by the Iowa group which maintained that "motivation," as defined in the Hullian framework, provides the psychological underpinnings for the CNV. In this view CNV amplitude is positively related to the motivation level of the subject in the particular situation. This theoretical formulation is able to account for much of the CNV data with one notable exception - the effects of distraction (Tecce 1972). It has been demonstrated by some investigators (McCallum 1967, 1969; Tecce and Scheff 1969; Tecce and Hamilton 1973) that distraction results in a decrement in the amplitude of the CNV which is somewhat independent of motivation (it should be noted that not all reports on the effect of distraction are in agreement; see Weinberg, Curry and Peters 1976). To account for the data on distraction Tecce (1970, 1971, 1976) and Tecce and Scheff (1969) proposed that the CNV is simultaneously related to both "attention" and "arousal" which are, it is argued, two separate albeit related constructs. According to this position the CNV is determined by the simultaneous interaction of arousal and attention processes. Attention is believed to be positively and monotonically related to CNV amplitude. On the other hand the relation between arousal level and the CNV is believed to be the familiar non-monotonic inverted-"U" (Tecce 1972) so that both extremely low and extremely high levels of arousal lead to CNV decrements. This point was further developed (Tecce and Cole 1976; Tecce _et al_. 1976) as the "distraction-arousal hypothesis." In this series of papers the authors argue that the decremental effect of distraction on the CNV is due to increased arousal levels.

As can be seen from this cursory review, the principal CNV researchers have attempted to demonstrate that the CNV is psychologically relevant by manipulation of variables known (or presumed) to produce changes in a particular psychological construct. If the CNV also varies with these manipulations ir is asserted that the CNV is related to, or is a reflection of, this particular construct. It is apparent that there are several problems with this approach. The first problem concerns the lack of precision in the definition and elaboration of terms such as "expectancy," "conation," "motivation" and "arousal." A second and related problem is that the constructs themselves are not even independent, let alone mutually exclusive. In any one behavioural situation an individual will be simultaneously expectant, conative, motivated, attentive and aroused to varying degrees. If the experimental manipulations are designed to increase something called "arousal," there will undoubtably be simultaneous alterations in for example, motivational and attentional levels. A third and even more serious problem is the recent evidence provided by Loveless and Sanford (1975) and others as to the non-unitary nature of the CNV. In addition to the previously discussed data obtained with long ISI paradigms (Loveless and Sanford 1974a, b; Weerts and Lang 1973; Klorman and Bensten 1975, 1976), other investigators have come to the same conclusion by examining the topography of the CNV (Weinberg and Papakostopoulos 1975; Cant and Bickford 1967). Additional support for the non-unitary nature of the CNV comes from intracerebral recordings in both human and infra-human species during CNV tasks.

Basically the intracerebral recordings provide four relatively consistent sets of findings to support the non-unitary CNV model. One interesting finding reported by several investigators is that there are changes in the distribution of the CNV as a function of task acquisition. Rebert (1972c) observed conditioned SPs in the reticular system 2 to 3 days prior to their appearance at the cortical surface. Hablitz (1973) employed 2-week training blocks and observed larger shifts more centrally than frontally during the first block of trials. However, by the third block this relationship had reversed so that larger shifts were recorded frontally.

multiple cortical recordings have demonstrated that there are at least two generators of the CNV. Large frontal as well as central CNVs have been reported in monkeys by Low (1969), Borda (1970), Donchin et al. (1971), McSherry and Borda (1973) and Hablitz (1973). Additionally the form and distribution of the CNV has been shown to be influenced by the task requirements. In monkeys Donchin et al. (1971) reported that during a standard CNV paradigm there was little evidence of SPs post-centrally as the distribution was frontally dominant. However, by requiring the monkey to make a motor response to S1, a large shift appeared at the post-central electrode and simultaneously the frontal CNV was reduced. Lastly, evidence has accumulated demonstrating both a dissociation between SPs recorded at cortical and subcortical sites and the multiplicity of subcortical shifts occuring concurrently (Haider 1968; Rebert 1972c, 1976; McCallum et al. 1973, 1976).

Taken as a whole these reports provide compelling evidence that there is no such entity as the CNV. Instead there appears to be a number of different SPs that either separately or in combination can be recorded in particular experimental situations. At least several of these SPs appear to be differently affected by various psychological processes so that the search for the psychological correlate of the CNV is probably fruitless.

Infra Slow Potential Oscillations

A separate class of slow brain activity has been described by Aladjalova (1964), Norton and Jewett (1965), Sano (1967) and others. These investigators have reported rhythmic slow oscillations ranging from 15 to .5 or less cycles per minute. These infra slow potential oscillations (ISPO) have been recorded from both human and infra-human species. Aladjalova (1964) and Sano (1967) both report ISPO obtained from humans that did not seem to relate to any observed physiological or psychological variable. However, Girton et al. (1973) report ISPO recorded from the human scalp that appeared to be related to respiration even though the oscillations continued during prolonged breath-holding. In recordings from implanted animals Aladjalova (1964) observed changes in ISPO that seemed to be related to the induction of stress although the latency of these changes, up to an hour or more, casts doubt on the nature of the relationship between the stimulation and ISPO. In addition, other investigations (Norton and Jewett 1965; Pirch and Norton 1967; Ramos and Rosenbleuth 1967) have reported ISPO in animals not specifically stressed. At present it seems clear that the physiological and/or psychological significance of these very slow oscillations has yet to be delineated.

Some Interelationships Between SPL, SPs, EPs and the EEG.

One of the first reports of brain electrical activity included the observation that the slow stimulus-induced negative shifts were always accompanied by a decrease in the "feebler" rhythmic currents (Beck 1891). This observation was nothing less than the first report of alpha blocking (EEG desynchronization) occuring simultaneously with surface negativity (Brazier 1961). Half a century later, Jasper (1936) became the first to explicitly hypothesize and demonstrate that negative SPL shifts are related to increased cortical excitability and as such should be related to low voltage fast activity in the EEG. Since that time there have been numerous observations of the relationship between SPL and the EEG. Probably the most thoroughly documented studies are those that have examined SPL fluctuations during the sleep-wakefulness cycle (see section on tonic SPs). In general it has been demonstrated that increased excitability (EEG desynchronization) is associated with surface negativity whereas high voltage slow activity is accompanied with surface positivity. Changes in the spectral composition of the EEG relative to phasic SP changes have been reported by Rowland and Goldstone (1963), McCallum and Walters (1968b), Peters (1976) and others. Basically these researchers have also found the same relationship between increased negativity and fast activity although there is some evidence (Rowland 1968; Peters 1976) that the changes in SP and EEG are not causally related as they can at times be dissociated.

In addition to the evidence just presented to demonstrate that the EEG and SPL are related, there is a comparable body of literature detailing the relationship between SPL and evoked potentials (EPs) recorded from the cortical surface (Bindman et al. 1962; Bishop and O'Leary 1950; Lippold et al. 1961; Goldring and O'Leary 1951; Fromm and Bond 1967). Quoting from Bindman et al. (1962):

> It has been demonstrated that the form, size and polarity of evoked responses are related to the pre-existing surface potential of the cortex. This seems to be true whether the changes in potential are spontaneous or produced experimentally. When the

> cortical surface of the brain goes positive the evoked potential becomes larger; if negative smaller. Specifically, if a relatively strong surface positive polarity is applied across the cortex and the amplitude of the EEG waves increase, the initial positive component of the visual evoked response dissapears, the negative component increases in size and the number of single cell discharges increase. The opposite effects are produced by surface negative polarization.

This finding of a reciprocal relationship between the polarity of the SPL fluctuations and the augmentation of particular EP components has been supported by numerous investigations manipulating SPL by such various means as applied polarization, anoxia, drugs and induced metabolic disturbances.

Further evidence that SPL changes can influence the amplitude of EP components has been provided by studies investigating the EPs to either S2 or an additional stimulus introduced into the ISI of the CNV paradigm. The relationship between the amplitude of the CNV and the EP to S2 was initially reported as inverse by Walter (1964a, b, 1966a). Several subsequent studies found either no relationship (Small and Small 1970) or a positive one (Cohen and Walter 1966). However, Smith (1976) systematically compared EPs to identical stimuli in both CNV (S2) and non-CNV situations and reported greater positivity, less negativity and shorter latency in the CNV situation. EPs to stimuli interjected into the ISI of the CNV task were found to be of larger amplitude and shorter latency than EPs to identical stimuli presented in the inter-trial interval (McAdam 1969; Timsit et al. 1969). These findings have been interpreted as evidence to support Walter's (1964a) notion that the CNV functions as a "cortical primer."

Although the data relating SPL to the EEG and the EP are not totally coherent, there are nonetheless certain consistencies worth summarizing. Surface negative SPL change has generally been related to low voltage fast activity, augmentation of the positive EP components, attenuation of the negative EP components and a decrease in the latency of all components. On the other hand surface positivity has been associated with EEG synchronization, augmentation of the negative and attenuation of the positive EP components. The data obtained from EPs collected during various sleep stages demonstrate that the latency of most components increases as a function of the level of sleep (Shagass and Trusty 1966; Shagass 1972). This provides indirect evidence that surface positivity is associated with increased latency since positive SPs are known to occur during sleep (see section on tonic SPs).

In striking contrast to the numerous attempts at relating SPL to both the EEG and the EP, there have been very few investigations concerning the relationships between various SP types. Despite this lack of data a theoretical relationship between the CNV and SPL has been postulated by Knott and Irwin (1967, 1968) to account for some seemingly anomalous CNV findings. In these studies and others (Low and Swift 1971; Knott and Peters 1974; Peters and Knott 1976) it was demonstrated that low anxiety subjects produced larger amplitude CNVs than did high anxiety subjects in a stressful situation whereas there were no differences in a low stress situation. "This was interpreted to be due to the fact that high anxiety subjects operated nearer to their maximum negative cortical level in all situations and that when they are stressed (and develop a diffuse conditioned emotional response) the shift goes to or nearly to the maximum. When the "response" condition (CNV) is added no further shift can be developed" (Knott 1972). This interpretation has been labelled the "ceiling hypothesis" in that the SPL is assumed to have a finite range and as the SPL approaches its point of greatest negativity, "the ceiling," any further negative shift will necessarily be reduced or eliminated. Indirect evidence concerning the validity of the ceiling hypothesis is rather sketchy. Low (1969) observed that in some cases the CNVs appeared to be larger if the pre-S1 baseline had shifted positively. Additionally Rebert (1976) reported the observation that in one monkey a 2 - 3 mV negative SPL fluctuation occurred spontaneously during a CNV paradigm and completely abolished the CNV for its duration. However, it has also been demonstrated that the CNV does not necessarily peak at its physiological limit as additional manipulations can result in greater negativity. Low and McSherry (1968) superimposed an additional CNV task between the S1-S2 interval and reported a further elevation of the CNV indicating that the two responses were somewhat additive. Further supporting evidence has been provided by Rebert et al. (1976) who were able to induce tonic SP changes during a CNV paradigm by having the subject lift weights with a hand grip. There appeared to be a positive relationship between the amount of weight pulled and the amplitude of the tonic negative SP, at least up to some limit (approximately 30 pounds of pull). CNV amplitude was shown to be related to the amount of exertion in that there was a 5 microvolt increase between 15 and 30 pounds of pull. However, there was no difference between either 0 and 15 or between 30 and 45 pounds of pull. These findings are interpreted as evidence for the independence of the CNV and the tonic SP since the CNV could still be superimposed upon the tonic shift even after it had approached its asymptote.

Taken as whole these few scattered observations provide conflicting hints as to the nature of the relationship between SPL and the CNV. This conflict merely points to the need for extensive and detailed investigation correlating SPL fluctuations with CNV amplitude. The research described in this thesis is one attempt.

Experimental Rationale and Hypotheses

The research presented in this thesis was designed to answer a number of questions about the inter-relationships between different types of recorded brain activity. The primary question concerned the relationship between scalp-recorded SPL and the CNV. One of the major difficulties in a study of this nature is that SPL recording requires DC methodology for accurate amplification of the extremely slow changes. DC recording in general is much more prone to artifact because of the vast number of possible sources for any observed steady potential (see Rowland 1974). DC scalp recording further compounds the problem immensely due to the remoteness of the electrodes from the desired source. Additionally the tissues separating the electrode from the cortex are all known to themselves produce bioelectric slow activity. Because of the multitude of potential problems with DC recording, the first and most extensive part of this project was dedicated to developing a DC recording system and technique capable of faithfully recording microvolt-level SPL fluctuations. This recording system is described in detail in the methods section. The special technique and procedures used for this DC recording were designed to minimize contamination of the SPL by the more obvious artifactual sources - the electrodes (Cooper 1969) and the skin (Picton and Hillyard 1972). The procedures utilized for electrode and skin preparation are also described in the methods section. Although it is impossible to assess the effects of electrode changes on the SPL, it is possible to indirectly examine the skin potential contribution by monitoring SPL and skin potential activity simultaneously. In order to examine the relationship between SPL and the galvanic skin potential (GSP) and to assess the efficacy of the skin preparations, 2 channels of GSP were recorded from differently prepared electrodes adjacent to the vertex SPL electrode. The reference for the GSP electrodes was an electrode placed either on the ear lobe or over the mastoid processes. The reference site and one of the GSP electrodes were prepared in the same fashion as the SPL electrodes with thorough lesioning of the outer layers of the skin. The activity recorded between these two sites was expected to be very similar to the activity on the SPL channel as no GSP should be recorded with both electrode sites lesioned. The second electrode was applied to the intact skin so whatever GSP activity was present on the superior surface of the scalp would be recorded. It was expected that correlations between the SPL and the GSP recorded from the lesioned site would be much higher than those obtained between SPL and the GSP recorded from the intact scalp.

The paradigm chosen for this investigation of the relationship between SPL and the CNV was an auditory discrimination task with three conditions presented in an A1-B-A2 sequence. The only substantive difference between the A and the B conditions was that during the B condition incorrect or delayed response was "punished" with a 1 second blast of 95 db white noise. This paradigm was chosen because of its similarity to the situations used by Knott and Irwin (1967, 1968), Peters and Knott (1976) and Knott and Peters (1973) to demonstrate the attenuating effects of "stress" on the CNV. The "stress" effect is hypothesized to result from increased arousal manifested as a sustained negative SPL shift. If the tonic negative SP is sufficiently large, it will increment the SPL towards the "ceiling" so that the range of further negativity becomes restricted. Therefore as the "ceiling" is approached the maximum possible amplitude of any superimposed negative shift becomes reduced. This reduction in CNV amplitude has been reported as more pronounced in females (Knott and Peters 1973) suggesting a more negative tonic SPL for females.

The specific hypotheses to be examined in this thesis are:

1) the relationship between SPL and CNV amplitude within any one subject will be inverse so that negative SPL changes will be associated with decreased CNV amplitude.

2) Within any one subject an inverse relationship will be found for the amplitude of the N1 component of the EP to S1 and SPL such that negative SPL changes will be associated with decreased N1 amplitude.

3) Within any one subject the amplitudes of the P2 and P3 components of the EP to S1 will be correlated with SPL such that negative SPL changes will be associated with

increased amplitudes of the positive components.

4) Within any one subject the amplitude of the N1 component of the EP to S1 will be related to CNV amplitude such that increased CNV amplitude will be related to increased N1 amplitude.

5) Within any one subject the amplitude of the P2 and P3 components of the EP to S1 will be correlated such that large CNVs will be associated with decreased P2 and P3 amplitudes.

6) Within any one subject the amplitude of the N1 component of the EP to S1 will be related to the P2 and P3 components such that increased N1 amplitude will be related to decreased P2 and P3 amplitudes.

7) Within any one subject the P2 and P3 components of the EP to S1 will be related such that large P2 amplitudes will be associated with large P3 amplitudes.

8) Within any one subject and across all subjects the CNV amplitude will be related to condition differences; specifically the CNV will be attenuated during the B or stressful condition.

9) The condition effect will be confounded with a significant sex (X) condition interaction such that the females will show greater CNV decrement during the B

condition.

10) There will be a significant electrode effect confirming the known topographical distribution of the CNV, N1, P2 and P3.

11) The intensity of the tone used as S1 will not influence CNV amplitude.

12) The intensity of the tone used as S1 will influence the amplitude of the EP components N1 and P2.

METHODS

Subjects

The subjects were seven male and eleven female asymptomatic paid volunteers ($2.50/hour) recruited from the university community. The subjects were right-handed and ranged in age from 18 to 29 years. All subjects but one (DC1) were naive with respect to the experimental procedures and protocol and all subjects were naive with respect to the particular hypothesis under investigation. An additional three subjects (males) were run but their data was discarded due to excessive artifact in the recordings.

Recording Techniques

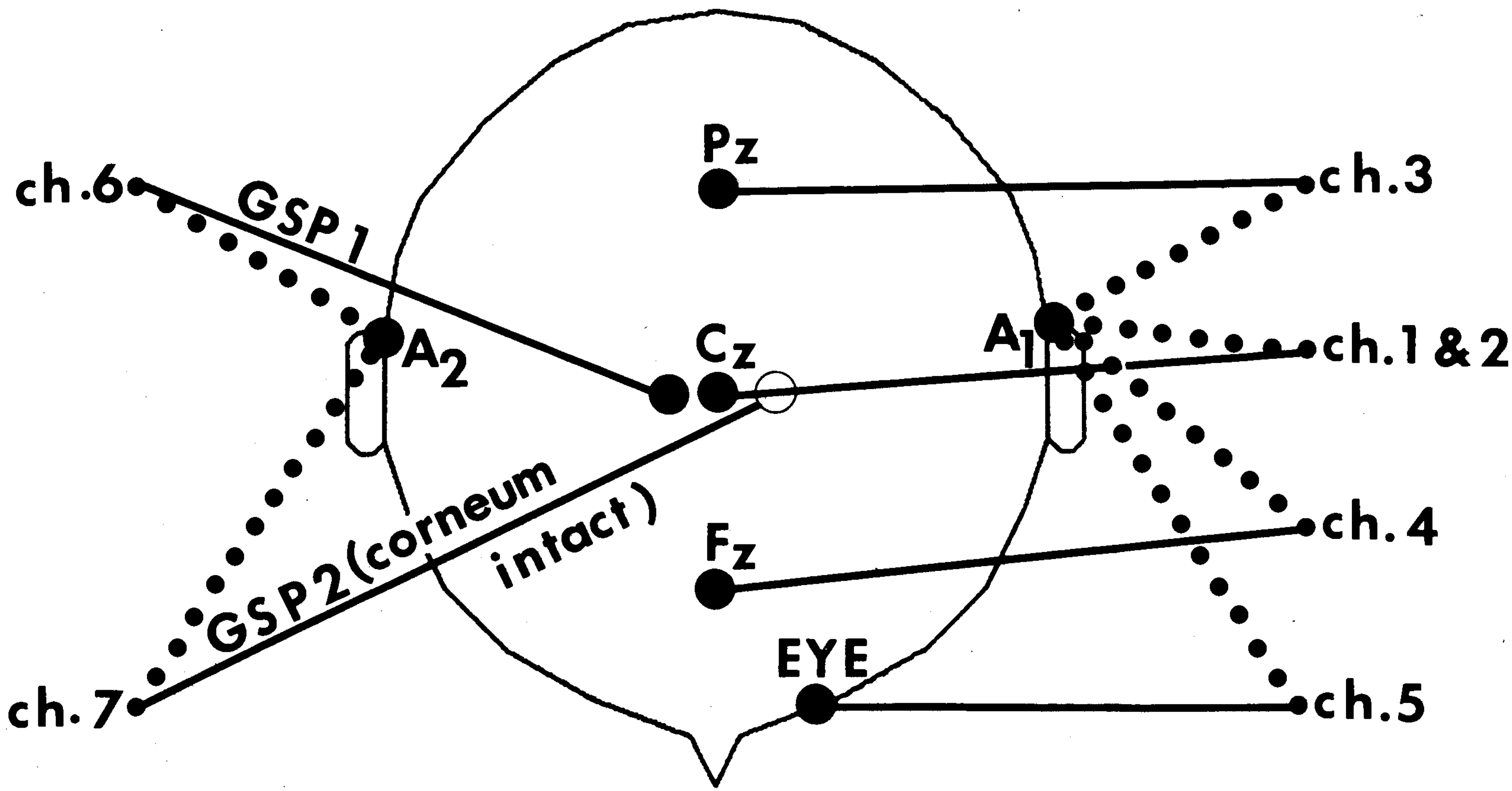
Steady Potential Level

Steady Potential Level (SPL) was recorded between selected pairs of Beckman Biopotential electrodes affixed to the vertex (Cz; Jasper, 1958) and either the left mastoid process or ear lobe with collodian soaked gauze patches (see Figure 1). Both reference sites were used to examine differential susceptibility to GSP artifact.

Figure 1

Recording Montage

RECORDING MONTAGE



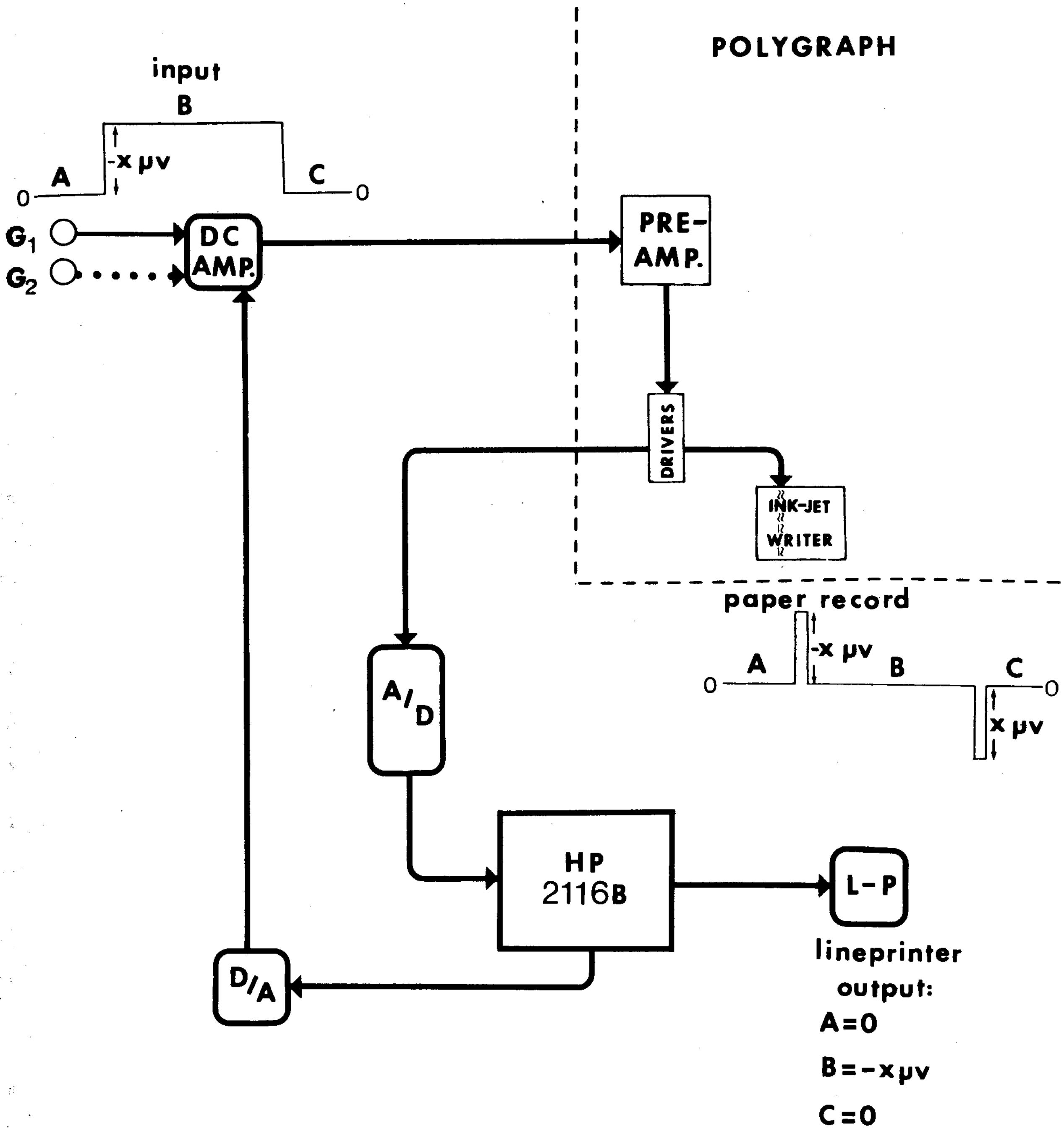
The two SPL electrode sites were first cleaned with rubbing alcohol and then thoroughly abraded with Redux. After a second cleaning with alcohol the sites were then lightly perforated with a sterile 30 gauge hypodermic needle (Picton and Hillyard, 1972; Marsh, personal communication, 1976) to insure lesioning of the outer skin layers. Finally a small amount of the electrolyte, EKG Sol (Burton, Parsons and Co, Inc.), was rubbed into the electrode sites just prior to electrode application. Interelectrode impedences for the SPL electrodes were always 1 K ohm or less as measured with a Grass EZM-1 Impedence Meter.

The DC recording system designed to monitor SPL included an eight-channel Elma-Schonander EMT 12-B and Mingograph 800 combination physiological recorder (Siemens), a separate true DC offsetable amplifier (built around a Burr-Brown Model 3620 K differential instrumentation amplifier), a Hewlett-Packard (HP) 2116 B computer with both analog-to-digital (A/D) and digital-to-analog (D/A) converters and the supporting software (DC00). A block diagram of this system can be found in figure 2.

Figure 2

Block Diagram of the DC

Recording System


POLYGRAPH
input
B
A
-x μv
C
0
0
G1
G2
DC AMP.
PRE-AMP.
DRIVERS
INK-JET WRITER
paper record
A
-x μv
B
C
0
0
x μv
A/D
HP 2116B
L-P
D/A
lineprinter output:
A=0
B=-xμv
C=0

The overall purpose of the recording system was to provide continuous, accurate microvolt level measurement of SPL changes by minimizing the influence of the recording system on the preparation. This was accomplished with a DC amplifier designed such that offset control was provided by summing a voltage into the final stages of the DC amplifier. This is in contrast to most DC recording systems that maintain offset control by "bucking" a voltage across the input signal and shifting the DC level at this point. The problem with systems of this sort is that the "bucking voltage" polarizes the electrodes producing a situation in which, at least temporarily, current will flow more readily in one direction than in the other. Even the best so-called reversible or "non-polarizable" electrodes behave differently (and rather unpredictably) when a DC voltage is passed between electrode pairs. As the electrodes polarize it therefore becomes impossible to separate true SPL fluctuations from polarization induced changes. To minimize this sort of artifact the system described here maintains offset control by influencing the final amplifier stage in such a way that no offset is reflected back to the signal source. For reasons of accuracy and convenience, this offset control, as well as the SPL measurement procedure, was put under automatic computer control.

Prior to each data collection session the DC recording system was calibrated as part of program initialization by requiring that sequentially a "baseline" or "zero" point and then a specified calibrated voltage be input to the A/D converter. With these levels specified, the computer could measure SPL fluctuations relative to this baseline level and convert these changes to microvolts. Because the initial calibration was made with the amplifier input shorted to ground, provision was made for offseting any standing potential between the SPL electrodes once the S was in place by manually biasing the Schonander pre-amplifier circuitry in such a way that once again no offset was reflected back to the signal source. Once the standing potential had been offset and thus the pen recentered, the program was ready to measure SPL changes relative to that "zero" point.

The specially prepared SPL electrodes were connected directly to the DC amplifier which had an input impedence of 150 megohms and provided 10 X amplification. The output of this DC amplifier went to one channel of the Schonander which was set to pass DC to 30 Hz (3 db point) with a sensitivity of

500 microvolts/cm per deflection. Since the DC amplifier had already boosted the signal by a factor of 10 the actual overall sensitivity of the system was 50 microvolts/cm, which was equivalent to the sensitivity of the EEG and EOG channels.

The fully amplified signal from the Schonander was input to the A/D converter of the HP and sampled at a rate of 5/second. The A/D output was continually compared with the "zero" level and any deviations from zero were calculated and converted to microvolts. The continuously calculated SPL was displayed on an oscilloscope in the lab. Any deviations from zero were automatically offset by the D/A converter which, under program direction, biased the final stage of the DC amplifier keeping the pen centered. This was also done at a rate of 5 times per second, alternating with the A/D sampling. The sequence of events was that the A/D would sample the record, the HP would calculate SPL relative to zero point and then the D/A would apply a voltage proportional and opposite in polarity to the SPL change to the amplifier, returning the pen to center (see figure 2).

The net result was a negative feedback loop such that the amount of offset was always directly proportional to the SPL and opposite in sign. The total amount of offset applied was continually readjusted in core by incrementing the "zero" point. Therefore at any one time point the SPL was calculated by adding the sampled A/D voltage (range +/- 75 microvolts) to the stored zero level (range +/- 9.5 microvolts). At the next sample point the previous SPL value would become the zero value and the new SPL would then be calculated by adding the most recently sampled A/D value to that "zero" point. Hard copy lineprinter output of SPL was provided every 2 seconds providing a running record of SPL over time.

EEG and EOG Recording Techniques

Brain electrical activity (EEG) was recorded from Beckman Biopotential electrodes affixed to the scalp with collodion soaked gauze patches at the vertex(Cz), a midline frontal (Fz) and a midline parietal (Pz) site (Jasper, 1958). Eye movements (EOG) were recorded with a Biopotential electrode secured with a double adhesive collar on the infra-orbital ridge of the left eye (see figure 1). These electrodes were referenced to another Beckman Biopotential electrode placed either on the left ear lobe or over the left mastoid. All electrode sites were thoroughly abraded with Redux prior to electrode application. Since the vertex and reference electrodes for the EEG were the same as for the SPL recording, the elaborate electrode preparation for these two sites are documented in the SPL recording section. Interelectrode impedences of the scalp electrodes never exceeded 2 K ohms and the EOG electrode impedence never exceeded 5 K ohms (Grass EZM-1).

The EEG and EOG activity was recorded on an 8-channel Elema-Schonander EMT 12-B and Mingograph 800 combination polygraph with a sensitivity of 50 microvolts/cm. A 70 Hz high frequency filter (3 db point) and a 5 second time constant were used for all EEG and EOG channels.

GSP Recording Techniques

Beckman biopotential electrodes secured with collodion impregnated gauze patches were used to record cephalic galvanic skin potential (GSP) from two differently prepared electrode sites located 2 cm to either side of the vertex (Cz) on the interaural line (see figure 1). One scalp site and the reference site either on the right ear or over the right mastoid process were prepared in the same manner as the SPL electrodes with thorough scalp cleaning and lesioning of the skin (see SPL section for details). The other GSP site preparation consisted of merely a gentle skin cleaning with rubbing alcohol to remove surface oil. Caution was exercised to avoid abrading this site with the cotton used for cleaning.

Interelectrode impedence for the abraded pair (GSP1) never exceeded 1 K ohm. For the unabraded electrode connected to the lesioned reference (GSP2) the impedence ranged between 8 and 20 K ohms (Grass EZM-1).

GSP activity was recorded on a DC system similar to the one designed for SPL recording. The major difference between these systems was that the SPL system was operated under direct computer control. The GSP recording systems, on the other hand, were under manual control. The two GSP amplifiers were constructed around OP-10 and OP-1 instrumentation operational amplifiers (Precision Monolithics) and had an input impedance of 100 Giga ohms. The gain of these amplifiers was set for unity with a bandpass of DC to 100 Hz (3 db point). Manual DC offset control was exercised by turning a 8-turn potentiometer that varied a voltage that was applied to the final amplifier stage (+/- 999 microvolts). These offset values reflected "true" voltage in that "0" was the ground or isopotential point.

The output from each of the GSP amplifiers was input to the Schonander-Mingograph polygraph with the preamplifiers set at 500 microvolts/cm sensitivity and the filter set to pass from DC to 30 Hz (3 db point). All offset values were recorded on the paper record for later analysis.

Event Marking

A 4-channel encoding/decoding device was used to code timing and stimulus events on th paper record and FM tape. This device connected a Grason-Stadler programming rack with one channel of the Schonander recorder. The preamplifier for that channel was set to record from DC to 700 Hz with a sensitivity of 1 millivolt/cm. Logic level flucuations from the programming rack corresponding to the occurence of each of the stimuli presented (S1, S2, feedback) as well as to a time point 750 msec prior to S1 each triggered one channel of the encoder. Each of these input signals output a pulse of particular amplitude to the polygraph and FM tape recorder. On tape playback into the decorder section each of the recorded voltage levels produced a pulse that could be used to synchronize computer sampling,etc.

On-Line Data Storage

Output signals from the Schonander-Mingograph recorder were stored on a PI 6200 FM tape recorder for subsequent off-line analysis on a PDP-12 computer (Digital Equipment Corporation). Prior to each data collection session a series of calibration pulses from a Grass SWC 1B calibrator were stored on the FM tape. For the EEG and EOG channels the calibrated pulses were -20 microvolts and for the two GSP channels the pulses were -200 microvolts.

Stimuli

Presentation and timing of all stimuli were controlled by a Grason Stadler Series 1200 programmable logic rack. The series of variable intensity 1000 Hz tones used as S1 and S2 were produced by a Marconi AF Oscillator, the output of which was amplified by one channel of a Monarch (Model SA-616) stereo amplifier. The amplifier output was gated through a programmable attenuator (Grason Stadler Model 1284) to a loudspeaker placed under the S's bed. This system produced 7 tones ranging from 48 to 90 db that could be selected in any order for presentation (see Appendix A for the specification and sequencing of tone stimuli). Whichever tone was selected for S1 was presented for 150 milliseconds and was followed 1.5 seconds later by the imperative stimulus, S2. Since S2 required a button press to terminate the tone, S2 duration was equal to either the S's reaction time (RT) or 1 second, whichever was the shorter.

Reaction time was recorded to the nearest millisecond by using an EAI 6200 counter driven by a Grass S-4 stimulator at a frequency of 1 K Hz. Since S2 onset gated the stimulator on and the S's response turned it off, the counter thus displayed reaction time in milliseconds.

In the "B" or stressful condition, performance feedback was provided to the S by presenting negative reinforcement for incorrect or delayed choice (Ss were to respond within 500 milliseconds of S2 onset). The feedback consisted of a 1 second presentation of 95 db white noise (Grason Stadler Model 1285) which had a center frequency of 1 K Hz.

Procedure

During data collection the S reclined on an adjustable hospital bed within an electrically shielded, sound-attenuated chamber (Bell-Croft Industries). The chamber was illuminated just sufficiently to permit closed-circuit video viewing. Immediately after the S was positioned comfortably he was instructed to close his eyes and relax while the recording systems were connected and calibrated. This relaxation period lasted for a sufficient amount of time to insure that at least 45 minutes had elapsed since the application of the SPL electrodes allowing the electrpde-electrolyte-skin interfaces to stabilize. At the end of this period the S was asked to open his eyes and was given the following set of instructions:

> The task that you are to do today is a simple auditory loudness discrimination. You will be presented with pairs of tones occassionally and you merely have to decide whether the two tones are the same or different loudness. You are to indicate your decision by pressing the appropriate button. This black button is for your right hand and this is to be pressed if the tones are the same. This red button is for your left hand and is to be pressed if the tones are of different loudness. The sequence of events is that one tone will be presented for a short period of time; this tone will then go off and sometime later a second tone will be presented. As soon

as you hear the second tone I want you to decide whether it is of the same or different loudness than the first and to press the appropriate button as quickly as possible. If you respond quickly you can obtain some feedback as to your performance because the correct button response will terminate the tone. The incorrect one will not. However the second tone will be presented for only a short period of time so it is important that you respond quickly to obtain feedback. Do you have any questions?

After responding to any questions the S might have had, the experimenter presented the pushbuttons to the S and instructed him about minimizing eye blink and body movements. To reduce eye movements a fixation point was provided and S's were asked to attempt to maintain fixation. The S was told at this time that there would be several separate data collection sessions interspersed with rest periods so that any one period of continuous ocular fixation would not be too prolonged. The S was also instructed in the use of an intercom and was informed that the experimenter would use the intercom to announce the beginning and end of data sessions.

After insuring that the S understood the instructions and was as relaxed as possible, the experimenter returned to the lab area and started data collection. Each S was presented with an identical experimental session consisting of three conditions run in an "A1-B-A2" order of presentation. The two "A" conditions were identical except for the sequencing of tone pairs. The "B" condition differed from the "A" conditions in tone sequencing and, more importantly, in that negative reinforcement was administered for incorrect or delayed response. The aversive stimulus was a 1 second burst of 95 db white noise.

In each of the three conditions there were 50 discrimination trials presented with the inter-trial interval varying between 2 and 20 seconds. The sequence of tone stimuli pairs (S1-S2) for each condition can be found in Appendix A. In order to insure the "difficulty" of the task, in each condition 8 trials of identical tone pairs were programmed to require a button response indicating that they were "different" in order to be scored as correct. In Appendix A these are the tone pairs marked with an asterisk.

At the end of both the A1 and B conditions a 10 minute rest period was instituted. The S was asked to close his eyes and relax. At the end of the rest break the S was instructed to open his eyes and appropriate instructions for the next condition were given. Preceding the B condition the S was told:

> This signals the end of your rest period. For the next session we are going to continue with the same discrimination task. However, this time you will receive some additional feedback as to how well you are doing. If you respond incorrectly or too slowly - that is, if it takes you longer than half a second to make your response - you will receive a 1 second blast of white noise indicating that you could be doing better - so I want you to respond as quickly and accurately as possible to avoid hearing the white noise. Okay?

Preceding the A2 conditions the instructions were:

> Its time to go back to work. This time we will continue with the discrimination task but there will be no white noise presented for errors - so this condition is the same as the first. Okay?

At the completion of the data collection the Ss were thoroughly debriefed as to the nature and purpose of the deception.

Off-Line Data Treatment and Storage

For each S the EEG, EOG and GSP data along with the calibration and timing pulses that had been stored on FM tape were played into a PDP-12 computer for off-line data collection. Each channel of recorded data was input directly into one of the PDP-12's A/D converters. In addition the vertex (Cz) EEG data was low-pass filtered at 5 Hz (Krohn-Hite Filter Model 3323) and input to another one of the A/D converters.

The data sampling was done by a program (Dump A/D, written by M.J.Falconer for J.F.Peters) that allowed the user to input an accept/reject trial table so data previously identified as contaminated with artifact could be skipped. Therefore all paper records were scanned prior to data storage and any trials showing excessive EOG activity or any other sign of artifact were eliminated from the analysis. The PI tape channel containing the encoded event pulses was input to the decoder so that the recorded pulse that occurred 750 msec prior to S1 could be sensed and used to trigger a pulse of sufficient magnitude to initiate computer sampling. The sample epoch was 3 seconds over 256 points per channel. All sampled single trial data were written on digital magnetic tape for permanent storage. For each S averages were constructed of all trials in each condition, in each quarter of each condition (condition subset) and for each of the tones used as S1. In all a total of 22 averages were formed for each of the data channels for each individual S.

Data Quantification

SPL values for each trial were obtained from the lineprinter listing produced by the on-line DC recording system. Every 2 seconds the program output the current SPL value to the printer with the time of the sample indicated. The Mingograph paper record was marked at the start of the DC sampling program and all trial times were calculated relative to that point. For each trial the time of occurence was checked against the SPL lineprinter log and the three SPL values preceding each trial (covering 6 - 8 seconds) were averaged to obtain a representative SPL measure.

Single trial cephalic skin potential levels (GSP) were quantified by obtaining the mean amplitude of the activity over the 750 msec pre-S1 interval for both the abraded and intact recording sites. For each trial this value was added to the amount of amplifier offset that had been required to zero the recording system. The offset values were obtained from the paper record as the initial offset value and any subsequent correction had been manually recorded during data collection.

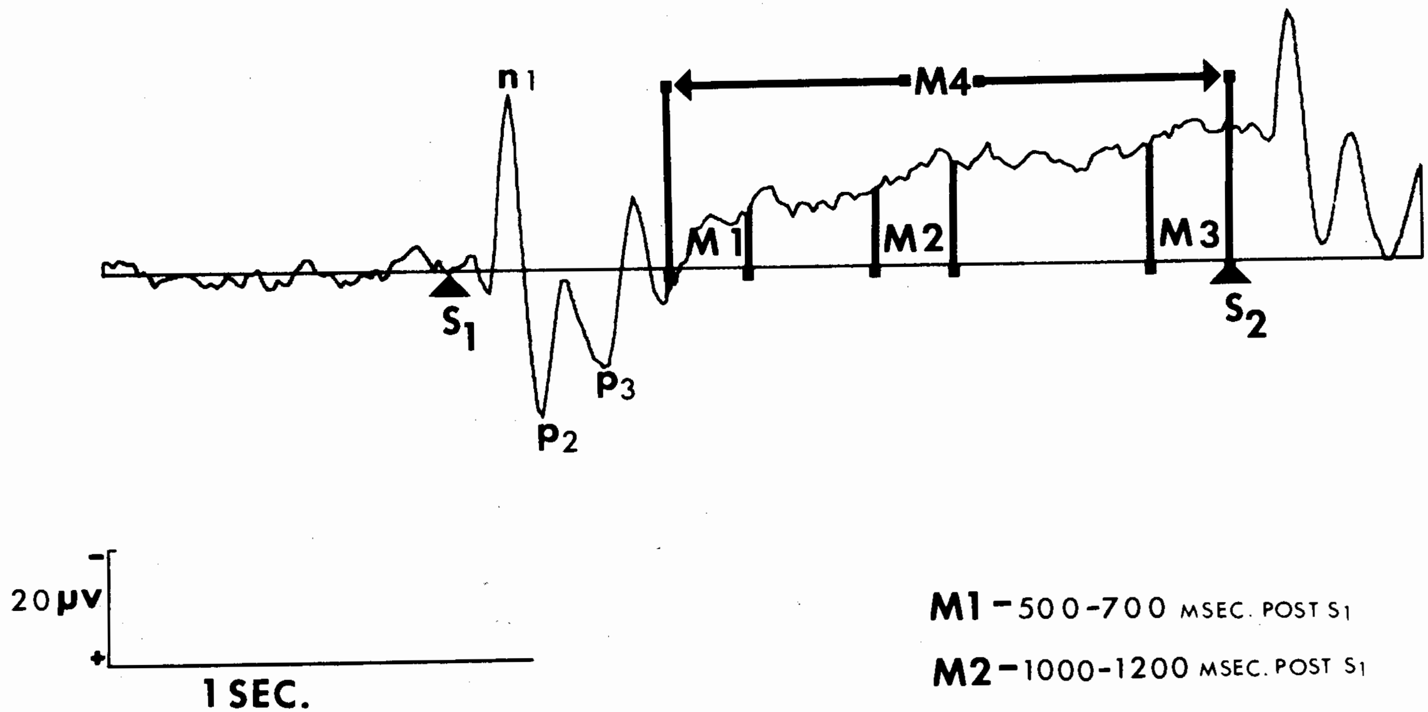
From the EEG data channels only the vertex (Cz) activity was quantified and analyzed on a single trial basis. Cz slow potential data were obtained from the channel which had been low-pass filtered at 5 Hz. The CNVs were quantified as both the mean amplitude of the 200 msec period preceding S2 (relative to the 750 msec pre-S1 "baseline") and the integral of the activity in the period from 500 msec post-S1 to the onset of S2 (M3 and M4 in figure 3). Single trial evoked potential (EP) measures consisted solely of baseline-to-peak amplitude measures of the N1, P2 and P3 components of the evoked response to S1. N1 was defined as a negative peak with a latency of approximately 100 - 150 msec and P2 and P3 were defined as positive peaks with latencies of respectively, 200-220 msec and 300-500 msec. The EP amplitude measures were made on the Cz data channel that was not additionally filtered at tape playback so the bandwidth was as determined by the Schonander filter settings (a 5 second time constant and 70 Hz

Figure 3

Sample Averaged CNV depicting the

EP and CNV measures employed

EP AND CNV MEASURES



M1 – 500-700 MSEC. POST S_1

M2 – 1000-1200 MSEC. POST S_1

M3 – 200 MSEC. PRE S_2

M4 – CNV INTEGRAL

high frequency filter were employed).

For each S the CNV and EP data at each electrode (Fz, Cz, and Pz) averaged by condition, by condition subset and by S1 tone intensity were quantified as follows. Four CNV measures (M1-M4) were obtained from each waveform (see figure 3). M1-M3 were mean amplitudes over the periods respectively, 500-700 msec post-S1, 1000-1200 msec post-S1 and 200 msec pre-S2. All amplitude measures were relative to the mean amplitude of the 750 msec pre-S1 "baseline." M4 was the integrated amplitude over the period 500 msec post-S1 to the onset of S2. Baseline to peak amplitude and latency measures were obtained for the N1, P2 and P3 components of the evoked response to S1.

Data Analysis

To investigate the relationships and interrelationships between the SPL, GSP and ERP single trial measures, correlation coefficients (Pearson R) for selected pairs of variables were obtained for each S. Correlation coeffecients were computed over both the entire data session as well as within each condition. Additionally, the single trial data was pooled over all males, over all females and over all Ss to examine the general patterns of relationship and the degree to which these interact with subject sex.

Initially a condition (X) tone analysis of variance was applied to each S's single trial data to insure that there was not a significant condition (X) tone interaction. No such interactions were found and consequently within-S one-way analyses of variance for condition and tone effects were employed. In this and in all other instances in which a one-way analysis of variance was used, a posteriori contrasts were examined with Duncan's Multiple Range Test. Additionally the single trial data were pooled over all Ss and examined with a sex (X) condition (X) tone analysis of variance. The resulting significant sex effects and the lack of higher-order interactions justified separate one-way analysis of variance for condition and tone effects for all the single trial data pooled over all males and over all females.

Analysis of the averaged data was primarily undertaken to examine the data from electrodes other than Cz as well as to confirm the condition and sex effects already observed. Initially a sex (X) condition (X) electrode analysis of variance was applied to the data averaged within condition subsets pooled over all Ss (4 subsets per condition). Significant main effects and the lack of higher-order interactions necessitated further separate one-way analysis of variance on the male and female data. The effect of S1 tone intensity was first examined using all the data which had been averaged separately for each tone in a tone (X) electrode (X) sex analysis of variance. Once again the lack of significant interaction, despite the significant main effects, allowed the use of one-way analyses of variance on the male and female data separately.

Results

Within-S Correlations

CNV and SPL

Tables I and II present the correlation coeffecients computed for the single-trial SPL and CNV (M3 and M4) measures for each of the 18 Ss. These tables present both the correlations obtained over all conditions as well as the correlations within each condition. Examination of these tables reveals very little consistency across subjects. For M3 (the mean amplitude 200 msec pre-S2) 11 of the 18 Ss had positive correlations with SPL over all conditions although only one (DC 21) reached significance ($p \leq .05$). For the remaining 7 Ss the correlations over all conditions were negative as hypothesized. However, only for 3 subjects (DC 10, DC 12 and DC 14) were the correlations significant ($p \leq .05$). The data relating SPL to CNV amplitude at Fz, Cz and Pz for each S are displayed graphically in figures 4 to 21. The CNV and SPL data were averaged by condition subset (4 subsets per condition). The 12 averages per S were plotted sequentially by shifting the y-axis between plots to provide an indication of the changes over and within

Correlation Coefficients Obtained Between
CNV Amplitude (M3) and SPL

S	Cond.A1	Cond.B	Cond.A2	Overall
01-Male	-.08	.15	-.02	-.29*
03-Male	-.05	-.36	.10	-.06
04-Male	.10	.23	.33*	.06
05-Male	-.02	-.09	-.09	-.16
06-Male	.13	-.28	.07	-.14
07-Male	.09	.17	.11	.03
08-Male	-.15	.05	-.39*	.15
09-Female	-.27	-.16	.16	-.15
11-Female	.05	.02	.26	.05
12-Female	-.31	-.19	.09	-.30*
13-Female	-.07	.19	-.05	.06
14-Female	-.35*	.00	.06	-.53*
15-Female	.02	-.10	-.09	.01
16-Female	-.10*	.11	.12	.16
18-Female	.13	-.25	.01	.01
19-Female	.14	.12	.10	.16
20-Female	.11	-.03	.04	.09
21-Female	-.36*	-.05	.24	.20*

* $p < .05$

Table I

Correlation Coefficients Obtained Between
CNV Integral Measure (M4) and SPL

S	Cond.A1	Cond.B	Cond.A2	Overall
01-Male	-.08	-.01	.04	-.23*
03-Male	-.27	-.19	.17	.09
04-Male	.34	.12	.27	-.10
05-Male	-.11	-.10	-.07	.01
06-Male	.34*	-.20	.04	-.05
07-Male	-.03	.05	.10	.04
08-Male	-.07	-.02	-.26	.25*
09-Female	-.29	-.27	.11	-.19*
11-Female	.01	.15	.10	.08
12-Female	-.36	.03	-.41	-.27*
13-Female	-.13	.27	.11	-.04
14-Female	-.23	.03	.21	-.48*
15-Female	.07	-.15	-.15	.01
16-Female	-.26	.13	.13	.08
18-Female	.19	-.37*	-.03	.06
19-Female	.00	-.01	.04	.03
20-Female	.08	.02	-.06	.07
21-Female	-.09	-.14	.21	.22*

* $p < .05$

Table II

Figure 4

CNV and SPL Data Averaged by

Condition Subset for Subject 01 (Male)

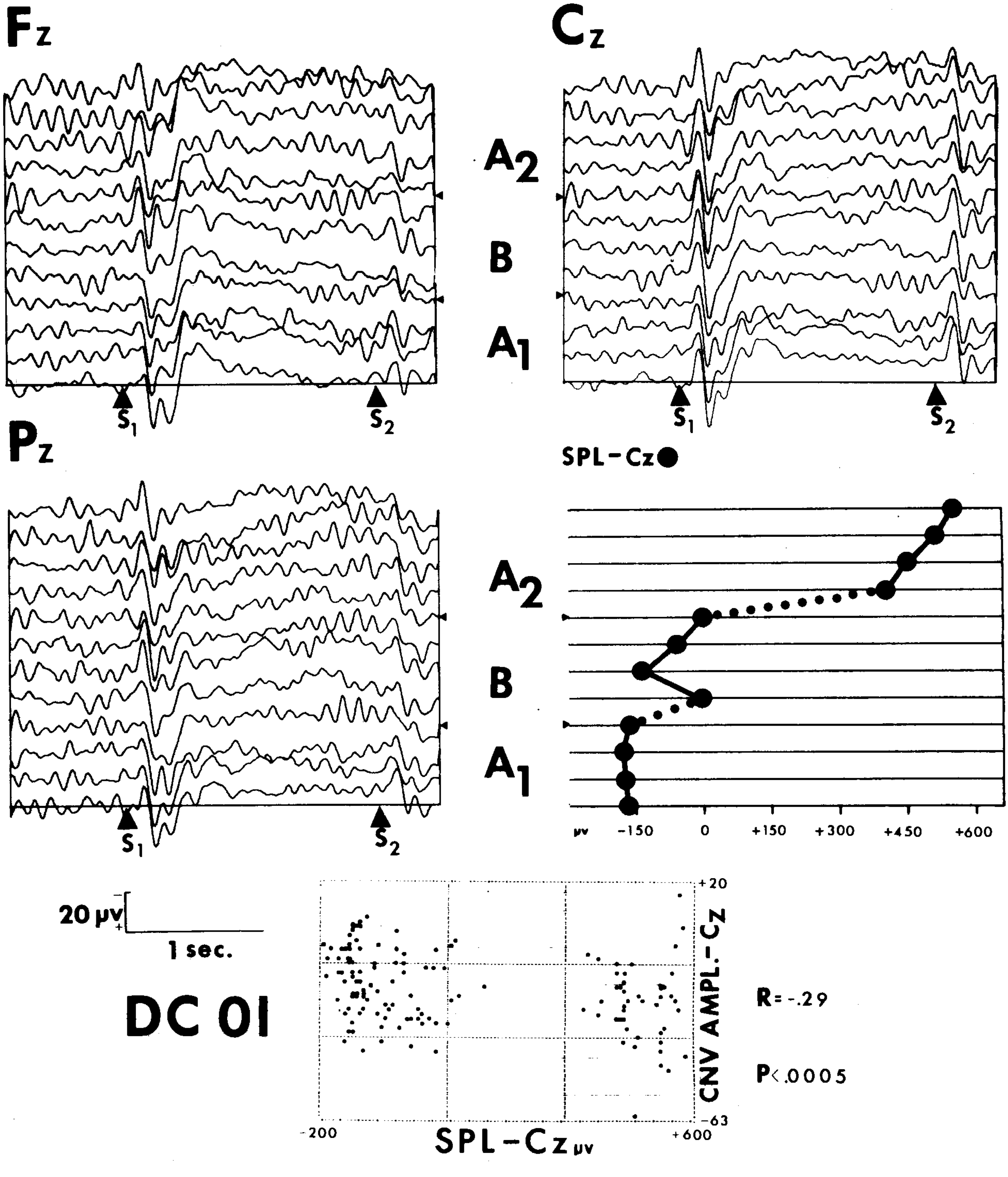

Fz
Cz
A2
B
A1
S1
S2
Pz
SPL-Cz●
A2
B
A1
µv -150 0 +150 +300 +450 +600
20 µv
1 sec.
DC 01
+20
-63
-200
+600
CNV AMPL.-Cz
SPL-Cz µv
R=-.29
P<.0005
single trial scattergram n=136

Figure 5

CNV and SPL Data Averaged by

Condition Subset for Subject 03 (Male)

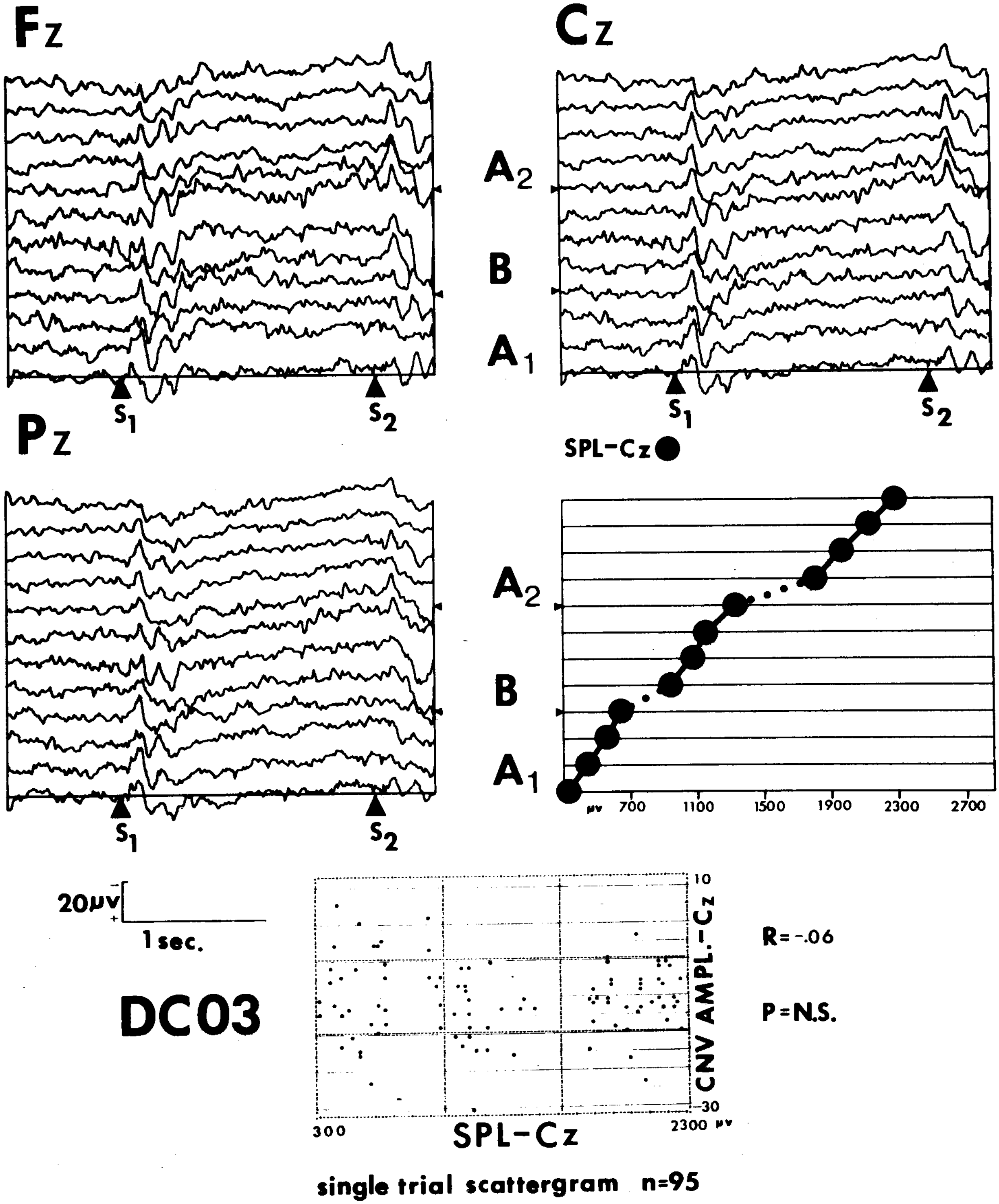

Fz
Cz
A2
B
A1
S1
S2
Pz
SPL-Cz
μv 700 1100 1500 1900 2300 2700
20μv
1 sec.
DC03
10
-30
CNV AMPL.-Cz
300
2300 μv
R=-.06
P=N.S.
single trial scattergram n=95

Figure 6

CNV and SPL Data Averaged by

Condition Subset for Subject 04 (Male)

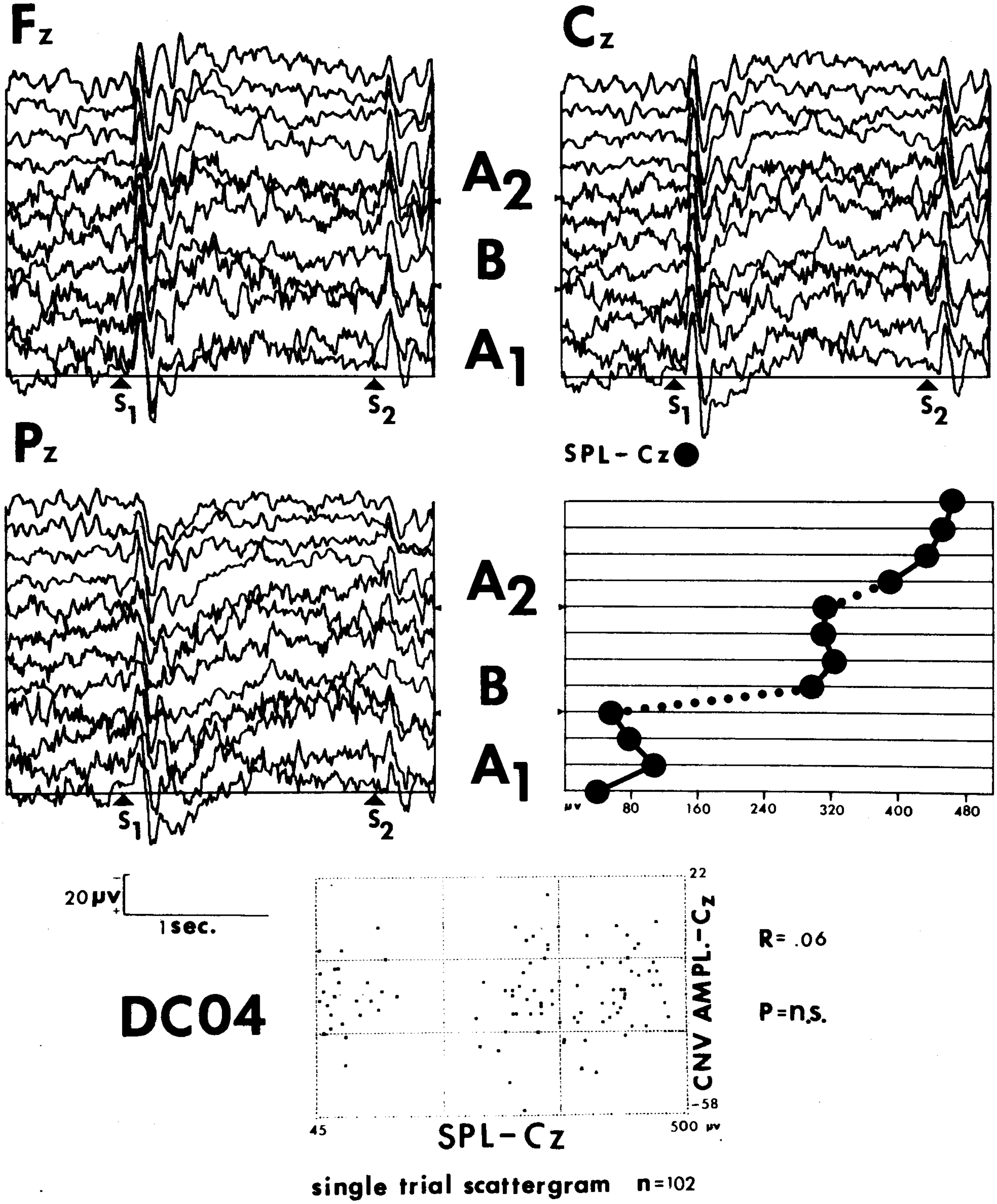

Fz
Cz
A2
B
A1
S1
S2
Pz
SPL - Cz
A2
B
A1
µv 80 160 240 320 400 480
20 µv
1 sec.
DC04
22
CNV AMPL. - Cz
-58
45
500 µv
SPL - Cz
R= .06
P=n.s.
single trial scattergram n=102

Figure 7

CNV and SPL Data Averaged by

Condition Subset for Subject 05 (Male)

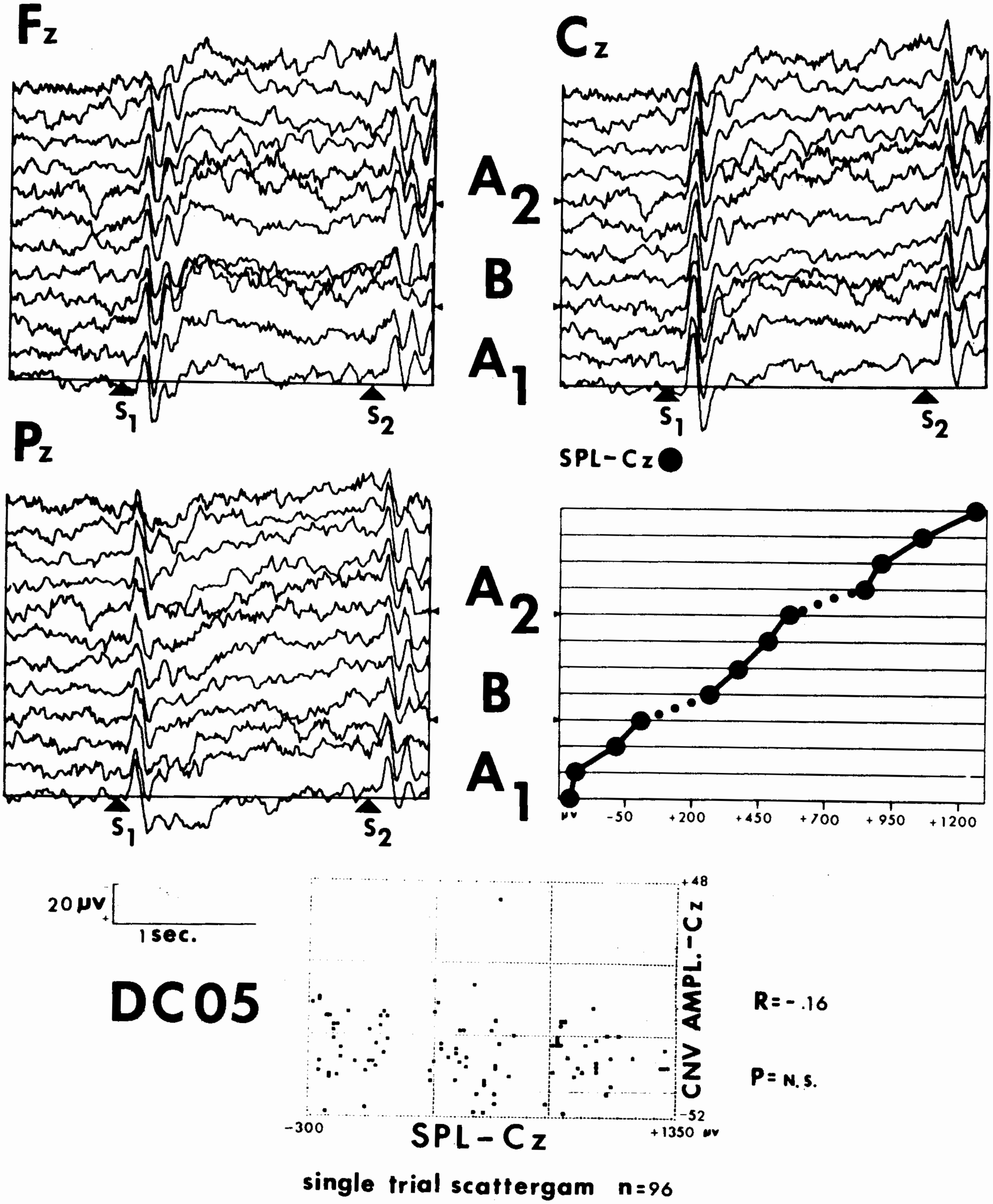
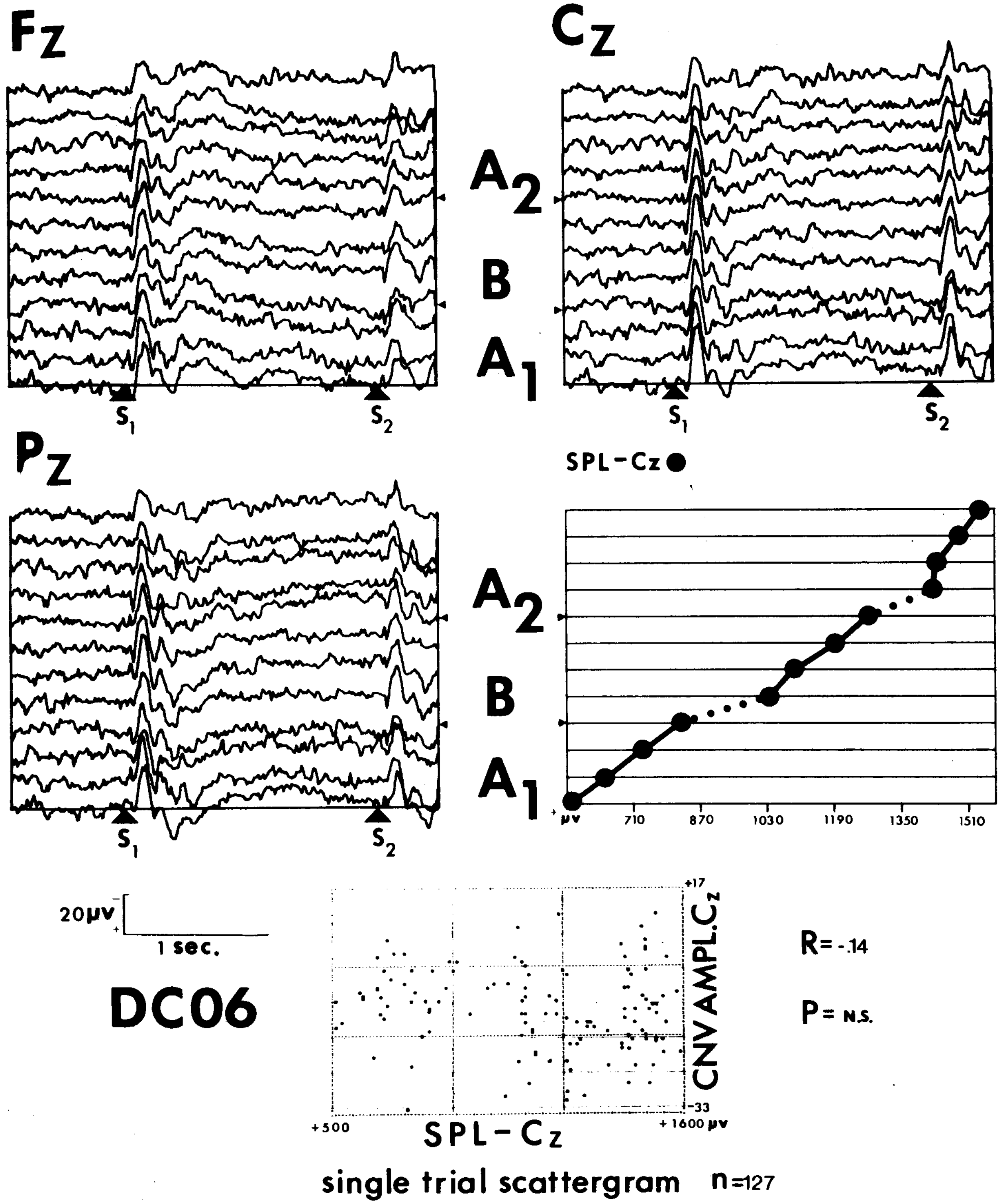

Fz
Cz
A2
B
A1
S1
S2
Pz
SPL-Cz
µv
-50
+200
+450
+700
+950
+1200
20 µv
1 sec.
DC05
+48
-52
CNV AMPL.-Cz
-300
SPL-Cz
+1350 µv
R= - .16
P= N.S.
single trial scattergam n=96

Figure 8

CNV and SPL Data Averaged by

Condition Subset for Subject 06 (Male)

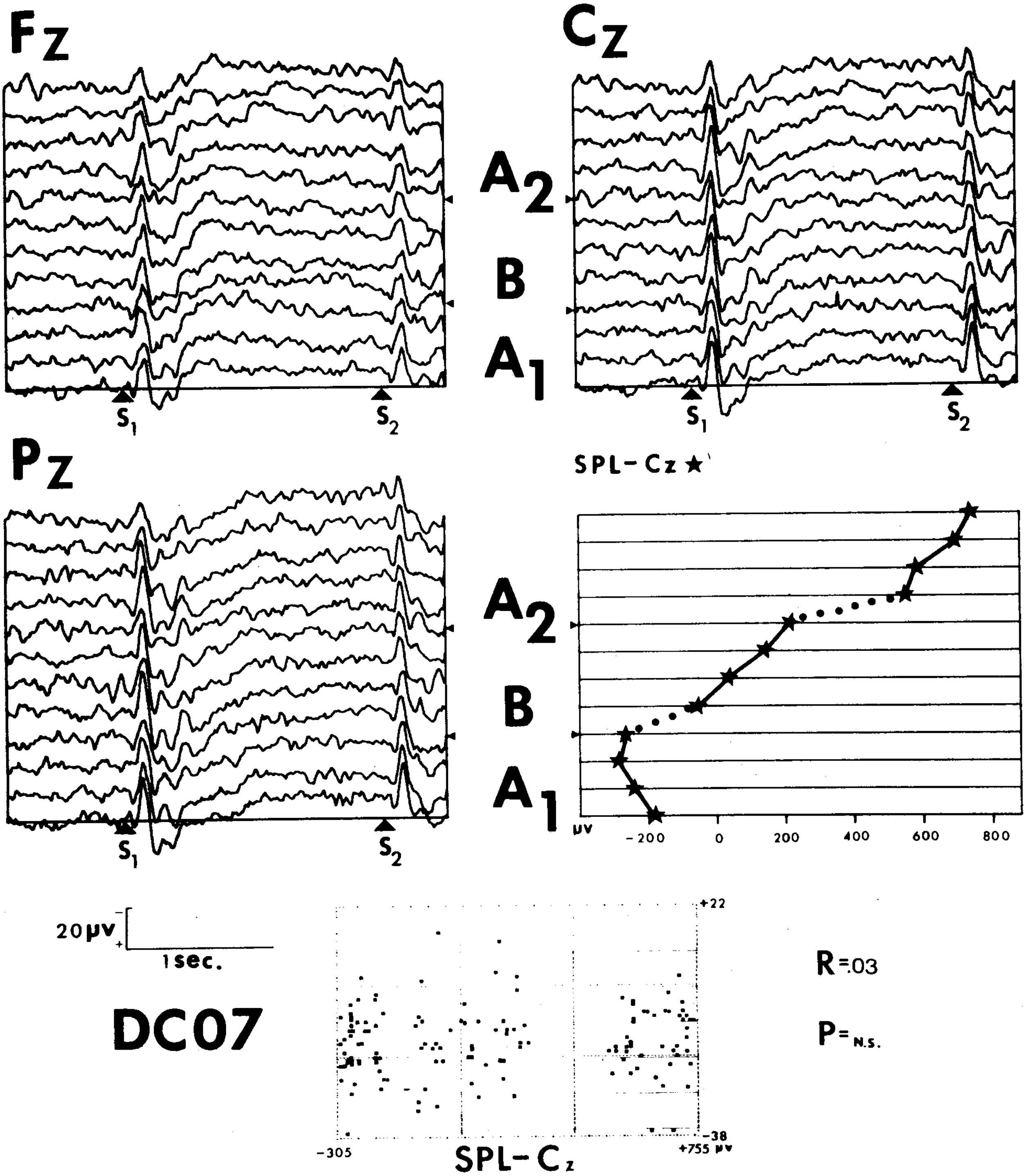


Fz
Cz
A2
B
A1
S1
S2
Pz
SPL-Cz
μv
710
870
1030
1190
1350
1510
20μv
1 sec.
DC06
+17
-33
CNVAMPL.Cz
+500
+1600 μv
SPL-Cz
R= -.14
P= N.S.
single trial scattergram n=127

Figure 9

CNV and SPL Data Averaged by

Condition Subset for Subject 07 (Male)

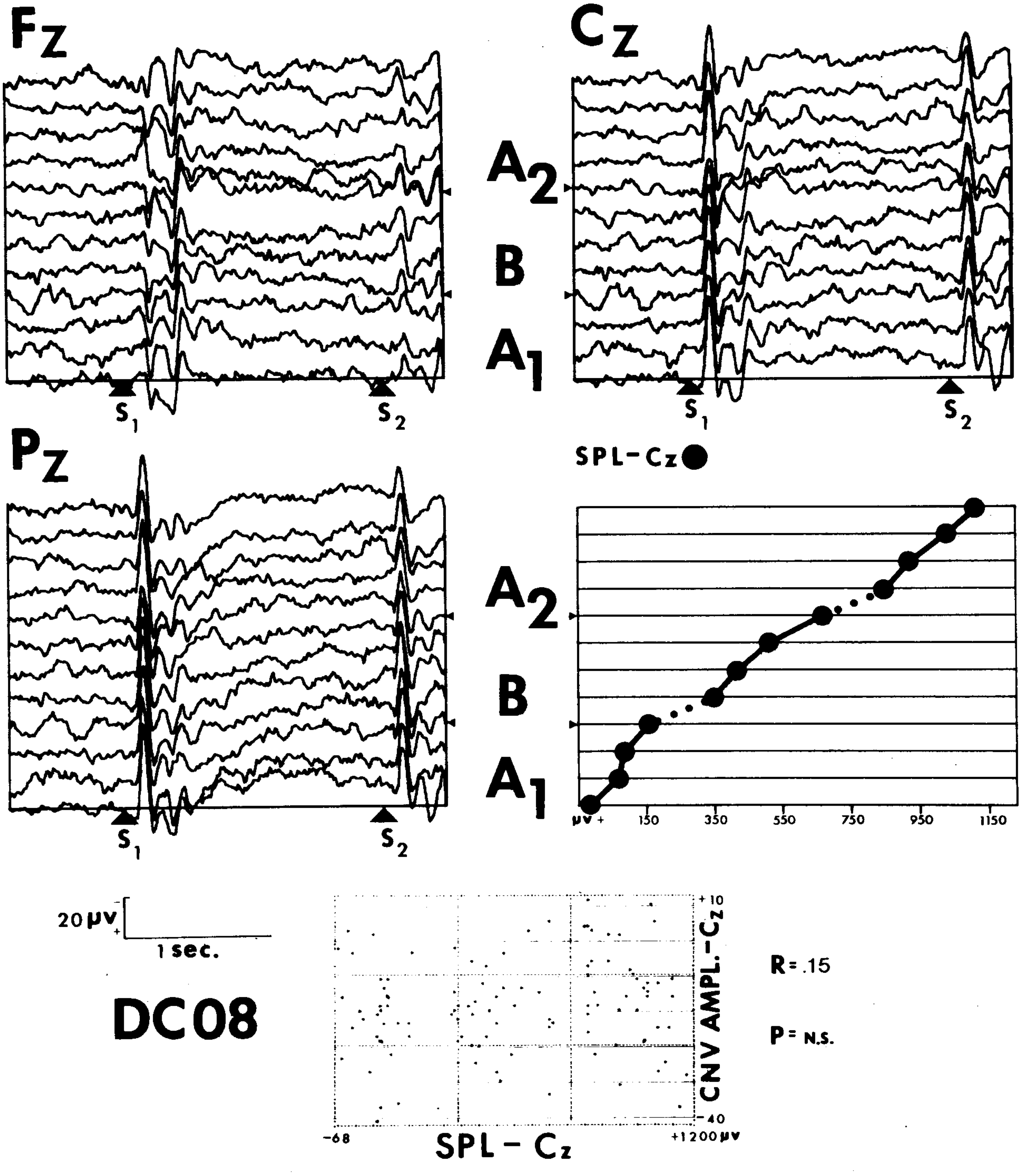


single trial scattergram n=132

Figure 10

CNV and SPL Data Averaged by

Condition Subset for Subject 08 (Male)

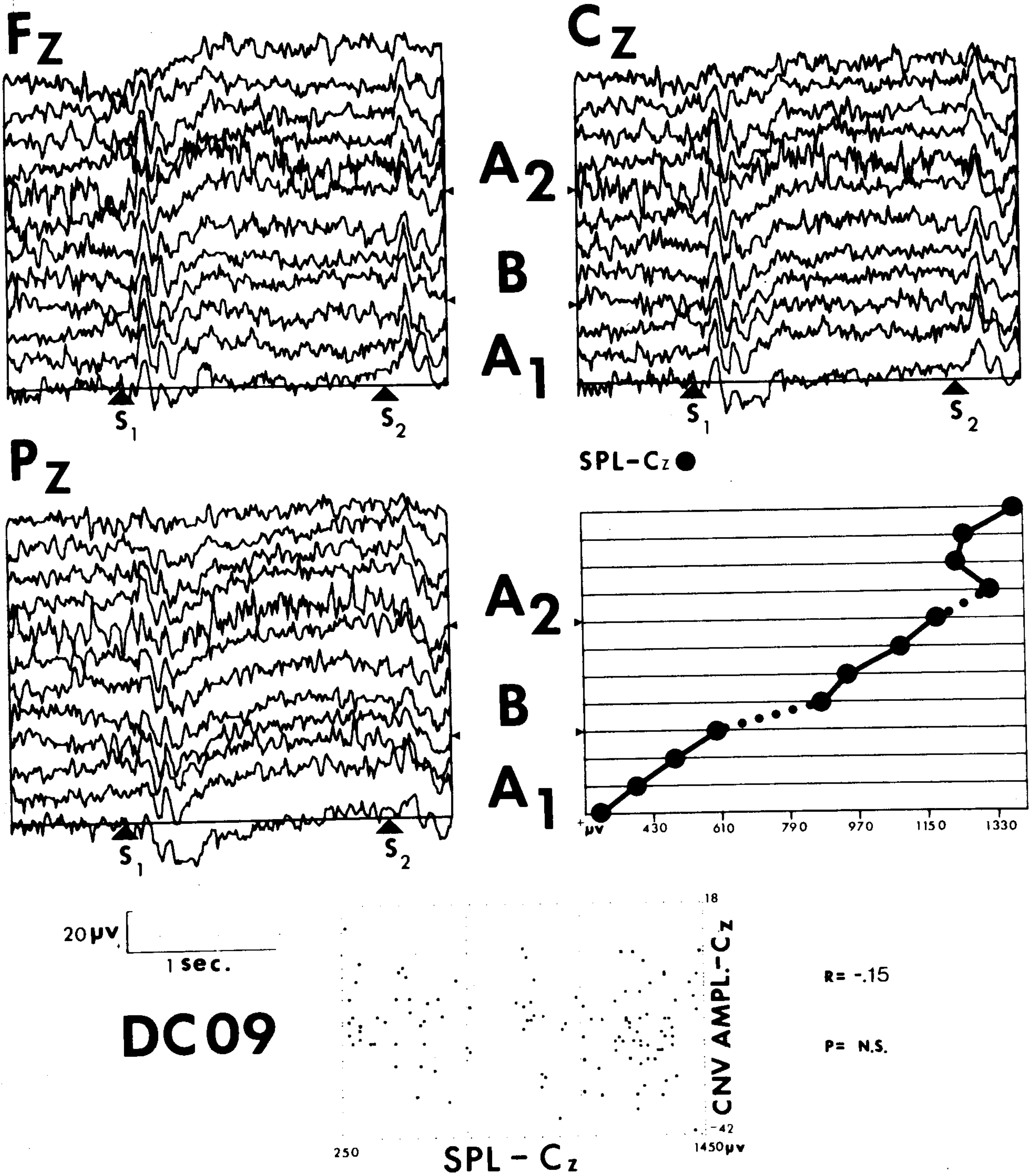


single trial scattergram n=111

Figure 11

CNV and SPL Data Averaged by

Condition Subset for Subject 09 (Female)



single trial scattergram n=112

Figure 12

CNV and SPL Data Averaged by

Condition Subset for Subject 11 (Female)

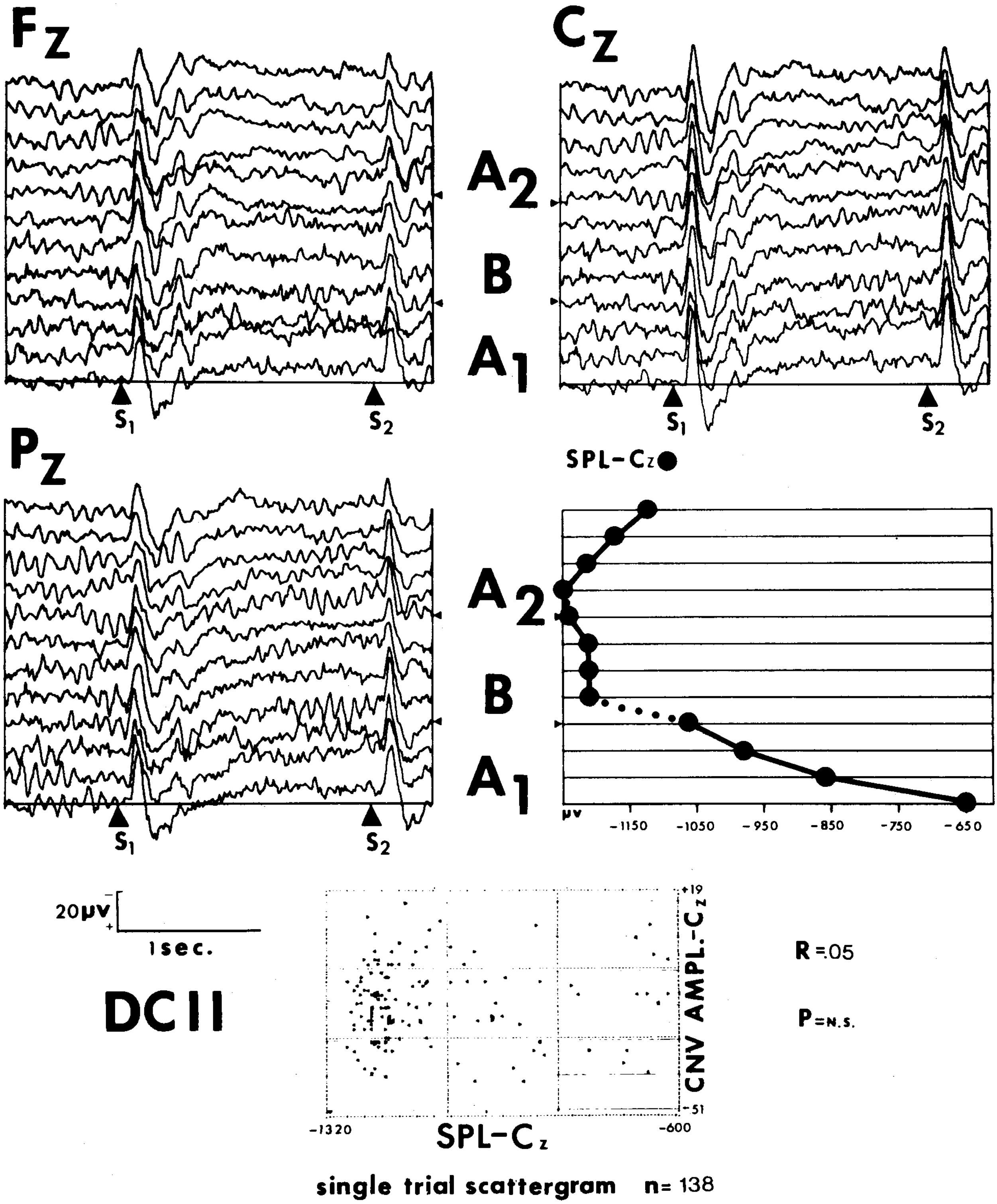
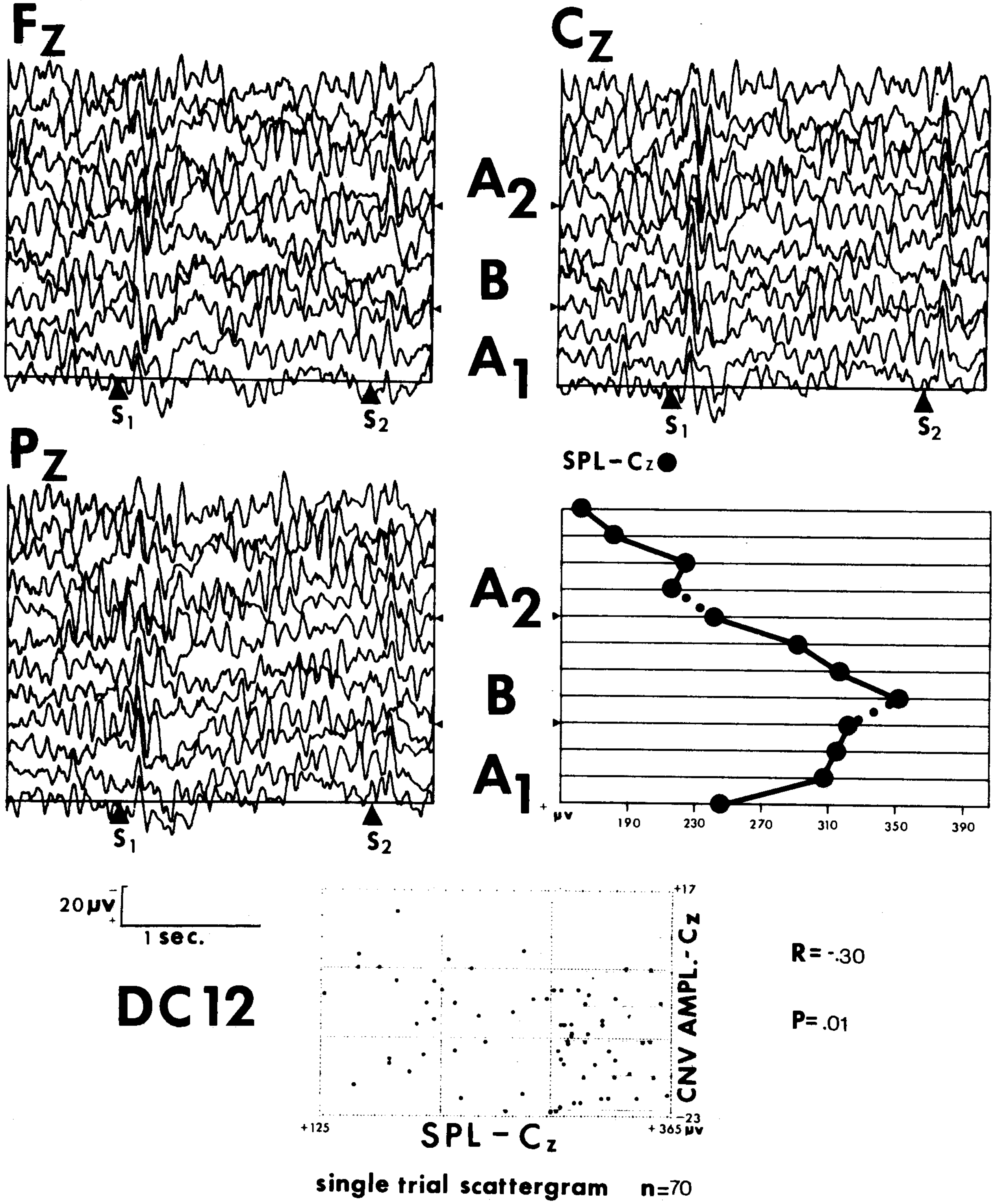

FZ
CZ
PZ
A2
B
A1
S1
S2
SPL-Cz
µv
-1150
-1050
-950
-850
-750
-650
20µv
1sec.
DC II
+19
-51
CNV AMPL.-Cz
-1320
-600
SPL-Cz
R=.05
P=N.S.
single trial scattergram n= 138

Figure 13

CNV and SPL Data Averaged by

Condition Subset for Subject 12 (Female)



Fz
Cz
A2
B
A1
S1
S2
Pz
SPL - Cz
μv
190
230
270
310
350
390
20 μv
1 sec.
DC12
+17
-23
CNV AMPL. - Cz
+125
+365 μv
SPL - Cz
single trial scattergram n=70
R= -.30
P= .01

Figure 14

CNV and SPL Data Averaged by
Condition Subset for Subject 13 (Female)

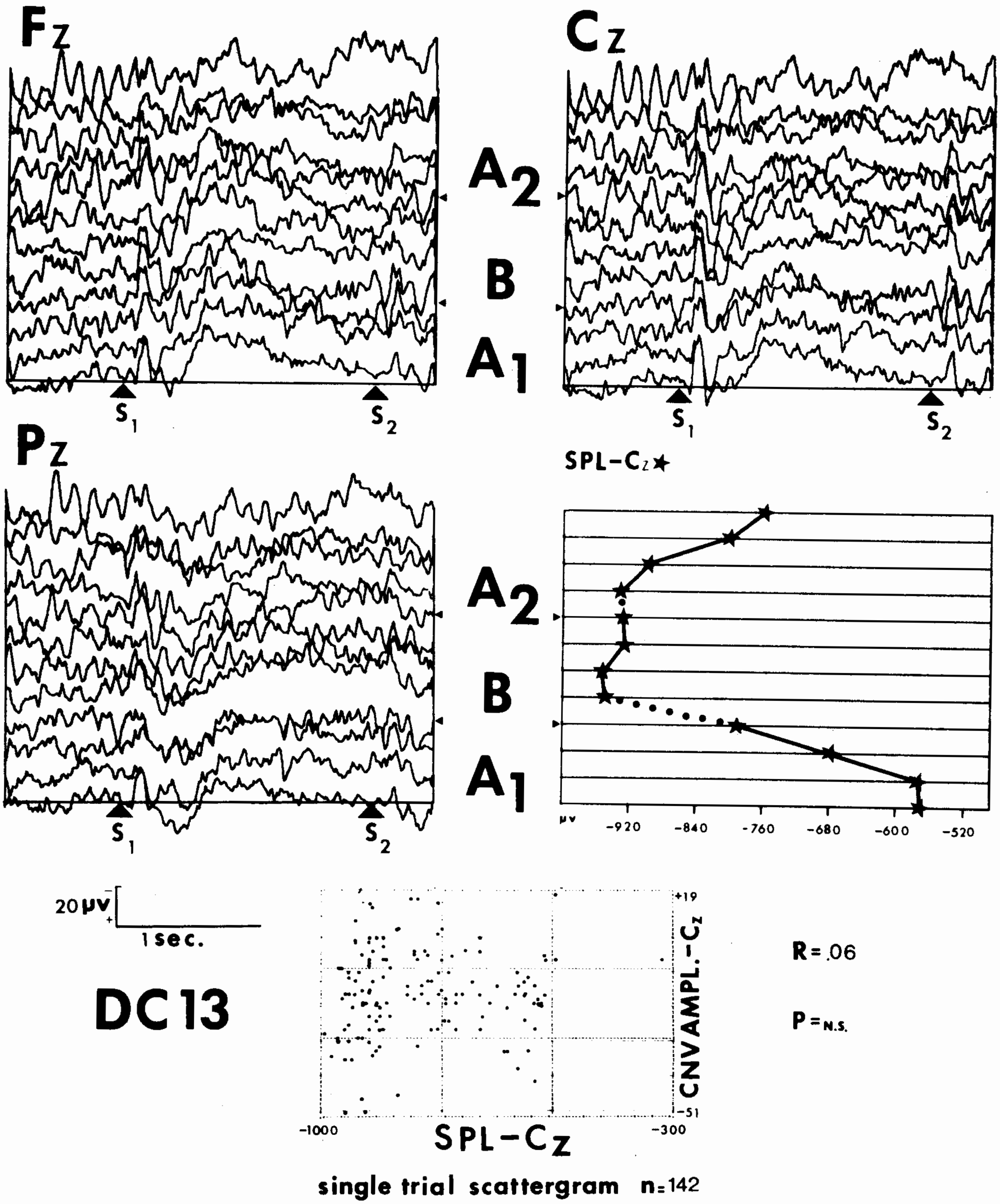
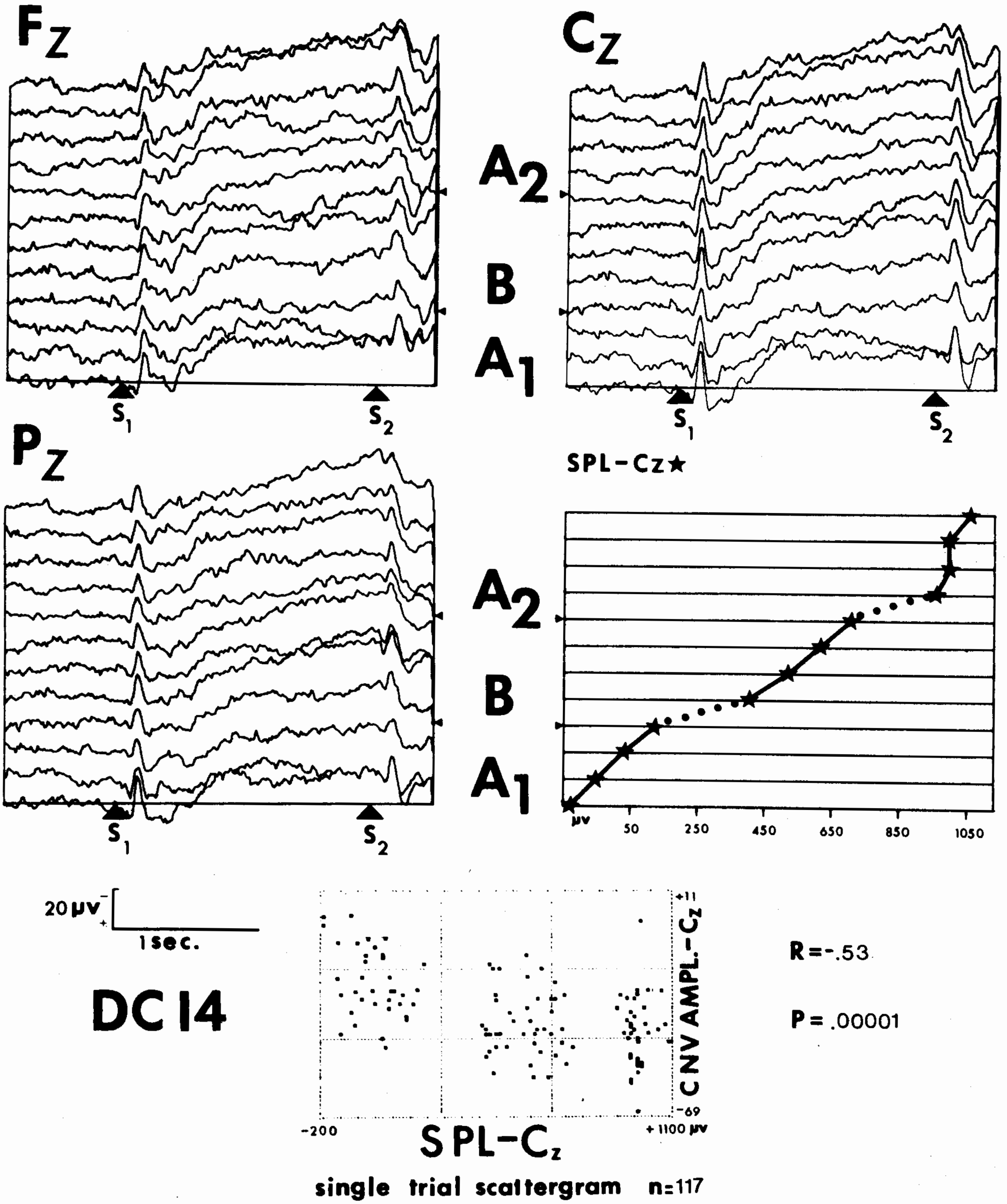

Fz
Cz
A2
B
A1
S1
S2
Pz
SPL-Cz★
μv
-920
-840
-760
-680
-600
-520
20μv
1 sec.
DC13
+19
-51
-1000
-300
CNVAMPL.-Cz
SPL-Cz
R = .06
P = N.S.
single trial scattergram n=142

Figure 15

CNV and SPL Data Averaged by

Condition Subset for Subject 14 (Female)



Fz
Cz
A2
B
A1
S1
S2
Pz
SPL-Cz★
µv
50
250
450
650
850
1050
20µv
1sec.
DC14
+11
-69
-200
+1100 µv
CNV AMPL.-Cz
SPL-Cz
single trial scattergram n=117
R=-.53
P=.00001

Figure 16

CNV and SPL Data Averaged by

Condition Subset for Subject 15 (Female)

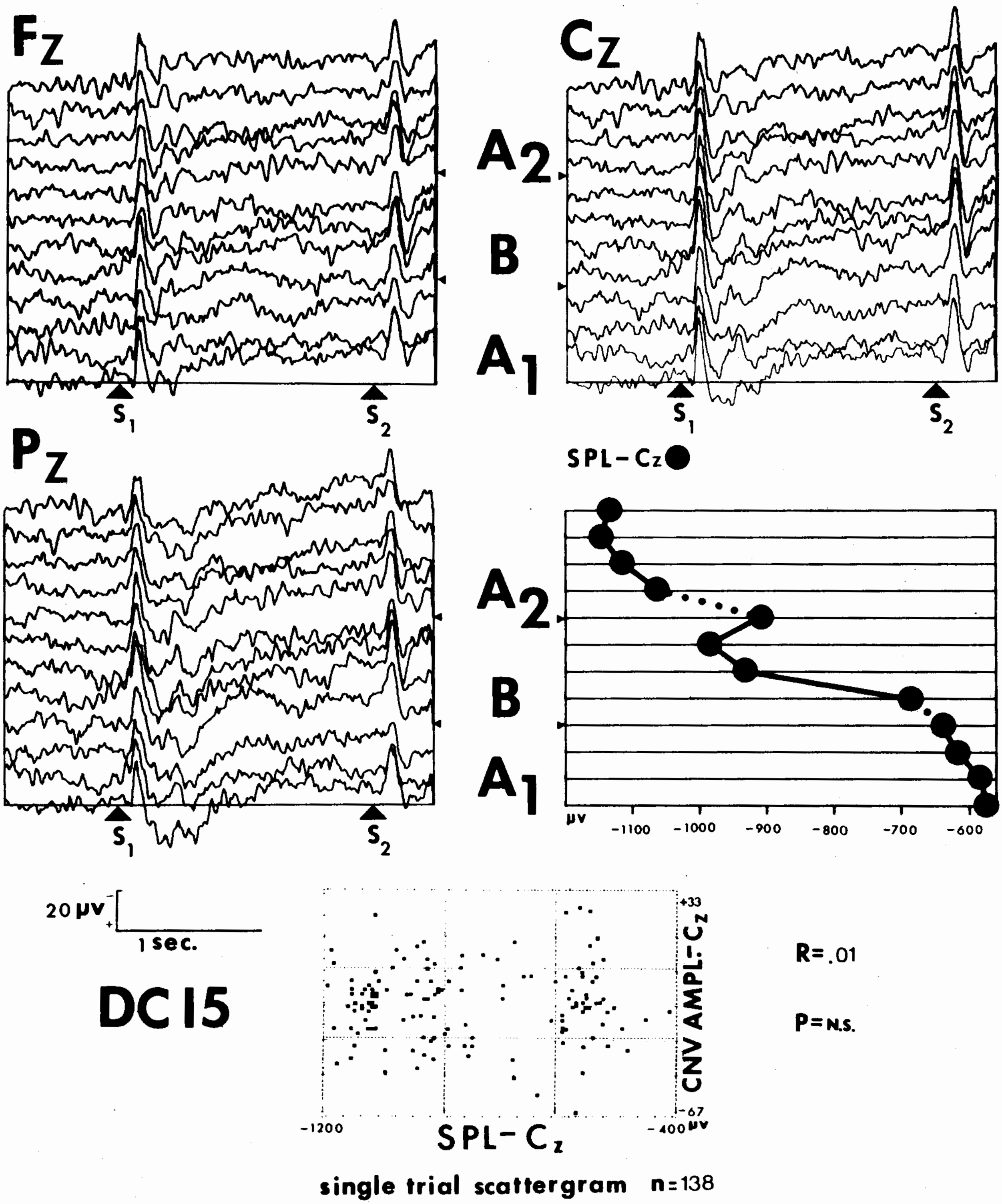
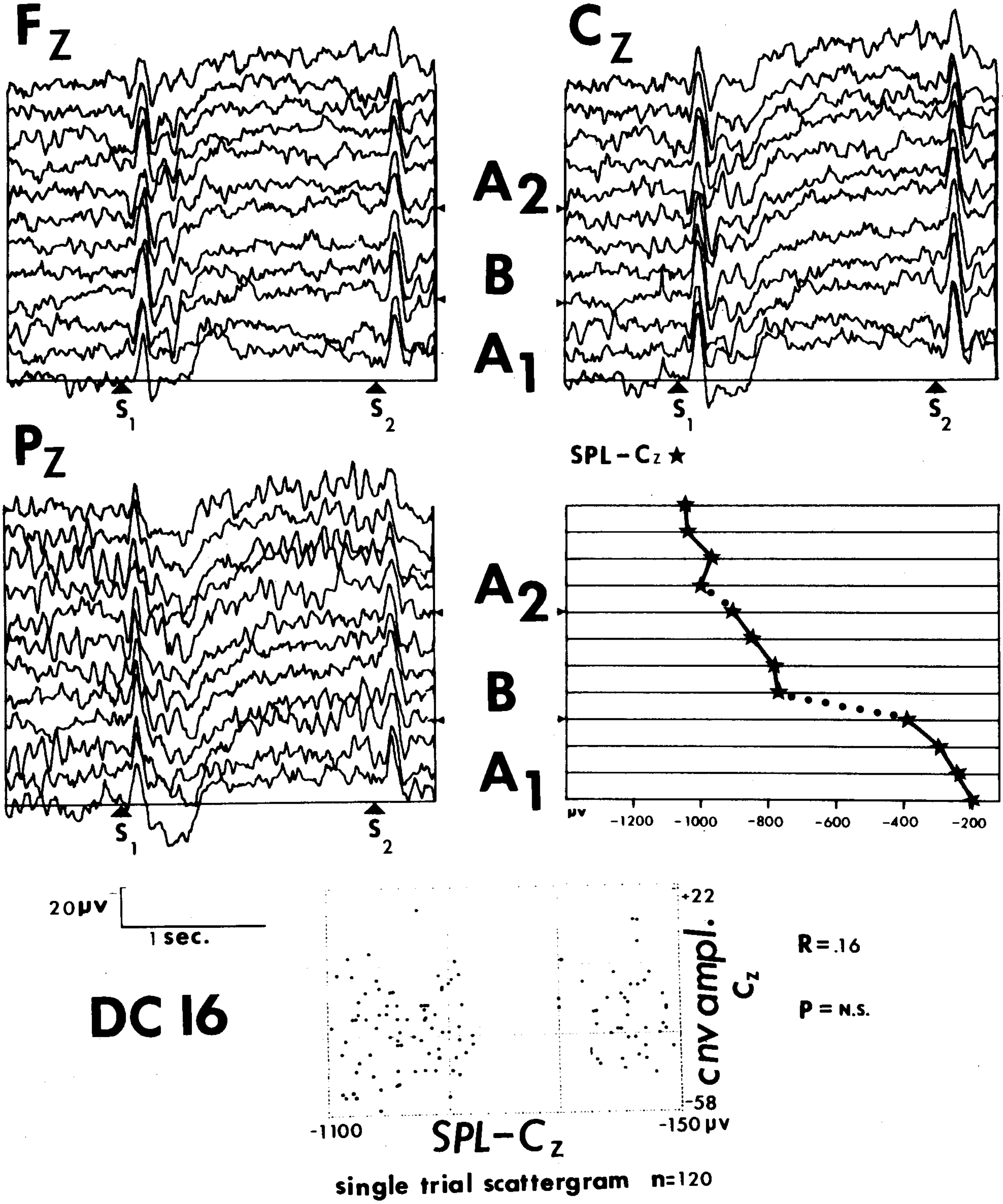

Fz
Cz
A2
B
A1
S1
S2
Pz
A2
B
A1
S1
S2
SPL-Cz
µV
-1100
-1000
-900
-800
-700
-600
20 µV
1 sec.
DC15
+33
-67
-1200
-400 µV
CNV AMPL-Cz
SPL-Cz
R=.01
P=N.S.
single trial scattergram n=138

Figure 17

CNV and SPL Data Averaged by

Condition Subset for Subject 16 (Female)



FZ
CZ
PZ
A2
B
A1
S1
S2
SPL - CZ ★
µv
-1200
-1000
-800
-600
-400
-200
20µv
1 sec.
DC 16
+22
-58
cnv ampl. CZ
-1100
-150 µv
SPL-CZ
single trial scattergram n=120
R = .16
P = N.S.

Figure 18

CNV and SPL Data Averaged by

Condition Subset for Subject 18 (Female)

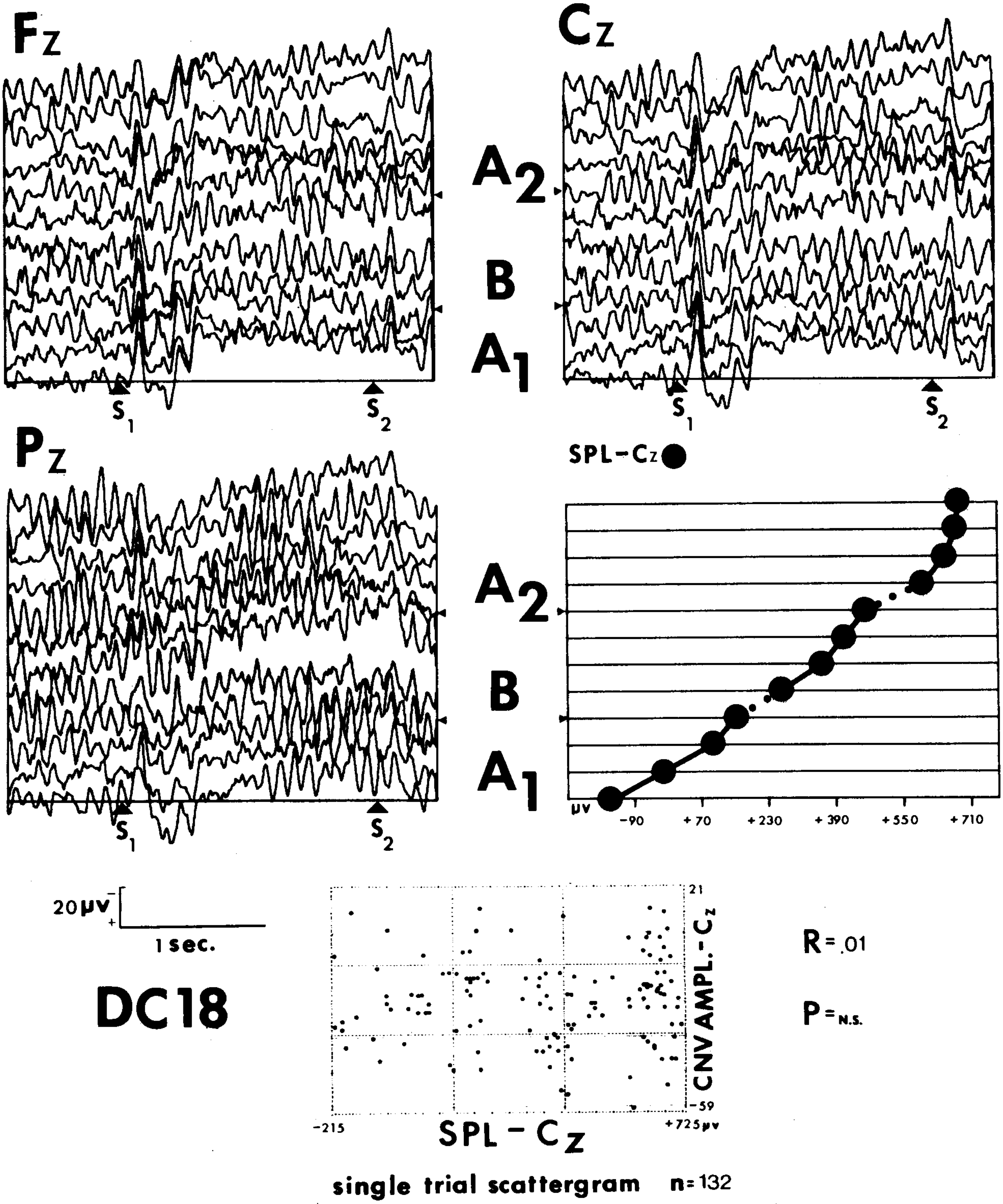
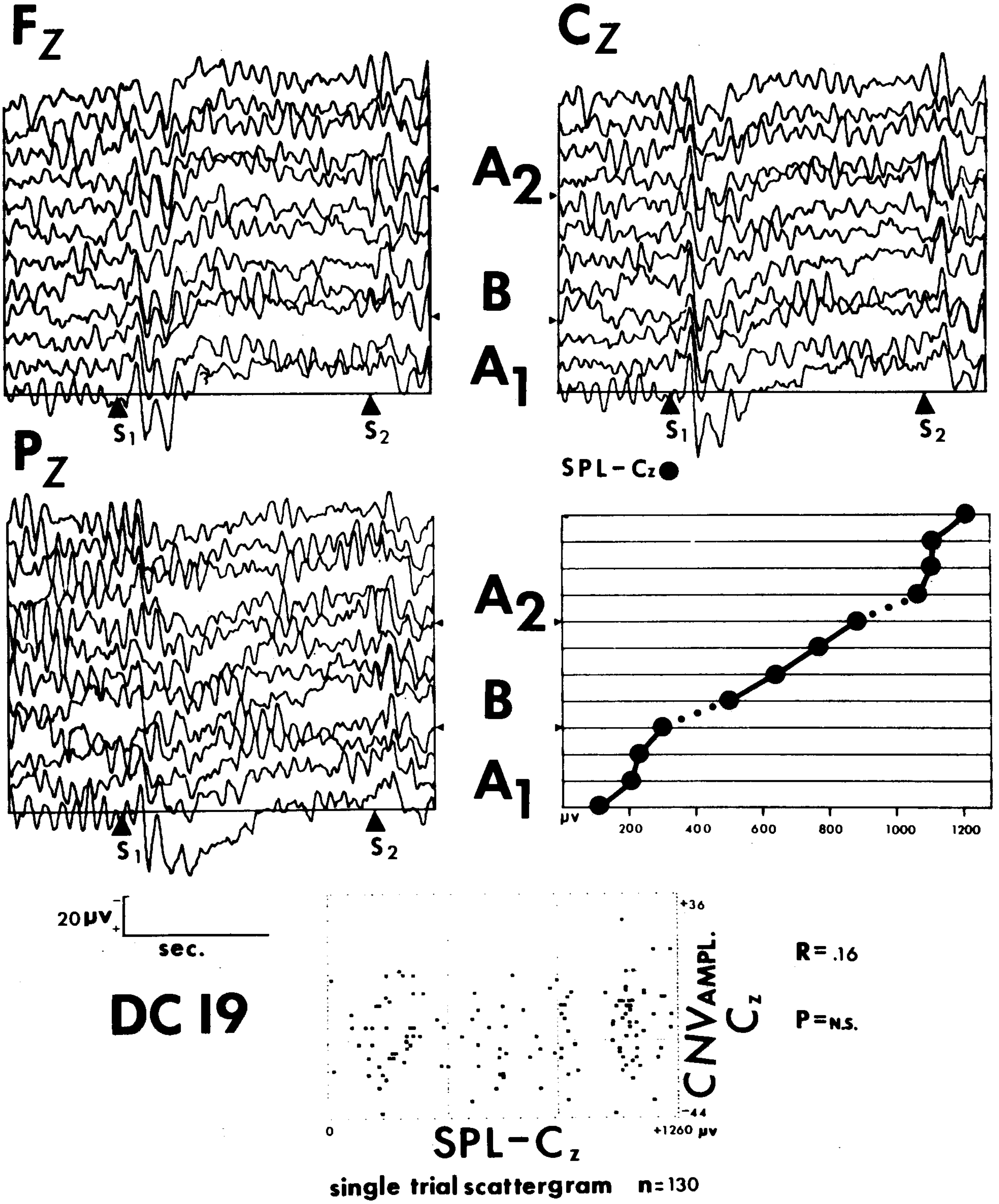

Fz
Cz
A2
B
A1
S1
S2
Pz
SPL-Cz
μv
-90
+70
+230
+390
+550
+710
20μv
1 sec.
DC18
21
-59
CNV AMPL.-Cz
-215
+725μv
SPL - Cz
R = .01
P = N.S.
single trial scattergram n = 132

Figure 19

CNV and SPL Data Averaged by

Condition Subset for Subject 19 (Female)

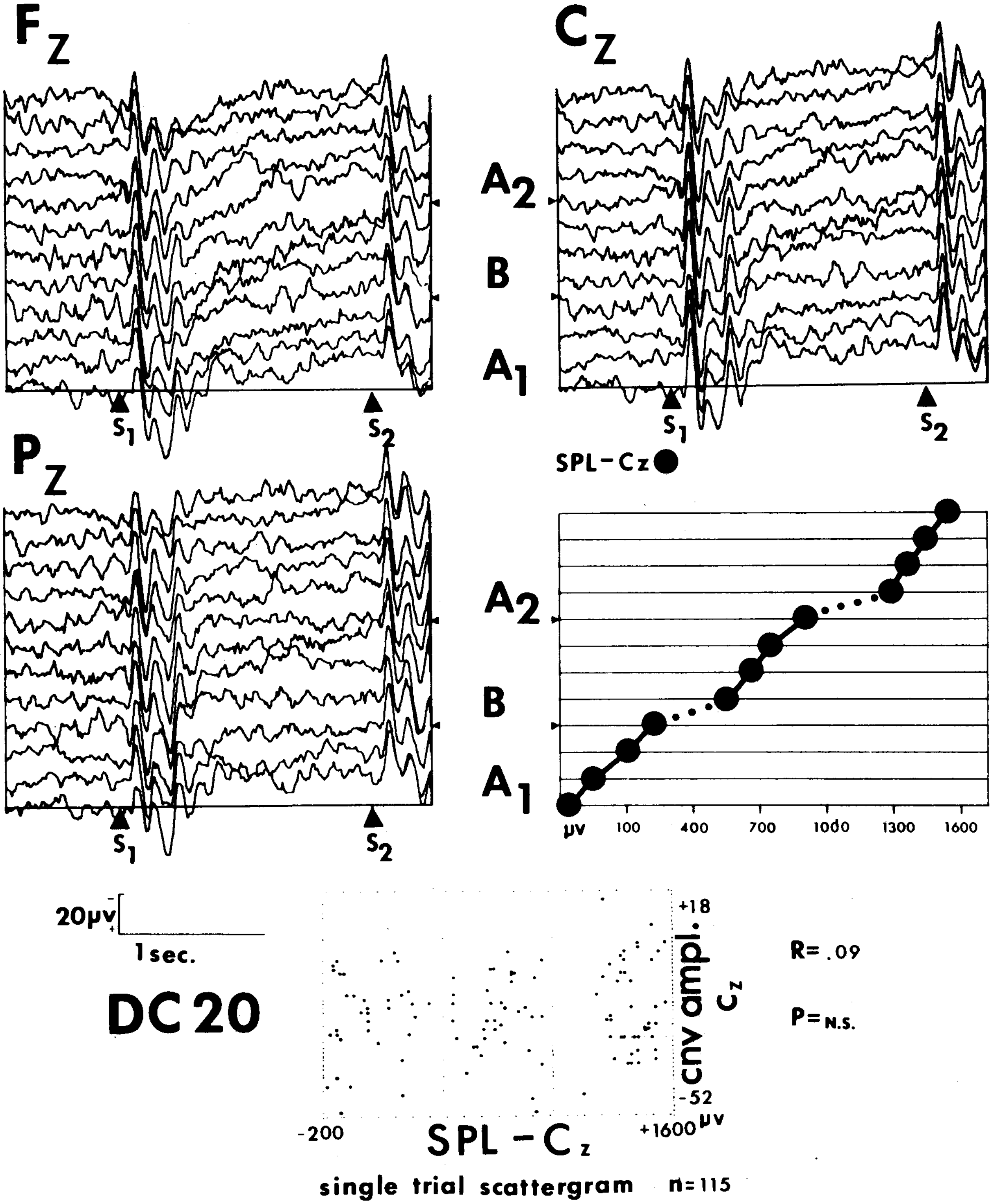


Fz
Cz
A2
B
A1
S1
S2
Pz
SPL-Cz
μv
200
400
600
800
1000
1200
20μv
sec.
DC 19
+36
-44
0
+1260 μv
CNV AMPL. Cz
R= .16
P= N.S.
SPL-Cz
single trial scattergram n=130

Figure 20

CNV and SPL Data Averaged by

Condition Subset for Subject 20 (Female)

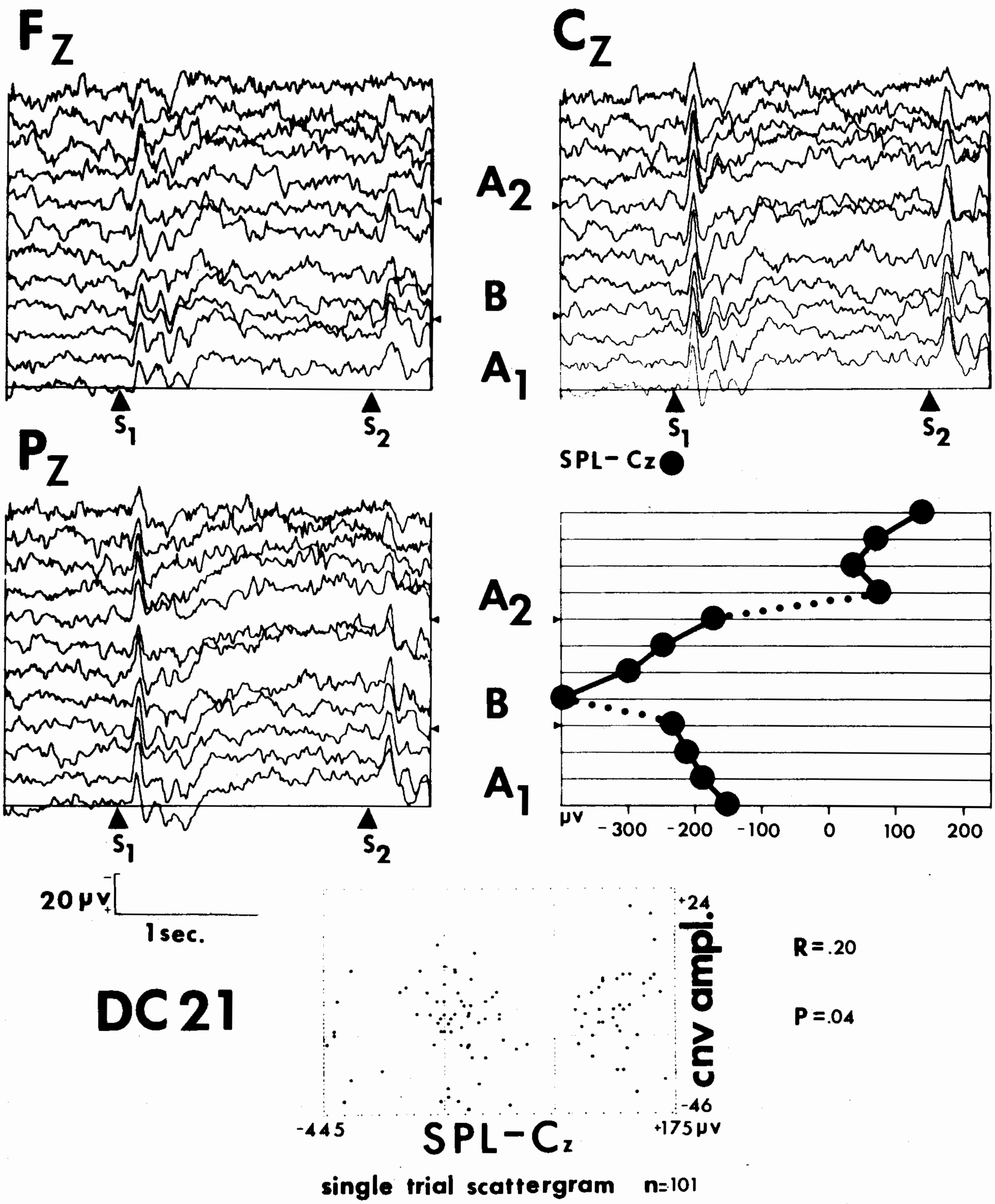


F_Z
C_Z
A_2
B
A_1
S_1
S_2
P_Z
SPL-Cz
A_2
B
A_1
µv
100
400
700
1000
1300
1600
20µv
1 sec.
DC 20
+18
cnv ampl. C_z
-52
-200
SPL - C_z
+1600 µv
single trial scattergram n=115
R= .09
P= N.S.

Figure 21

CNV and SPL Data Averaged by

Condition Subset for Subject 21 (Female)



FZ
CZ
A2
B
A1
S1
S2
PZ
SPL-Cz
μv
-300
-200
-100
0
100
200
20 μv
1 sec.
DC 21
+24
-46
cnv ampl.
-445
+175 μv
SPL-Cz
R=.20
P=.04
single trial scattergram n=101

conditions. Additionally a scatterplot of the SPL and the CNV (M3) measures is displayed to graphically index the degree of relationship.

Table II indicates that the correlations obtained between the SPL values and M4 (integral of the activity 500 msec post S1 to S2) displayed the same general patterns as was observed for M3. This is not at all surprising as the correlations obtained between M3 and M4 (table XV) ranged between .76 and .89. For both M3 and M4 the patterns of correlation show even less consistency as the within-condition correlations are examined (tables I and II). In general these results cannot be interpreted as support for the hypothesis that there is an inverse relationship between SPL and CNV amplitude.

N1 and SPL

Table III displays the correlation coeffecients obtained between the single-trial N1 and SPL values for each of the Ss. For 7 of the 18 Ss the correlations were in the expected negative direction although for only one S (DC 16) was the correlation statistically significant ($p \leq .05$). The remaining 11 Ss all displayed positive correlations of which 4 (DC 06, 08, 18, and 20) were significant. This inconsistent pattern does not support the hypothesized inverse relationship between N1 amplitude and SPL.

P2, P3 and SPL

Examination of tables IV and V indicate that the observed relationships between SPL and the positive components of the EP to S1 were more consistent both across subjects and with the hypothesis. For P2 amplitude the correlations with SPL were inverse for 10 of the 18 Ss. Furthermore 5 of these correlations were statistically significant ($p \leq .05$). For the remaining 8 Ss the correlations were positive although none was significant. The P3 and SPL correlations displayed the same general pattern of inverse relationship. For 11 Ss the correlations with SPL were negative and 5 of these were statistically significant. However the correlation coefficient obtained from one of the Ss displaying a positive correlation was also significant. In general these results somewhat equivocally support the hypothesis that as SPL shifted positively the amplitude of the positive going EP components was attenuated.

Correlation Coefficients Obtained Between
N1 Amplitude and SPL

S	Cond.A1	Cond.B	Cond.A2	Overall
01-Male	-.01	.01	.11	.07
03-Male	-.25	-.03	.14	.11
04-Male	.54*	-.14	.30	.10
05-Male	-.12	.02	.31	.03
06-Male	.38*	.14	.33*	.34*
07-Male	-.35*	.29	.29	.04
08-Male	.43*	.54*	.20	.19*
09-Female	.19	-.31	.04	-.03
11-Female	-.48*	.18	.22	-.11
12-Female	.04	-.34	-.50*	-.13
13-Female	-.18	.22	.17	.07
14-Female	.29	.15	-.13	-.05
15-Female	-.20	-.06	.01	-.02
16-Female	-.16	-.23	.24	-.28*
18-Female	.32	.09	.08	.25*
19-Female	.24	.15	-.05	.06
20-Female	.39*	.16	-.18	.19*
21-Female	.08	-.12	.36	-.04

* $p < .05$

Table III

Correlation Coefficients Obtained Between
P2 Amplitude and SPL

S	Cond.A1	Cond.B	Cond.A2	Overall
01-Male	.19	.01	-.14	-.28*
03-Male	-.33	-.11	.02	-.13
04-Male	-.02	.16	.03	-.08
05-Male	-.34	-.36*	-.50*	-.26*
06-Male	.12	-.15	-.08	.07
07-Male	.18	-.42*	.23	-.03
08-Male	.17	.03	-.12	.03
09-Female	.07	-.20	.21	-.23*
11-Female	.07	.21	-.38*	.00
12-Female	.22	-.09	.12	.09
13-Female	.09	.06	.11	-.02
14-Female	-.17	-.29	.03	-.28*
15-Female	-.17	-.08	.09	.10
16-Female	-.10	.11	.22	-.05
18-Female	.13	-.19	.17	.03
19-Female	-.19	-.26	-.25	-.29*
20-Female	.45*	-.13	-.34*	-.18
21-Female	-.23	-.17	.16	.14

* $p < .05$

Table IV

Correlation Coefficients Obtained Between
P3 Amplitude and SPL

S	Cond.A1	Cond.B	Cond.A2	Overall
01-Male	.05	.06	.10	-.30*
03-Male	-.21	.05	.14	.11
04-Male	.12	.11	.03	-.38*
05-Male	-.32	-.28	.05	.16
06-Male	.02	-.31*	-.16	-.19
07-Male	-.06	-.19	-.39*	-.07
08-Male	-.33	-.04	-.43*	-.09
09-Female	-.15	-.40	-.07	-.25*
11-Female	.06	-.04	.10	.18
12-Female	.16	.00	.22	.17
13-Female	-.21	.04	-.10	-.03
14-Female	-.21	.08	-.21	-.39*
15-Female	.35*	-.38*	.39*	.20*
16-Female	-.12	-.14	.24	.19
18-Female	-.08	-.33	.12	-.14
19-Female	-.56*	-.36*	-.21	-.18
20-Female	-.07	-.18	-.23	-.24*
21-Female	-.17	-.29	.42	.09

* $p < .05$

Table V

CNV and N1

Tables VI and VII demonstrate the relatively consistent relationship observed between the CNV measures (M3 and M4) and N1 amplitude. For all Ss the M3 (table VI) and the M4 (table VII) measures were positively correlated with N1 amplitude. For 8 of the Ss the correlations between M3 and N1 were statistically significant ($p \leq .05$). The M4 measure was even more consistently and highly correlated with N1 amplitude as the correlation for 11 of the Ss were significant and the obtained coefficients larger. These findings are interpreted as support for the hypothesis that CNV amplitude is directly related to the amplitude of the N1 component of the EP to S1.

P2, P3 and CNV

Tables VIII - XI illustrate the inverse relationship observed between both P2 and P3 amplitude and the CNV measures (M3 and M4). The correlations obtained between P2 and M3 (table VIII) were positive for 17 of the 18 Ss. Of the 17, 12 were statistically significant ($p \leq .05$). For all Ss M4 was positively correlated with P2 amplitude (table IX). For 14 Ss this correlation was significant. Significant positive

Correlation Coefficients Obtained Between
CNV Amplitude (M3) and N1 Amplitude

S	Cond.A1	Cond.B	Cond.A2	Overall
01-Male	.23	.25	.19	.26*
03-Male	.21	.11	-.06	.07
04-Male	.28	.14	.32*	.24*
05-Male	.06	.05	.19	.08
06-Male	.17	.47*	.40*	.31*
07-Male	.28	-.01	.04	.08
08-Male	.00	.14	.13	.10
09-Female	.09	.29	-.06	.08
11-Female	.19	.29*	.00	.20*
12-Female	.10	.51*	.05	.18
13-Female	.19	.09	.16	.15
14-Female	.12	.37*	.49*	.34*
15-Female	.35*	.22	.11	.24*
16-Female	.21	.09	.27	.14
18-Female	.34*	-.34*	.00	.04
19-Female	.21	.05	-.02	.07
20-Female	.34*	-.11	.48*	.30*
21-Female	.11	.23	.57*	.28*

* $p < .05$

Table VI

Correlation Coefficients Obtained Between
CNV Integral Measure (M4) and N1 Amplitude

S	Cond.A1	Cond.B	Cond.A2	Overall
01-Male	.38*	.36*	.40*	.41*
03-Male	.31	.12	.10	.18
04-Male	.59*	.18	.40*	.36*
05-Male	.13	.03	.22	.09
06-Male	.35*	.56*	.41*	.41*
07-Male	.47*	.18	-.00	.20*
08-Male	.09	.12	.29	.19
09-Female	.27	.31	-.07	.13
11-Female	.17	.39*	-.04	.21*
12-Female	.35	.53*	.47*	.40*
13-Female	.32*	.26	.36*	.30*
14-Female	.39*	.59*	.59*	.52*
15-Female	.40*	.39*	.29*	.37*
16-Female	.28	.12	.23	.18
18-Female	.37*	-.24	-.09	.06
19-Female	.04	.18	-.08	.04
20-Female	.51*	-.06	.60*	.43*
21-Female	.33	.33	.50*	.38*

* $p < .05$

Table VII

Correlation Coefficients Obtained Between
CNV Amplitude (M3) and P2 Amplitude

S	Cond.A1	Cond.B	Cond.A2	Overall
01-Male	.43*	.04	.45*	.41*
03-Male	.49*	.46*	.32	.41*
04-Male	.33	.22	.37*	.30*
05-Male	.21	.06	.21	.16
06-Male	.05	.50*	.26	.28*
07-Male	.21	.19	.40*	.24*
08-Male	.27	.19	.39*	.29*
09-Female	.27	.24	-.13	.14
11-Female	.41*	.04	-.10	.13
12-Female	.36	-.10	.32	.19
13-Female	.26	.10	.45*	.25*
14-Female	.45*	.57*	.41*	.54*
15-Female	.32*	.26	.28	.29*
16-Female	.15	.36*	.22	.22*
18-Female	.32*	-.07	-.27	-.02
19-Female	.21	.16	-.06	.07
20-Female	.22	.03	.48*	.28*
21-Female	.33*	.18	.20	.25*

* $p < .05$

Table VIII

Correlation Coefficients Obtained Between
CNV Integral Measure (M4) and P2 Amplitude

S	Cond. A1	Cond. B	Cond. A2	Overall
01-Male	.38*	.12	.52*	.42*
03-Male	.56*	.50*	.37*	.45*
04-Male	.31	.19	.60*	.39*
05-Male	.16	.07	.18	.12
06-Male	.19	.64*	.37*	.43*
07-Male	.33*	.16	.44*	.29*
08-Male	.31	.34*	.38*	.34*
09-Female	.43*	.19	-.16	.19
11-Female	.50*	.23	.16	.29*
12-Female	.28	-.13	.12	.10
13-Female	.54*	.18	.55*	.39*
14-Female	.55*	.68*	.63*	.65*
15-Female	.50*	.46*	.49*	.48*
16-Female	.32*	.43*	.26	.32*
18-Female	.43*	-.03	-.27	.05
19-Female	.29	.36*	-.14	.14
20-Female	.23	.06	.51*	.33*
21-Female	.43*	.32	.28	.35*

* $p < .05$

Table IX

Correlation Coefficients Obtained Between
CNV Amplitude (M3) and P3 Amplitude

S	Cond.A1	Cond.B	Cond.A2	Overall
01-Male	.31*	.30*	.20	.38*
03-Male	.61*	.40*	.32	.46*
04-Male	.41*	.33	.29	.30*
05-Male	.35	.03	.22	.13
06-Male	.47*	.49*	.66*	.55*
07-Male	.07	.31	.41*	.27*
08-Male	.49*	.34	.36*	.38*
09-Female	.50*	.35	.21	.39*
11-Female	.19	.21	.34*	.29*
12-Female	.67*	.09	.09	.26*
13-Female	.25	.10	.27	.23*
14-Female	.36	.55*	.74*	.65*
15-Female	.25	.33*	.38*	.32*
16-Female	.30	.40*	.57*	.45*
18-Female	.12	.02	-.09	-.01
19-Female	-.14	.20	-.33*	-.16
20-Female	.45*	.29	.56*	.41*
21-Female	.33	.51*	.52*	.46*

* $p < .05$

Table X

Correlation Coefficients Obtained Between
CNV Integral Measure (M4) and P3 Amplitude

S	Cond.A1	Cond.B	Cond.A2	Overall
01-Male	.51*	.57*	.41*	.53*
03-Male	.69*	.65*	.47*	.62*
04-Male	.45*	.42*	.58*	.48*
05-Male	.38	.13	.10	-.10
06-Male	.51*	.62*	.75*	.62*
07-Male	.25	.30	.46*	.33*
08-Male	.46*	.46*	.42*	.42*
09-Female	.66*	.53*	.34	.56*
11-Female	.27	.32*	.48*	.59*
12-Female	.55*	.22	.22	.34*
13-Female	.50*	.35*	.33	.38*
14-Female	.53*	.65*	.74*	.71*
15-Female	.49*	.64*	.59*	.57*
16-Female	.65*	.51*	.80*	.66*
18-Female	.29	.16	-.25	.01
19-Female	.09	.25	-.32	-.07
20-Female	.56*	.51*	.71*	.56*
21-Female	.50*	.75*	.60*	.60*

* $p < .05$

Table XI

correlations were obtained for all Ss but three between P3 amplitude and M3 (table X). P3 and M4 were as consistently correlated as P3 and M3 and, in addition, the correlation coefficients were generally larger (table XI). These results support the hypothesis that the amplitude of the positive components of the EP to S1 is related to CNV amplitude such that large amplitude CNVs are associated with low amplitude EP positivity.

P2, P3 and N1

Table XII and XIII present the correlation coefficients between both P2 and P3 amplitudes and N1 amplitude. For all of the Ss N1 and P2 amplitudes were positively correlated (table XII). 13 of these correlations were significant ($p \leq .05$). However N1 and P3 were not as well correlated as a positive correlation was obtained for only 16 of the 18 Ss (table XIII). Of these 16 correlations 9 were statistically significant. Thus it appears that both P2 and P3 are related to N1 such that large N1 amplitudes tend to be related to low amplitude P2 and P3 components. However this relation appears to be more robust for N1 and P2 than for N1 and P3.

Correlation Coefficients Obtained Between
N1 and P2 Amplitudes

S	Cond.A1	Cond.B	Cond.A2	Overall
01-Male	.35*	.17	.25	.28*
03-Male	.09	.41*	.33	.28*
04-Male	.02	.06	.48*	.24*
05-Male	.25	.54*	.19	.28*
06-Male	.61*	.36*	.40*	.46*
07-Male	.01	-.14	.22	.03
08-Male	.48*	.27	-.06	.21*
09-Female	.41*	.43*	.21	.33*
11-Female	.25	.00	.16	.13
12-Female	.27	.09	.09	.14
13-Female	.27	.23	.21	.23*
14-Female	.43*	.59*	.70*	.58*
15-Female	.40*	.59*	.34*	.44*
16-Female	.35*	.27	.18	.28*
18-Female	.32*	-.11	-.03	.08
19-Female	.04	.04	-.02	.01
20-Female	.30	.39*	.47*	.36*
21-Female	.46*	.57*	.17	.37*

* p< .05

Table XII

Correlation Coefficients Obtained Between
N1 and P3 Amplitudes

<u>S</u>	Cond.A1	Cond.B	Cond.A2	Overall
01-Male	.21	.35*	.18	.29*
03-Male	.23	.31	.35*	.30*
04-Male	.35	.03	.39*	.19
05-Male	.38	.44*	.14	.29*
06-Male	.11	.22	.20	.13
07-Male	.19	.09	-.07	.07
08-Male	.08	-.10	-.04	-.03
09-Female	.11	.48*	.17	.22*
11-Female	-.43*	.02	.04	-.09
12-Female	.34	.33	.18	.34*
13-Female	.47*	.21	.18	.28*
14-Female	.33	.65*	.69*	.56*
15-Female	.04	.29	.21	.17
16-Female	.27	.19	.34	.20
18-Female	.08	.40*	.19	.17
19-Female	-.01	.08	.13	.06
20-Female	.38*	.20	.61*	.36*
21-Female	.24	.23	.30	.23*

* $p < .05$

Table XIII

P2 and P3

Table XIV illustrates the direct relationship observed between the P2 and P3 components of the EP to S1. For all of the Ss the two positive components were positively related and 15 of these correlations were statistically significant ($p \leq .05$). These findings support the hypothesis that P2 and P3 are directly related so that large P2 amplitudes tend to be associated with large P3 amplitudes.

Pooled Correlations

Because of the consistent pattern of correlations observed between the CNV and EP measures the single-trial data was pooled over all males, all females and all subjects to examine overall patterns of CNV and EP relationship by sex. These correlations are presented in table XVI. It can be seen that the correlation between M3 and M4 of the CNV were uniformly and significantly high regardless of sex. However, the correlations between M3 and the EP components, particularly N1 and P2, appear to interact with sex. N1 amplitude correlated more highly with M3 for males than for females whereas for P2 the reverse was found. The differences for P3 are not as obvious.

Correlation Coefficients Obtained Between
P2 and P3 Amplitude

S	Cond.A1	Cond.B	Cond.A2	Overall
01-Male	.33*	-.08	.43*	.34*
03-Male	.61*	.48*	.36*	.45*
04-Male	.43*	-.05	.62*	.26*
05-Male	-.11	.44*	.19	.13
06-Male	.02	.56*	.15	.25*
07-Male	.16	.36*	.06	.20*
08-Male	.53*	.54*	.14	.34*
09-Female	.15	.20	.09	.18
11-Female	.09	-.05	.24	.07
12-Female	.65*	.48*	.21	.45*
13-Female	.25	.27	.26	.26*
14-Female	.71*	.58*	.54*	.64*
15-Female	.38*	.46*	.58*	.48*
16-Female	.45*	.28	.21	.31*
18-Female	.26	.57*	.36*	.36*
19-Female	.43*	.31	.30	.35*
20-Female	.17	.28	.60*	.40*
21-Female	.69*	.21	.35	.44*

* $p < .05$

Table XIV

Correlation Coefficients Obtained Between
CNV Amplitude (M3) and Integral Measures (M4)

S	Cond.A1	Cond.B	Cond.A2	Overall
01-Male	.69*	.69*	.84*	.78*
03-Male	.86*	.86*	.84*	.84*
04-Male	.77*	.84*	.86*	.82*
05-Male	.80*	.89*	.81*	.84*
06-Male	.81*	.89*	.90*	.87*
07-Male	.79*	.84*	.82*	.82*
08-Male	.90*	.72*	.85*	.84*
09-Female	.81*	.88*	.93*	.87*
11-Female	.92*	.85*	.87*	.89*
12-Female	.75*	.87*	.64*	.76*
13-Female	.77*	.77*	.78*	.78*
14-Female	.83*	.83*	.87*	.87*
15-Female	.87*	.86*	.77*	.84*
16-Female	.77*	.77*	.83*	.79*
18-Female	.92*	.84*	.86*	.88*
19-Female	.85*	.71*	.91*	.83*
20-Female	.84*	.80*	.90*	.85*
21-Female	.78*	.87*	.90*	.86*

* $p < .05$

Table XV

Correlation Coefficients Obtained Between CNV Amplitude (M3) and CNV Integral (M4), N1, P2 and P3 Using Single Trial Data Pooled Over Males, Females and All Ss

	CNV Ampl (M3) (X) CNV INT (M4)	N1 Ampl	P2 Ampl	P3 Ampl
Males	.84*	.22*	.09*	.33*
Females	.85*	.11*	.22*	.29*
All Ss	.84*	.14*	.17*	.27*

*p<.05

Table XVI

All of the correlations are significant ($p \leq .05$) and in the direction hypothesized for the within-S correlations.

Within-S Analysis of Variance

Figures 22-39 present the CNV and EP data averaged by condition for each of the 18 Ss. Examination of these figures reveals that for each of the Ss the expected substantial decrement in CNV amplitude during the "B" condition did not occur. In fact, for most Ss CNV amplitude was increased as a result of the negative reinforcement. This trend is illustrated in figures 40 and 41 which are plots of the condition means for the Cz M3 and M4 CNV measures for each of the subjects. Similar plots for the reaction time and EP data are presented in figures 42-45. Examination of these figures shows that reaction time (figure 42) generally decreased over conditions. Furthermore this decrease was more pronounced between the "A1" and the "B" condition than between the "B" and the "A2" condition. The EP amplitudes were inconsistently related to the conditions as some subjects showed increased and others decreased amplitude between the A1 and B condition. These condition mean values for all single-trial measures are tabled in Appendix B. To statistically examine these condition effects

Figure 22

Fz, Cz and Pz CNV Data Averaged

by Condition for Subject 01 (Male)

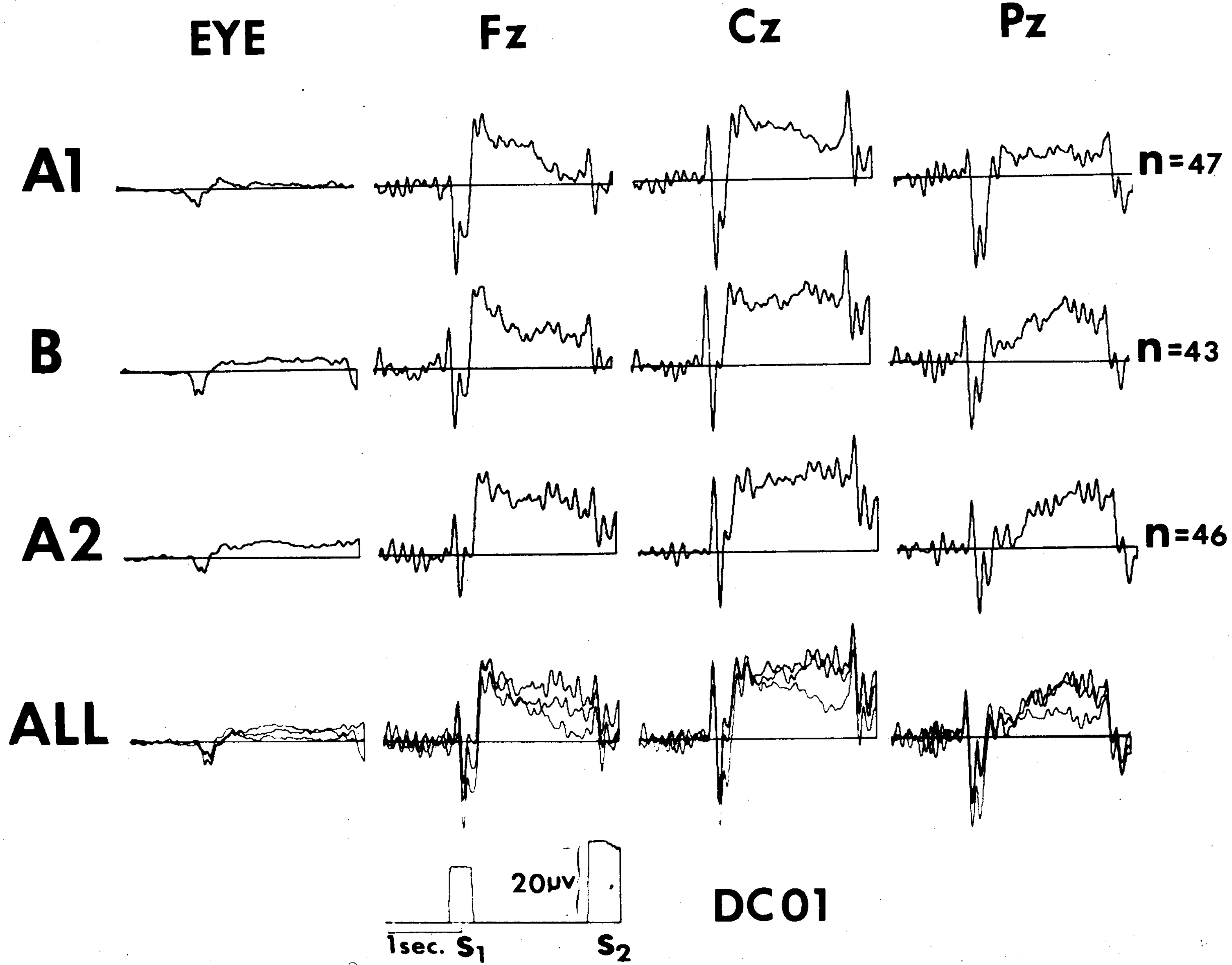

EYE
Fz
Cz
Pz
A1
B
A2
ALL
n=47
n=43
n=46
20μv
1sec.
S_1
S_2
DC01

Figure 23

Fz, Cz and Pz CNV Data Averaged

by Condition for Subject 03 (Male)

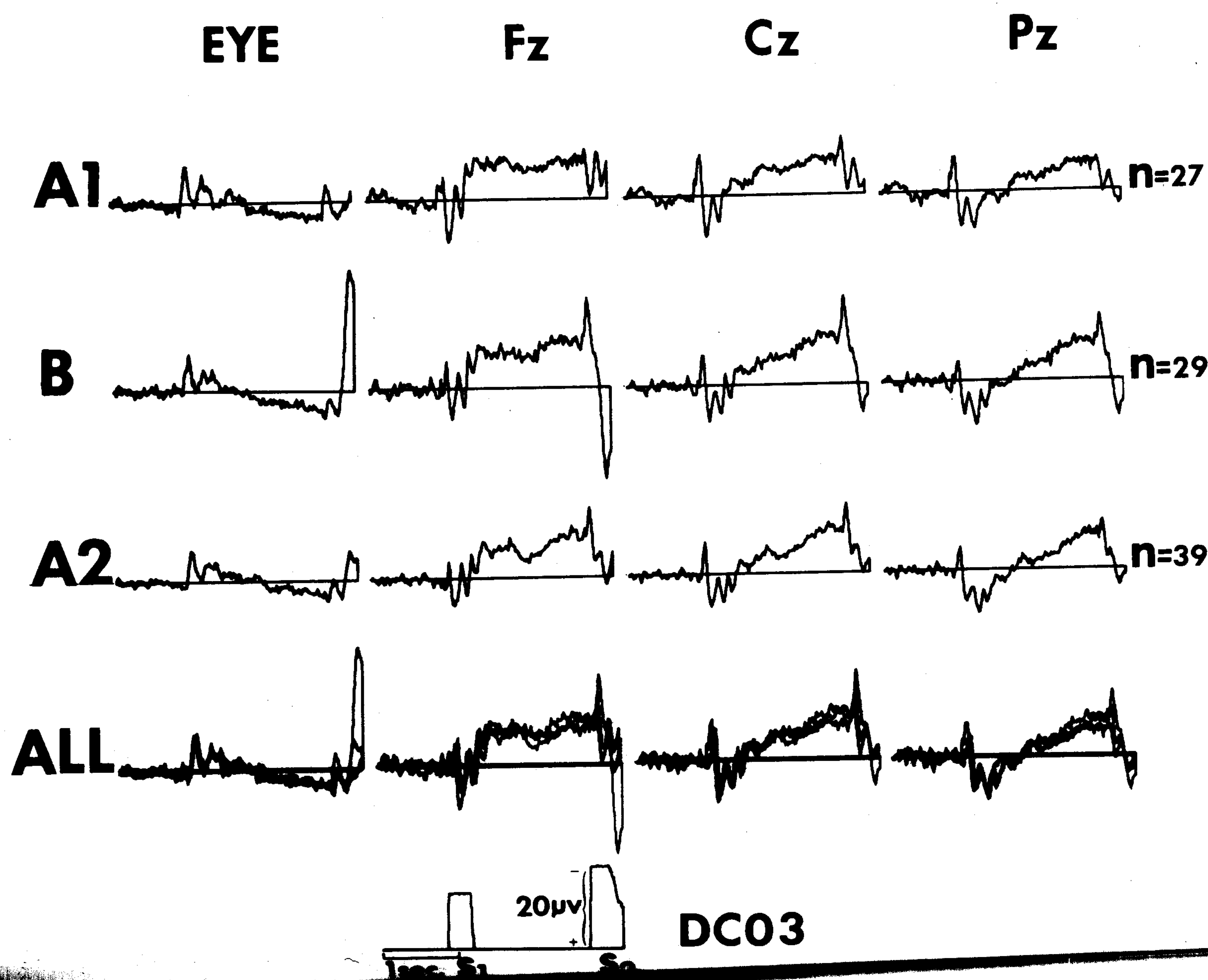

EYE
Fz
Cz
Pz
A1
n=27
B
n=29
A2
n=39
ALL
20µv
S1
So
DC03

Figure 24

Fz, Cz and Pz CNV Data Averaged
by Condition for Subject 04 (Male)

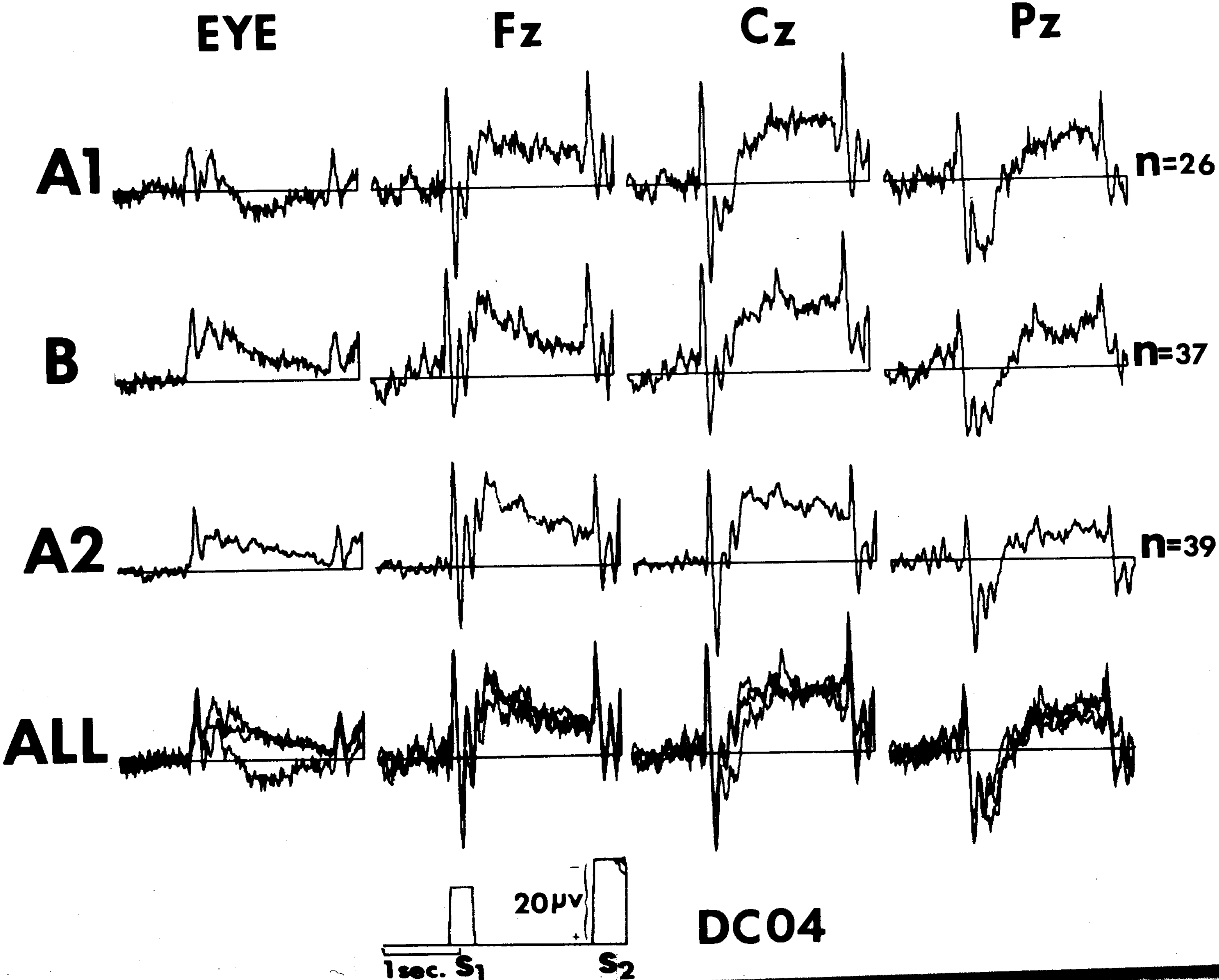

EYE
Fz
Cz
Pz
A1
n=26
B
n=37
A2
n=39
ALL
20μv
+
-
1sec.
S_1
S_2
DC04

Figure 25

Fz, Cz and Pz CNV Data Averaged

by Condition for Subject 05 (Male)

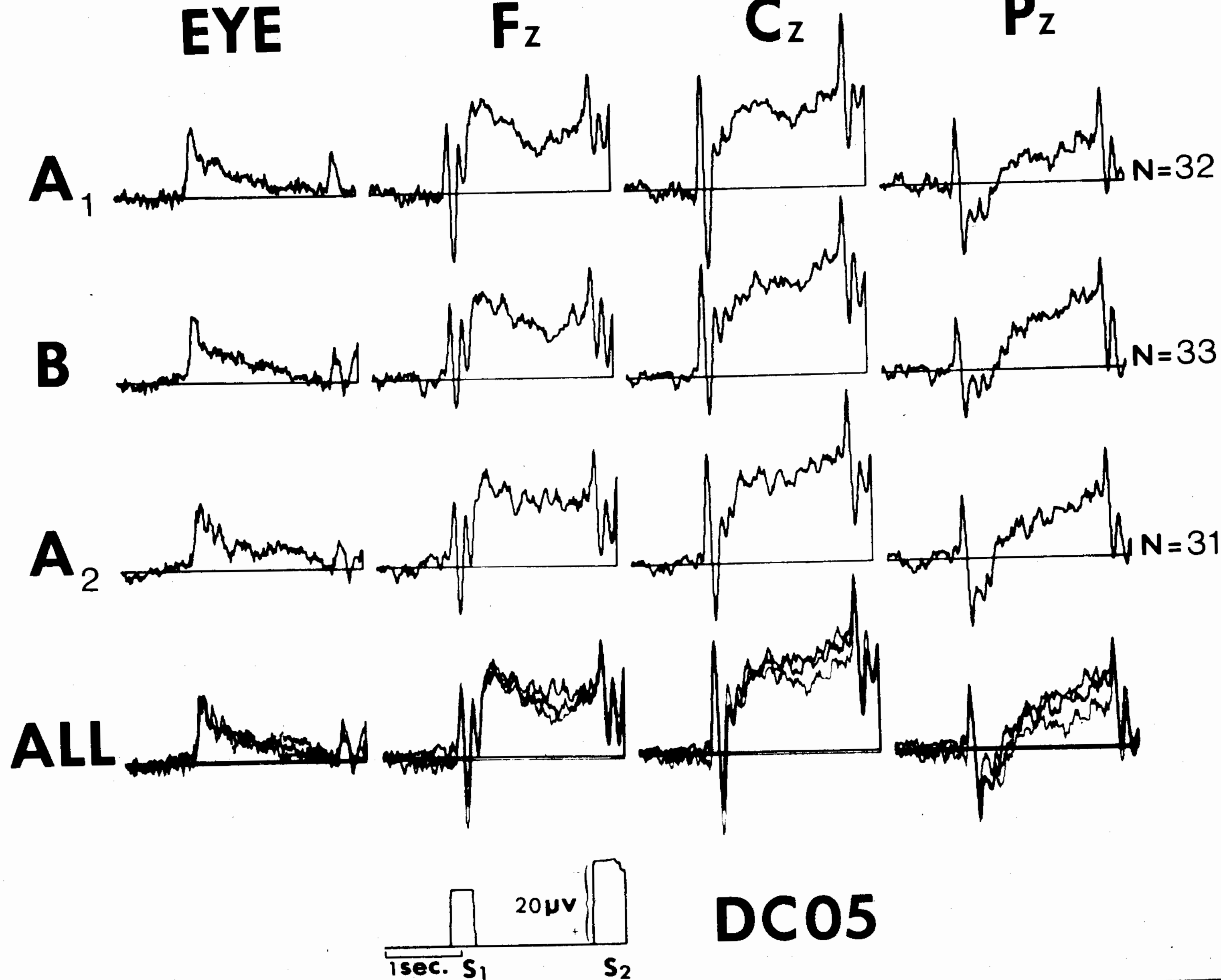

EYE
F_z
C_z
P_z
A_1
B
A_2
ALL
N=32
N=33
N=31
20μv
1sec.
S_1
S_2
DC05

Figure 26

Fz, Cz and Pz CNV Data Averaged

by Condition for Subject 06 (Male)

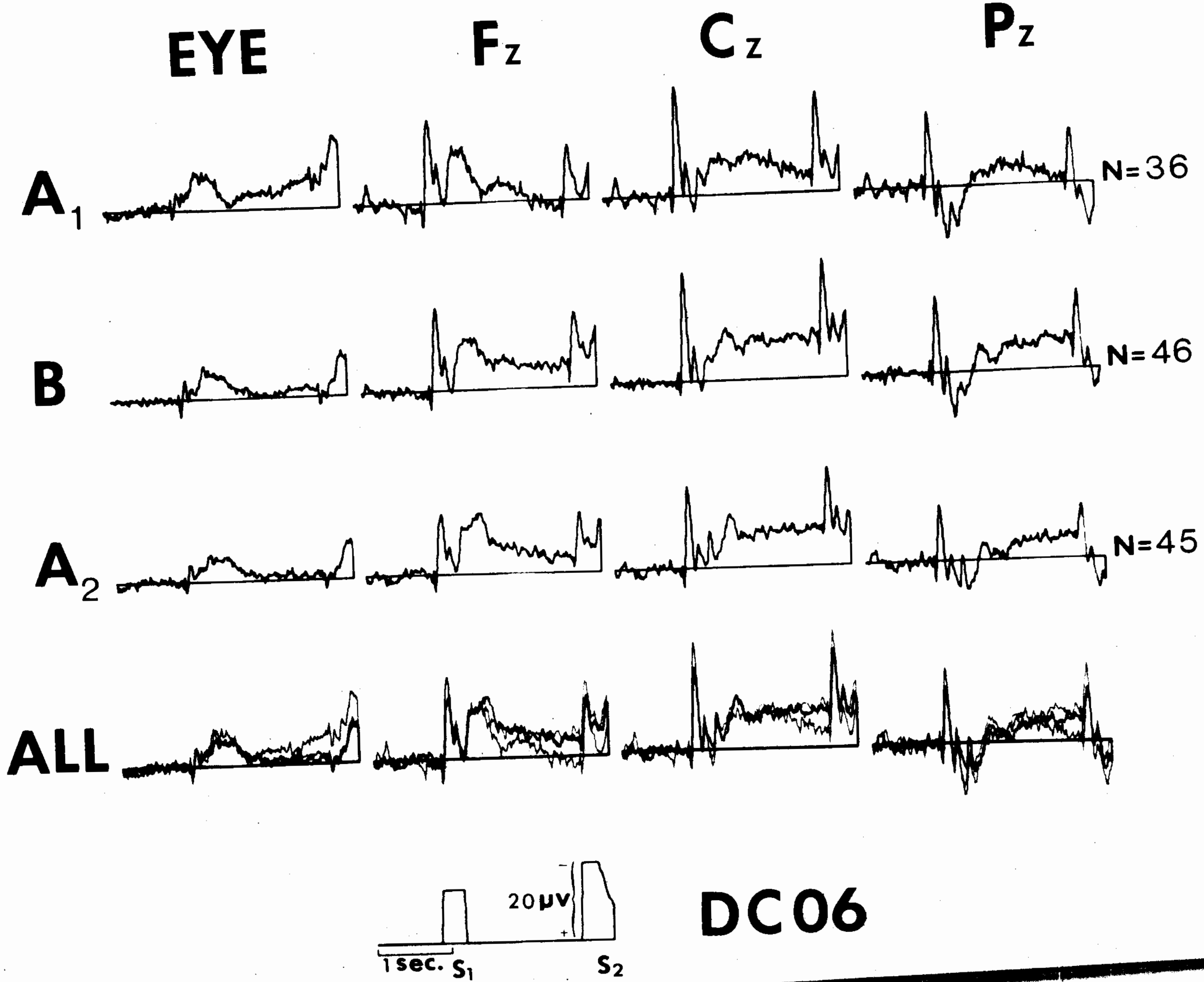

EYE
Fz
Cz
Pz
A1
B
A2
ALL
N=36
N=46
N=45
1 sec.
S1
20µV
S2
DC06

Figure 27

Fz, Cz and Pz CNV Data Averaged

by Condition for Subject 07 (Male)

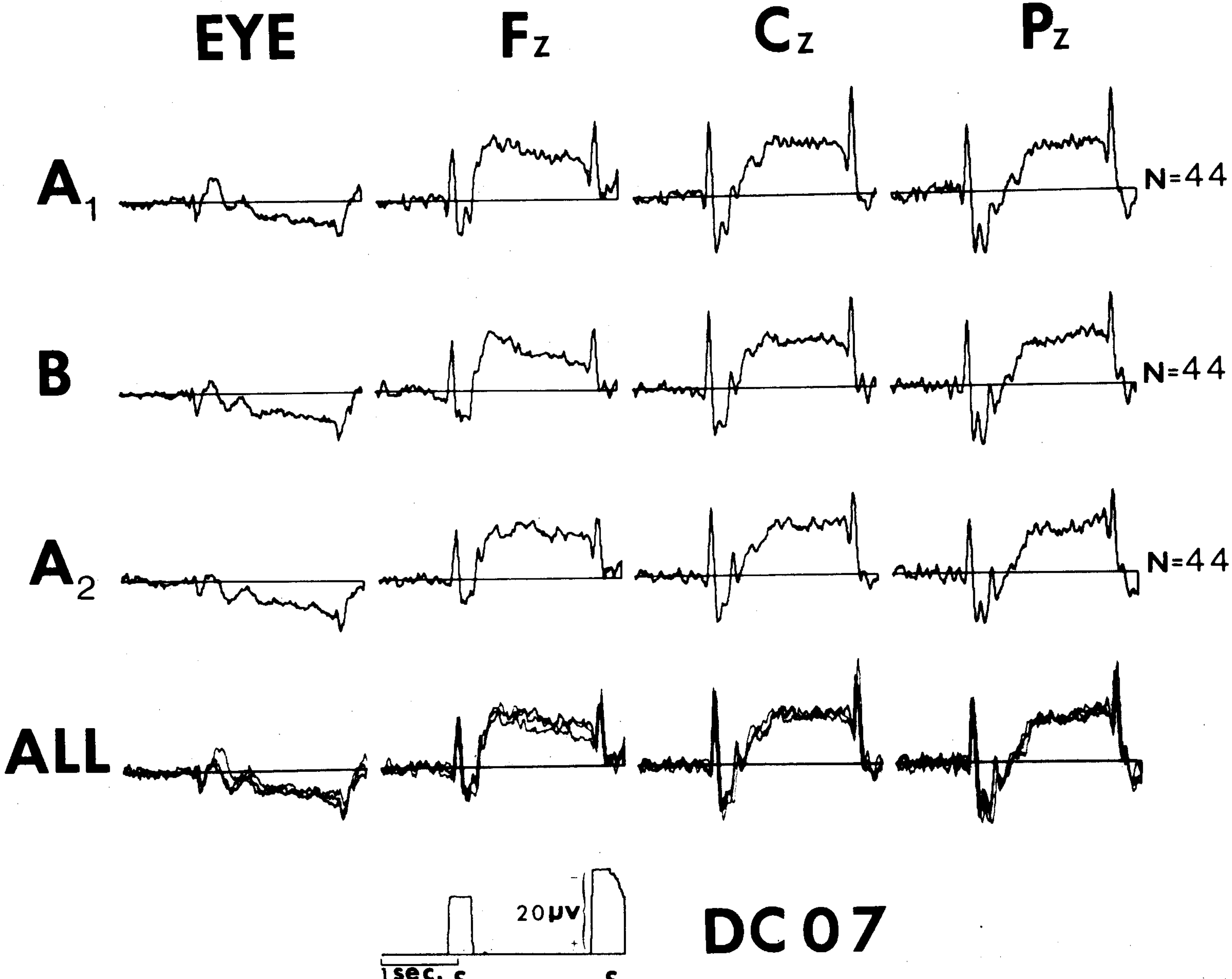

EYE
Fz
Cz
Pz
A1
B
A2
ALL
N=44
N=44
N=44
20μV
1sec.
S1
S2
DC07

Figure 28

Fz, Cz and Pz CNV Data Averaged

by Condition for Subject 08 (Male)

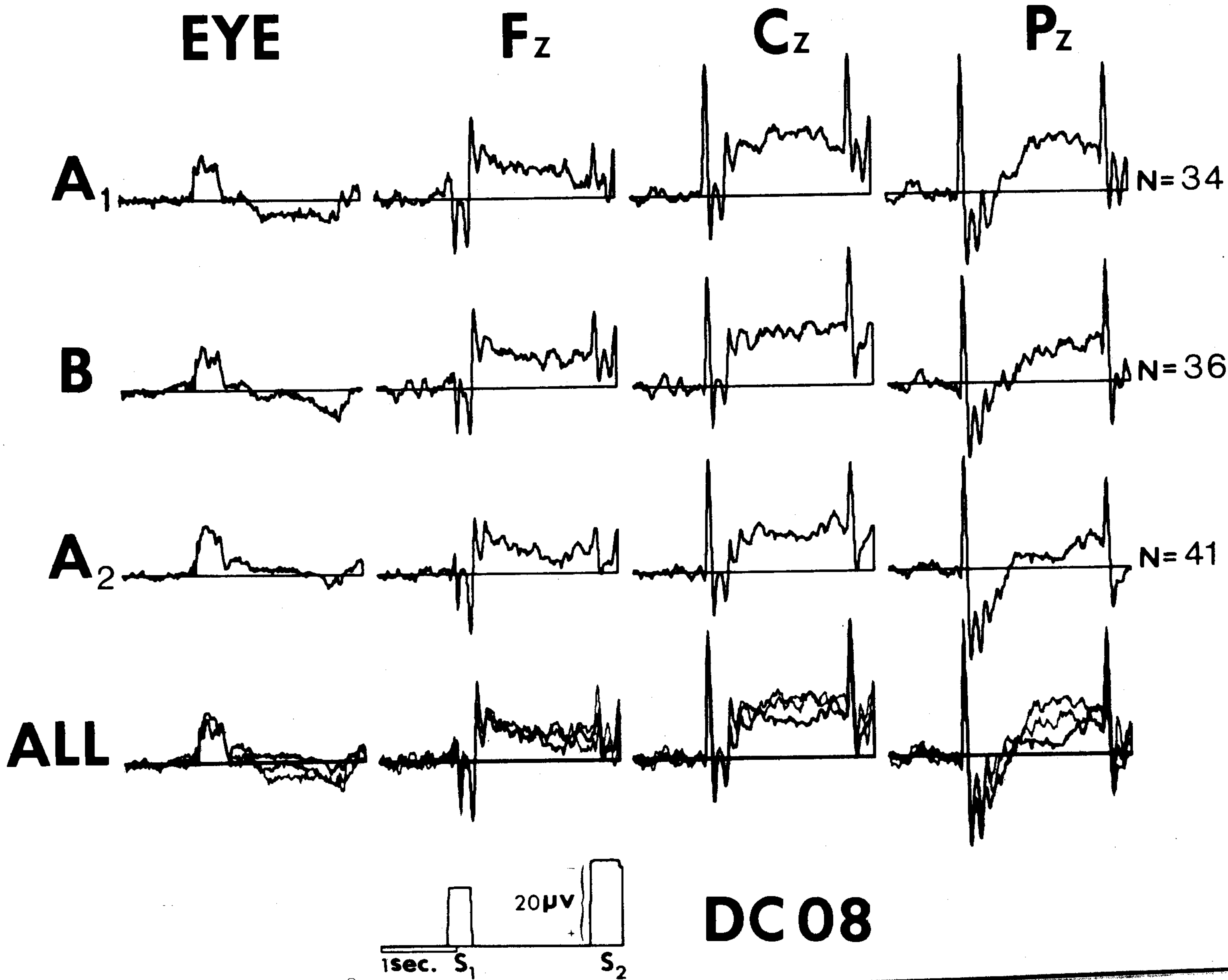

EYE
F_z
C_z
P_z
A_1
B
A_2
ALL
N= 34
N= 36
N= 41
20µv
1sec.
S_1
S_2
DC08

Figure 29

Fz, Cz and Pz CNV Data Averaged

by Condition for Subject 09 (Female)

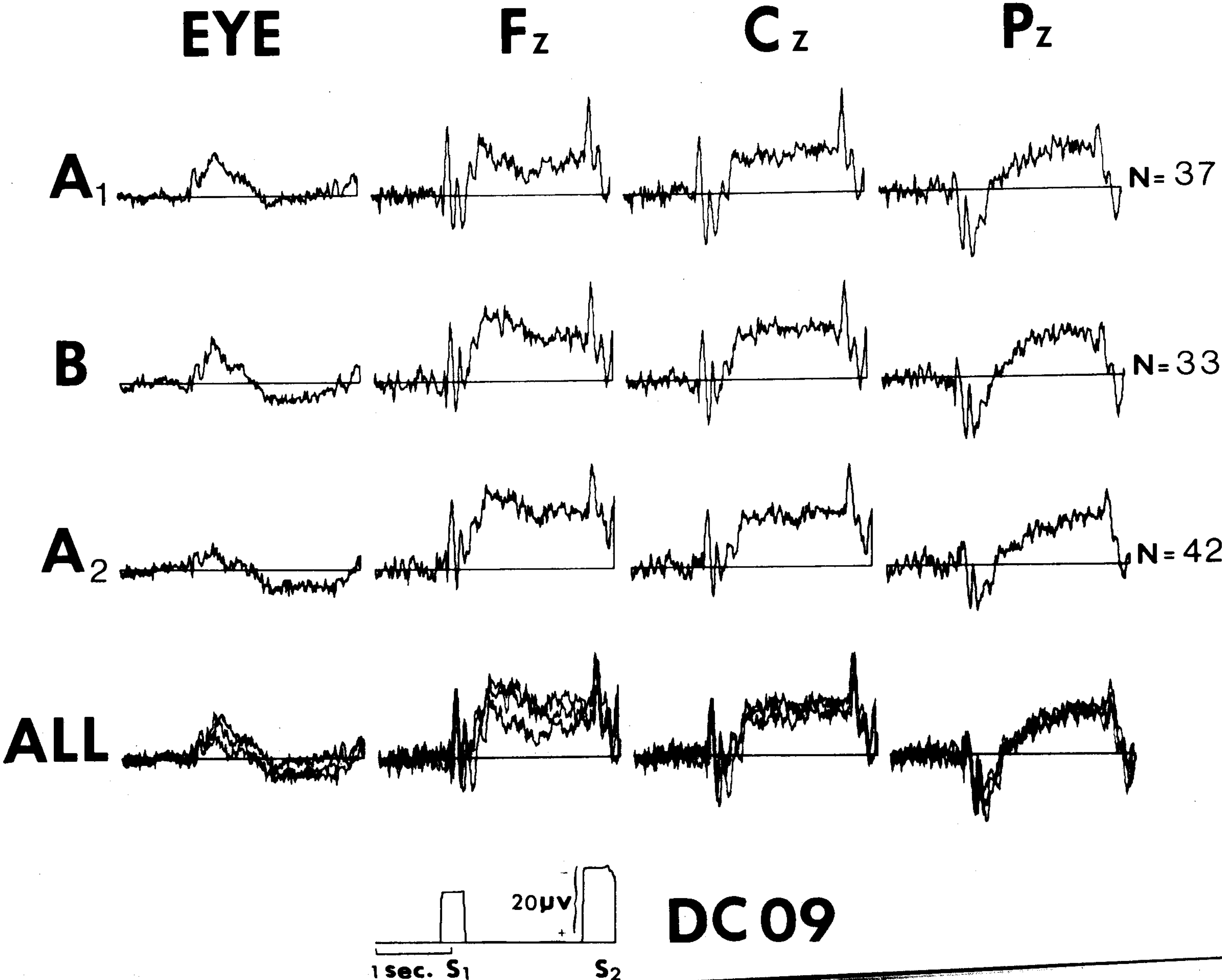

EYE
F_z
C_z
P_z
A_1
N = 37
B
N = 33
A_2
N = 42
ALL
20µv
1 sec.
S_1
S_2
DC09

Figure 30

Fz, Cz and Pz CNV Data Averaged
by Condition for Subject 11 (Female)

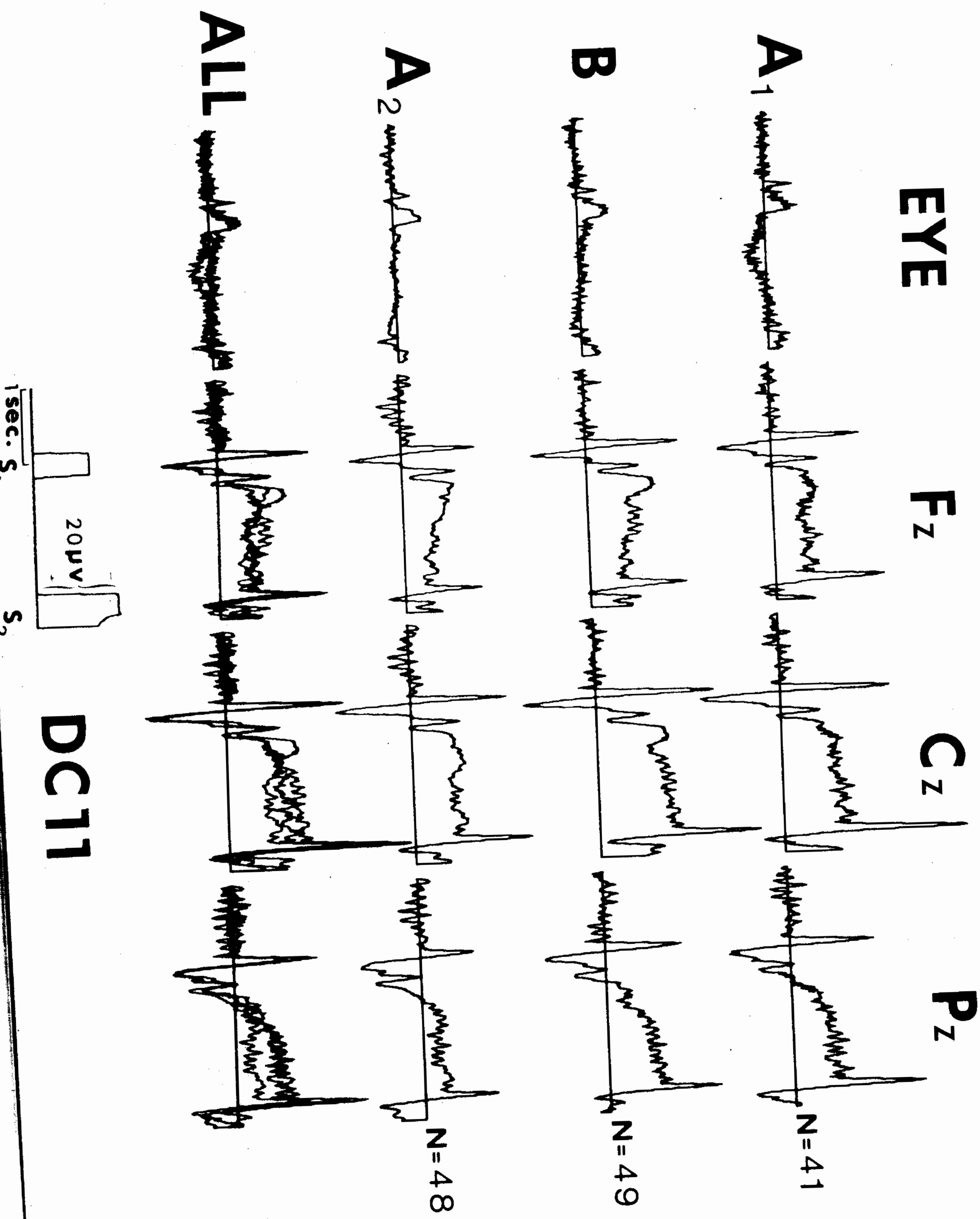
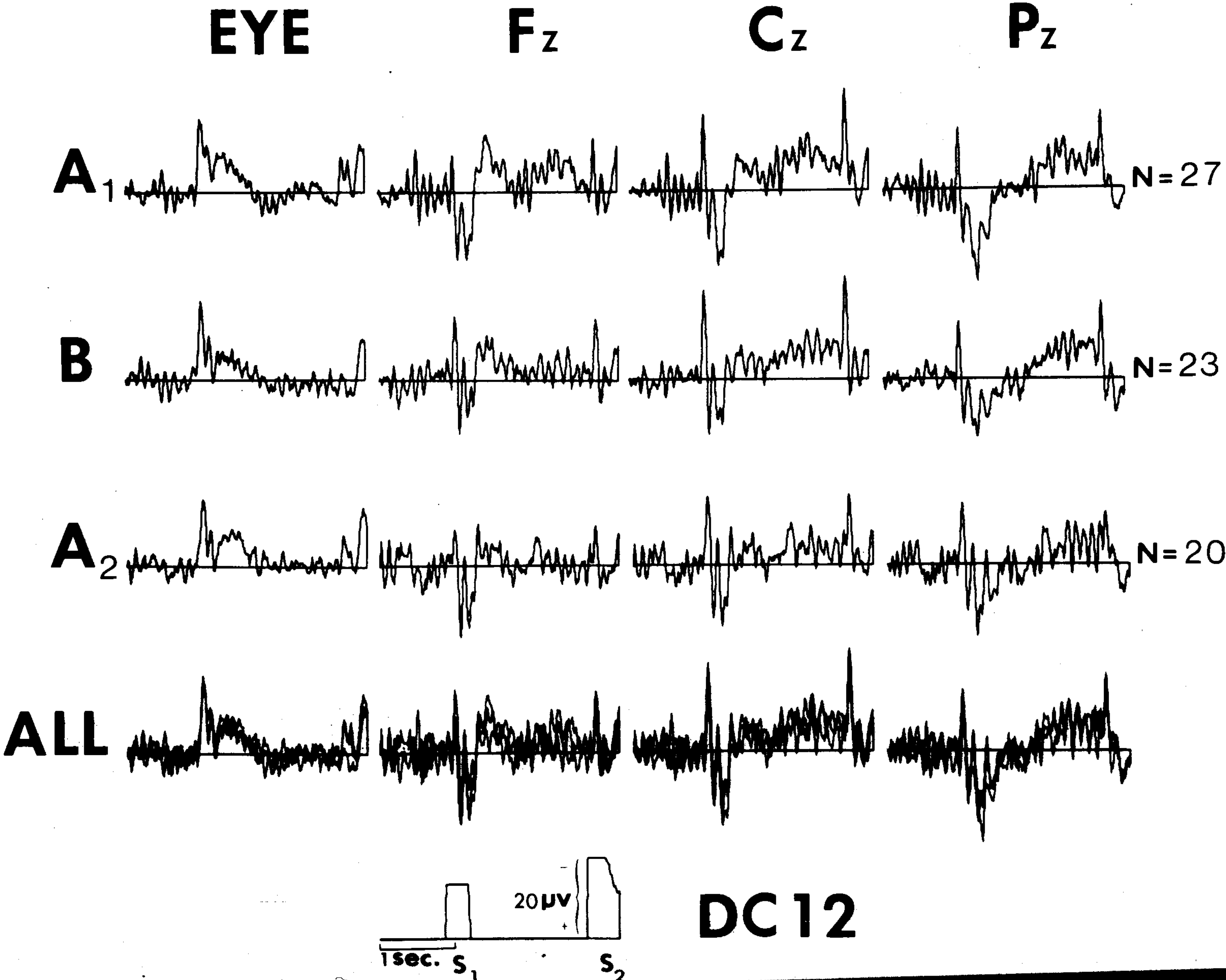

EYE
Fz
Cz
Pz
A1
B
A2
ALL
N=41
N=49
N=48
1sec.
S1
20µV
S2
DC11

Figure 31

Fz, Cz and Pz CNV Data Averaged

by Condition for Subject 12 (Female)



DC12

Figure 32

Fz, Cz and Pz CNV Data Averaged

by Condition for Subject 13 (Female)

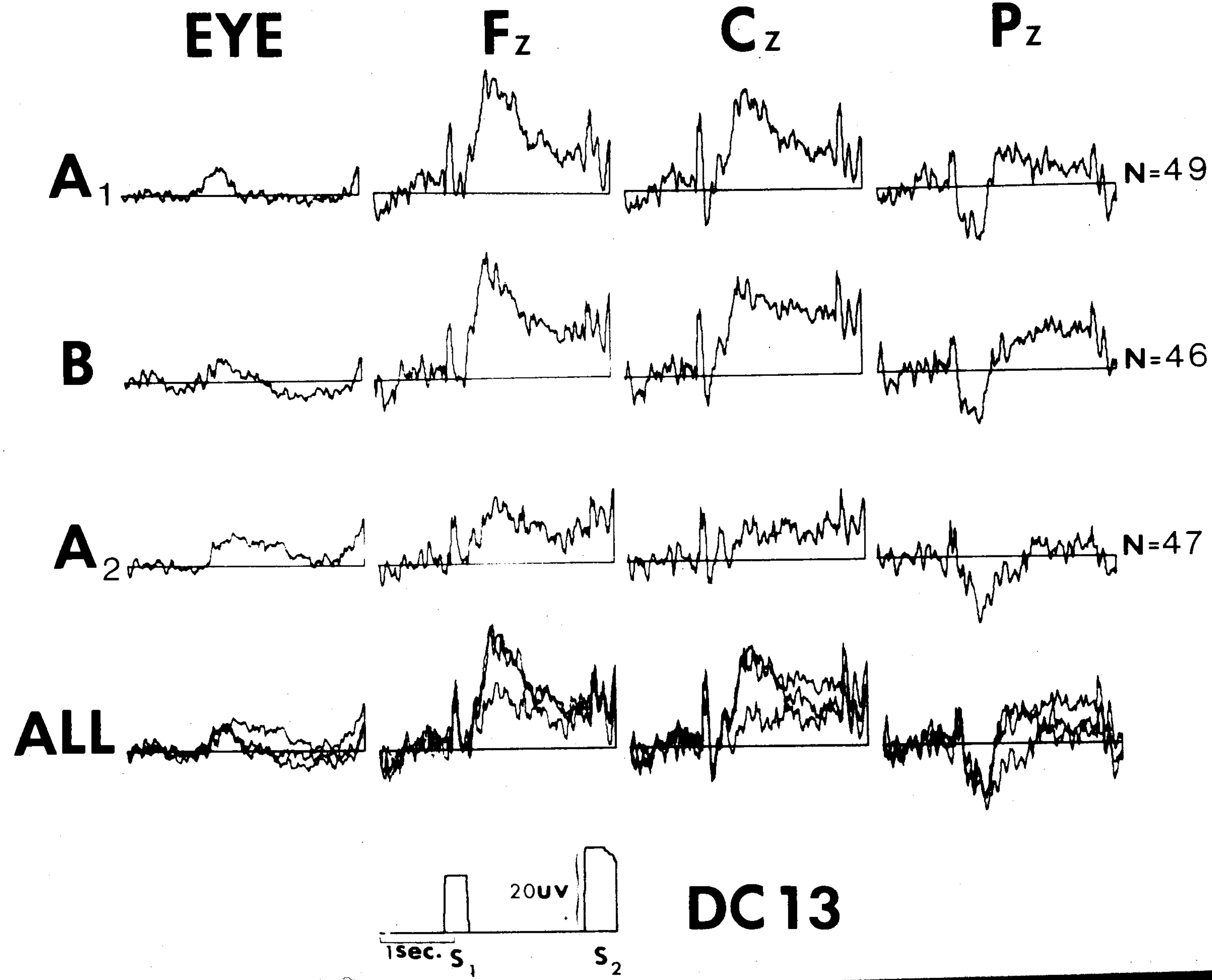
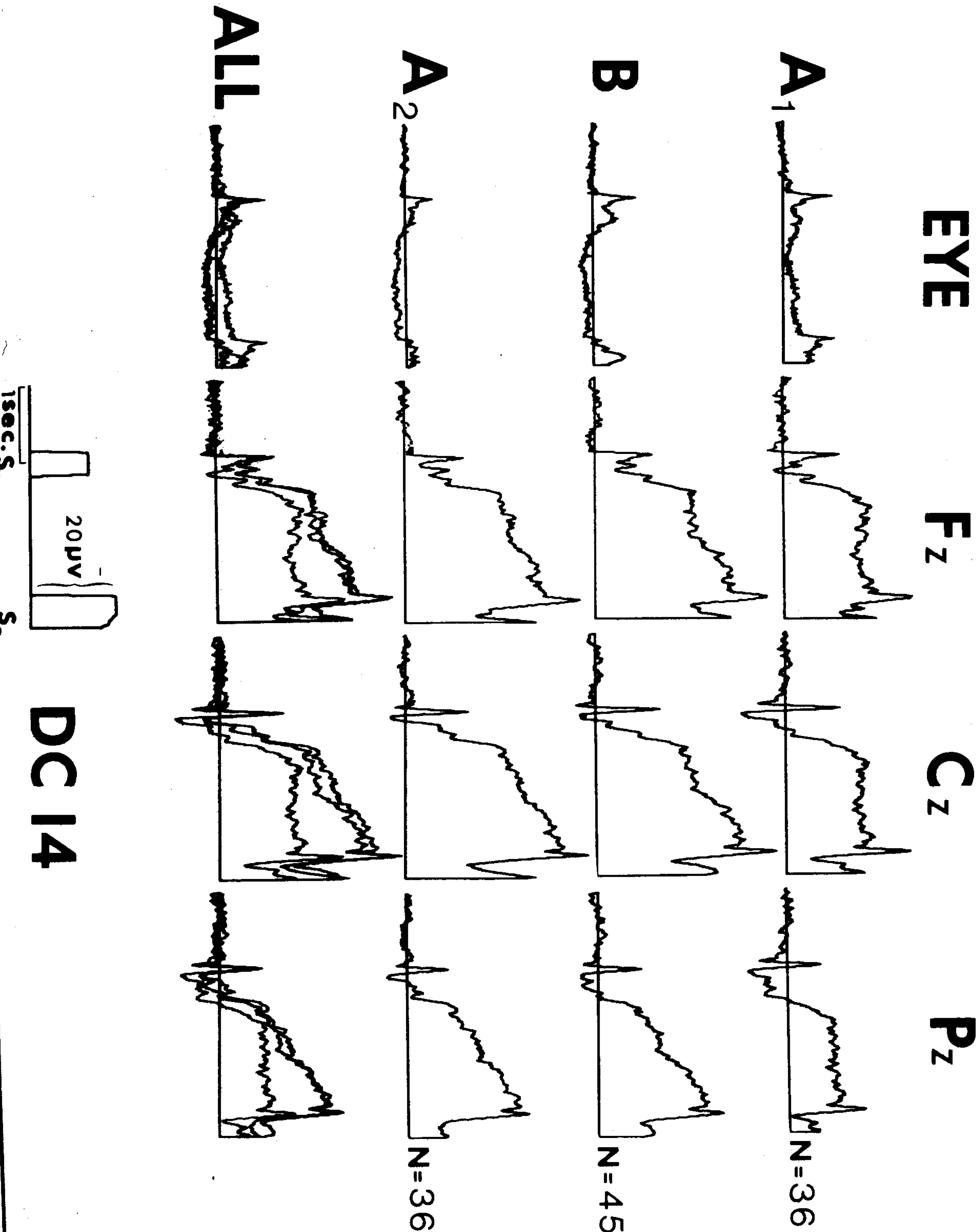

EYE
Fz
Cz
Pz
A1
B
A2
ALL
N=49
N=46
N=47
20UV
1sec.
S1
S2
DC13

Figure 33

Fz, Cz and Pz CNV Data Averaged

by Condition for Subject 14 (Female)



EYE
Fz
Cz
Pz
A1
B
A2
ALL
N=36
N=45
N=36
20μV
1sec. S1
S2
DC 14

Figure 34

Fz, Cz and Pz CNV Data Averaged

by Condition for Subject 15 (Female)

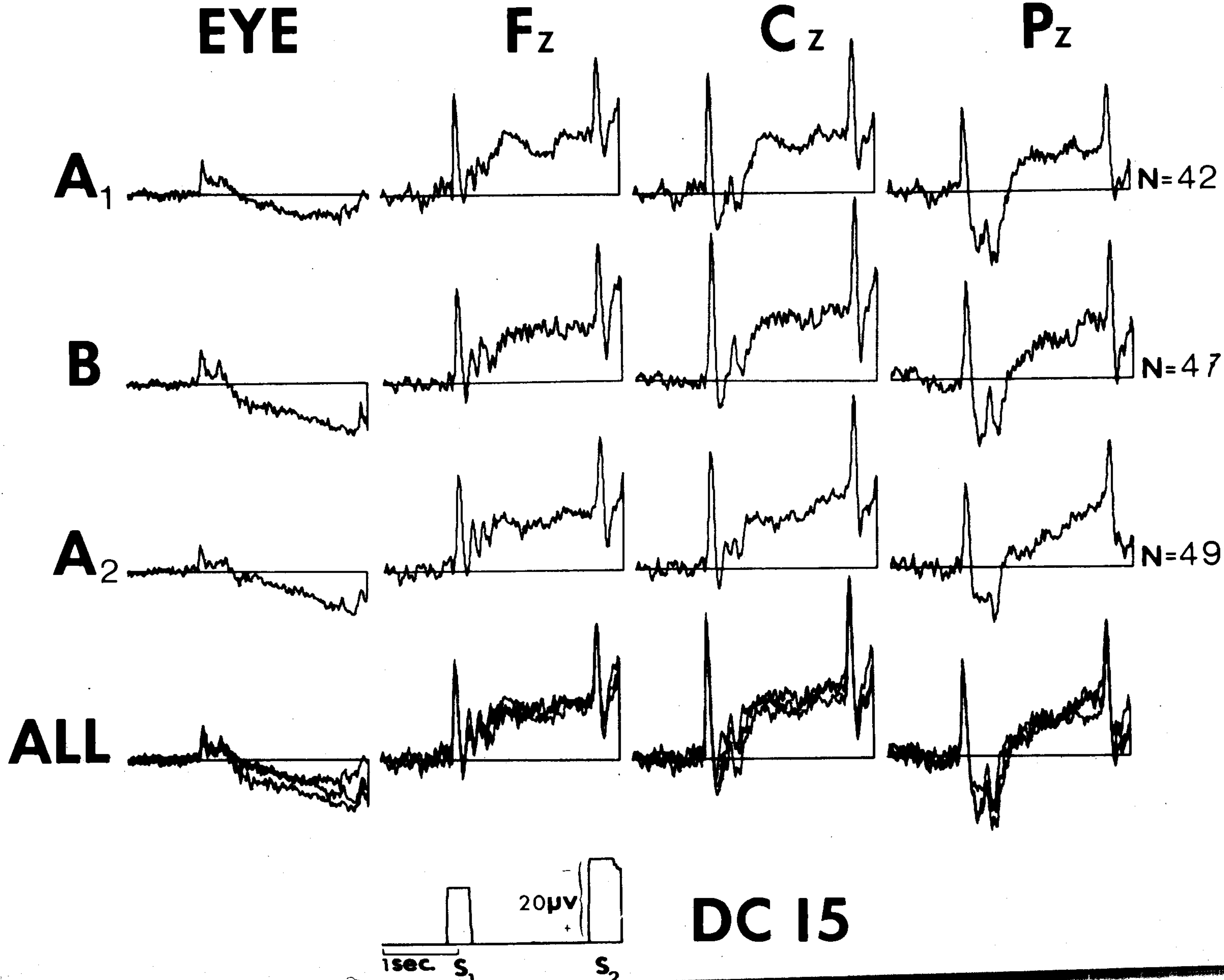
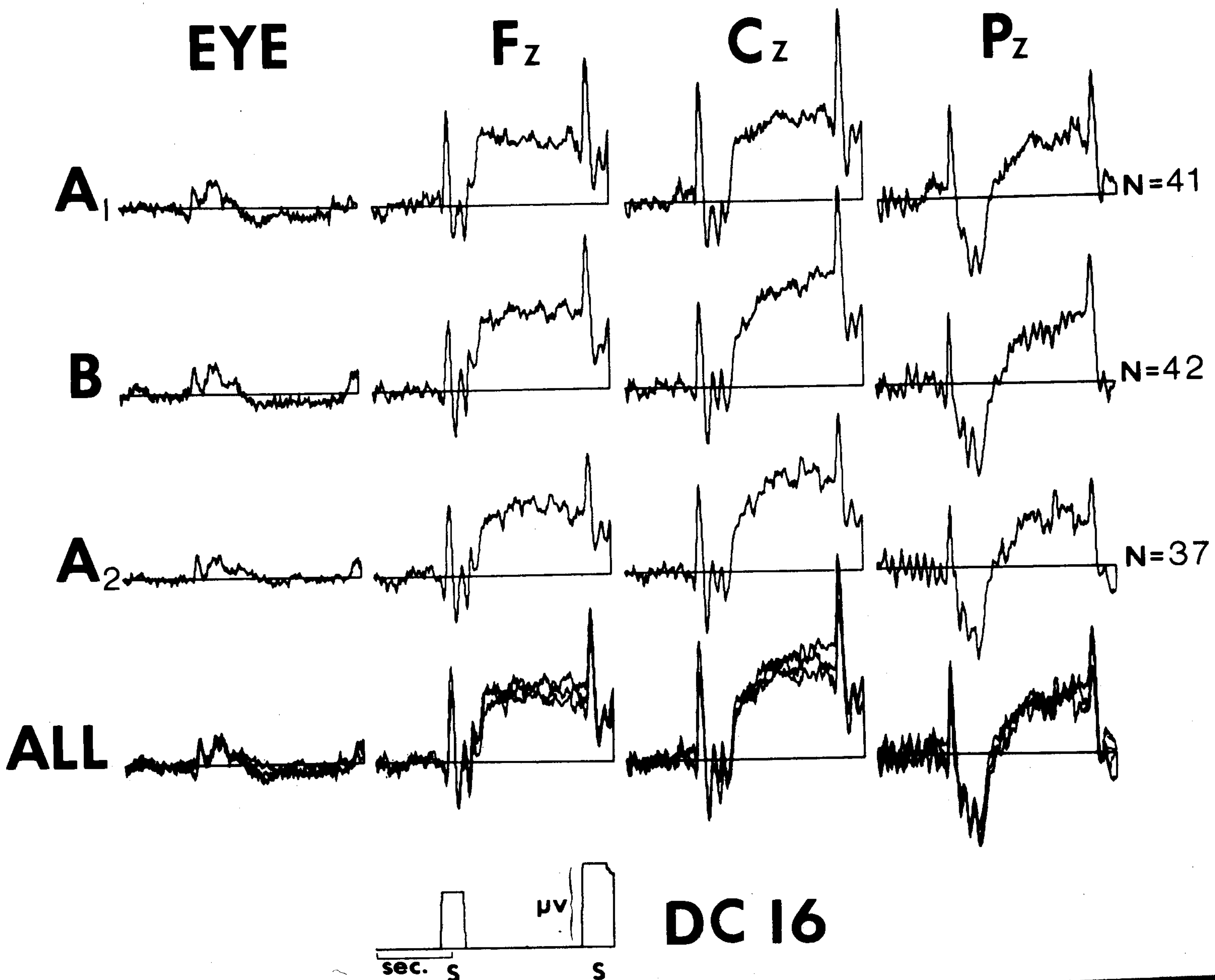

EYE
Fz
Cz
Pz
A1
B
A2
ALL
N=42
N=47
N=49
20μV
1sec.
S1
S2
DC 15

Figure 35

Fz, Cz and Pz CNV Data Averaged

by Condition for Subject 16 (Female)



EYE
Fz
Cz
Pz
A1
B
A2
ALL
N=41
N=42
N=37
μv
sec.
S
S
DC 16

Figure 36

Fz, Cz and Pz CNV Data Averaged

by Condition for Subject 18 (Female)

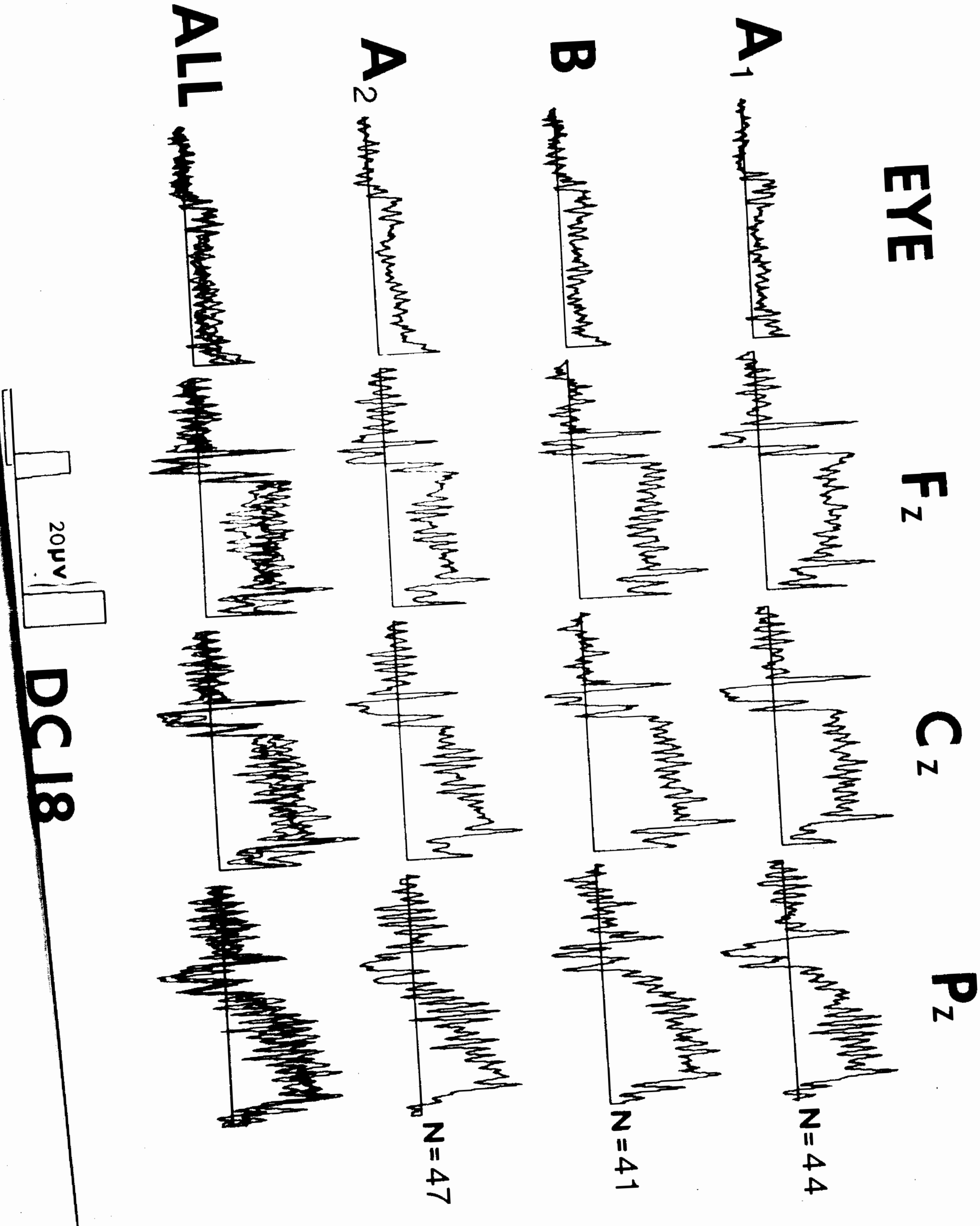
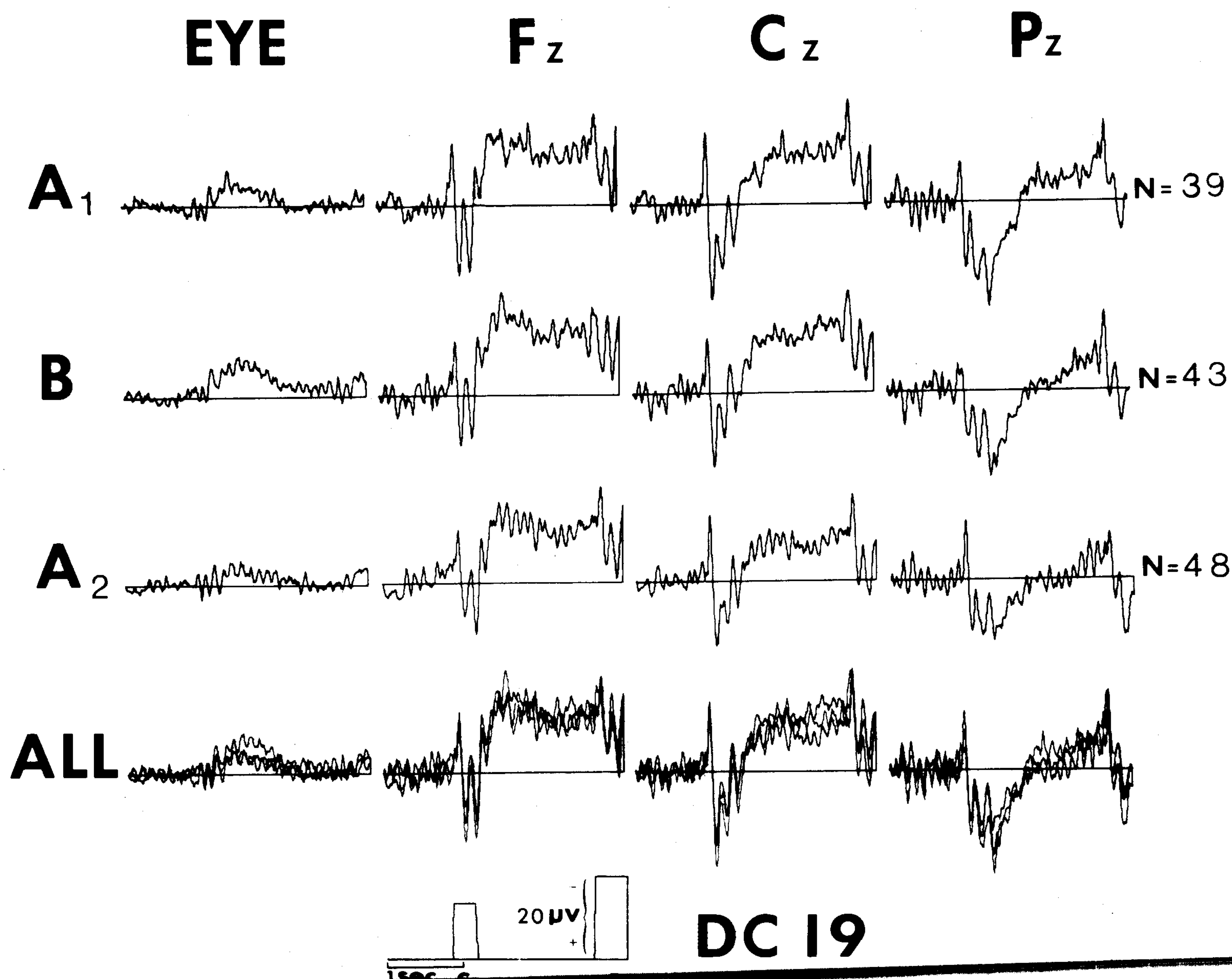

EYE
Fz
Cz
Pz
A1
B
A2
ALL
N=44
N=41
N=47
20μv
DC18

Figure 37

Fz, Cz and Pz CNV Data Averaged

by Condition for Subject 19 (Female)



DC 19

Figure 38

Fz, Cz and Pz CNV Data Averaged

by Condition for Subject 20 (Female)

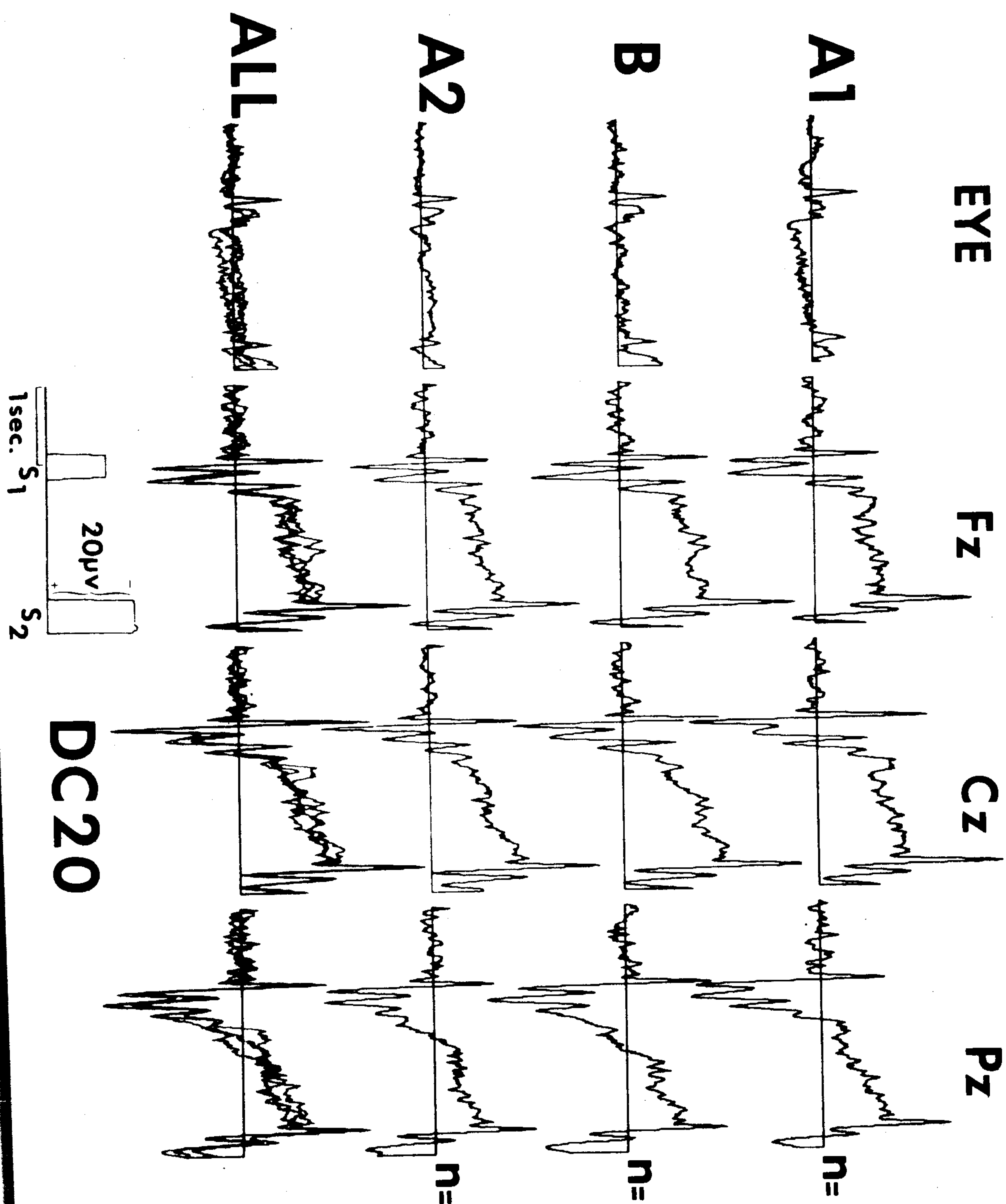

EYE
Fz
Cz
Pz
A1
B
A2
ALL
n=35
n=37
n=43
1sec.
S_1
S_2
20µv
DC20

Figure 39

Fz, Cz and Pz CNV Data Averaged

by Condition for Subject 21 (Female)

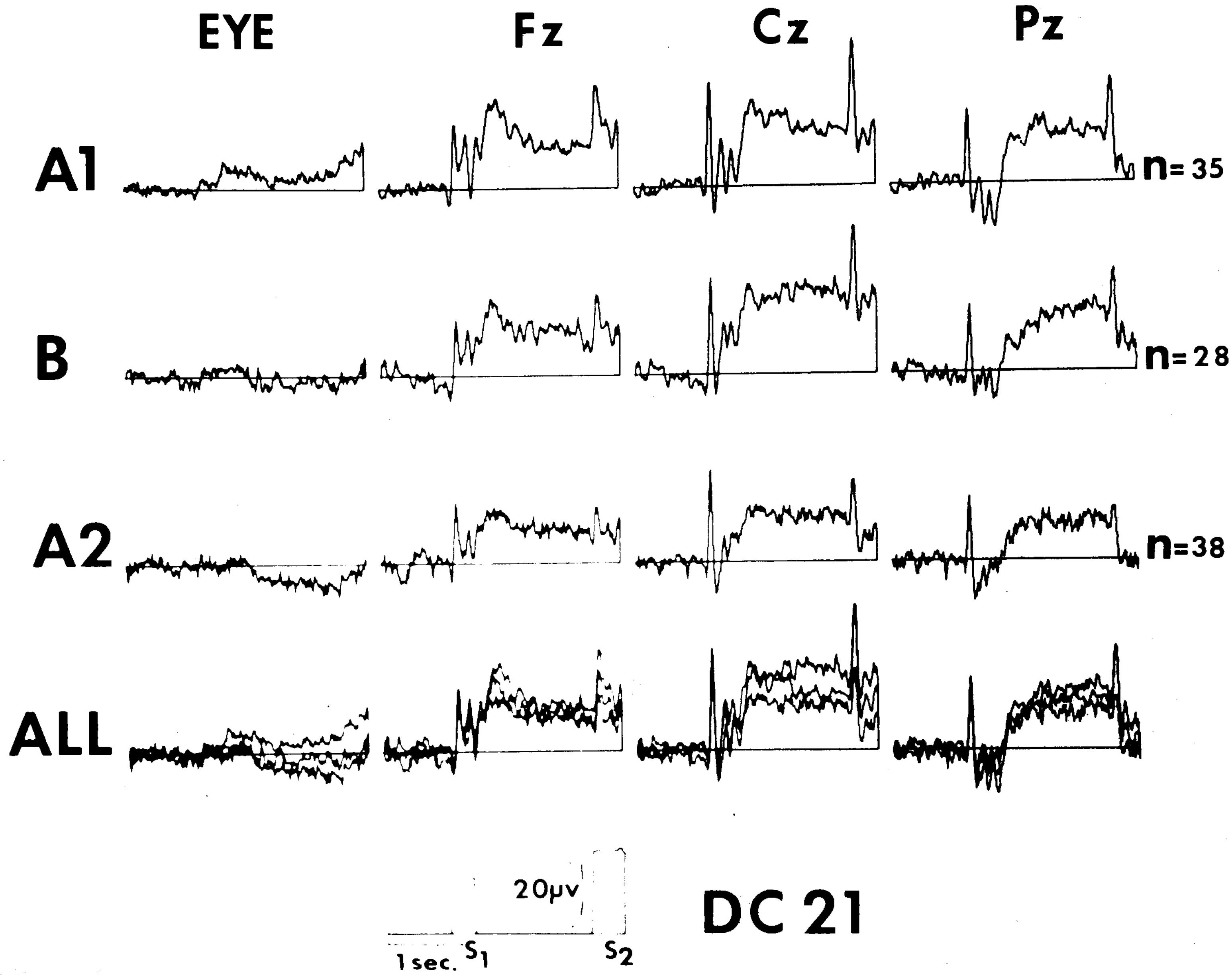

EYE
Fz
Cz
Pz
A1
B
A2
ALL
n= 35
n= 28
n=38
20μv
1 sec.
S_1
S_2
DC 21

Figure 40

Mean CNV Amplitude (M3) by Condition

for Each of the 18 Subjects

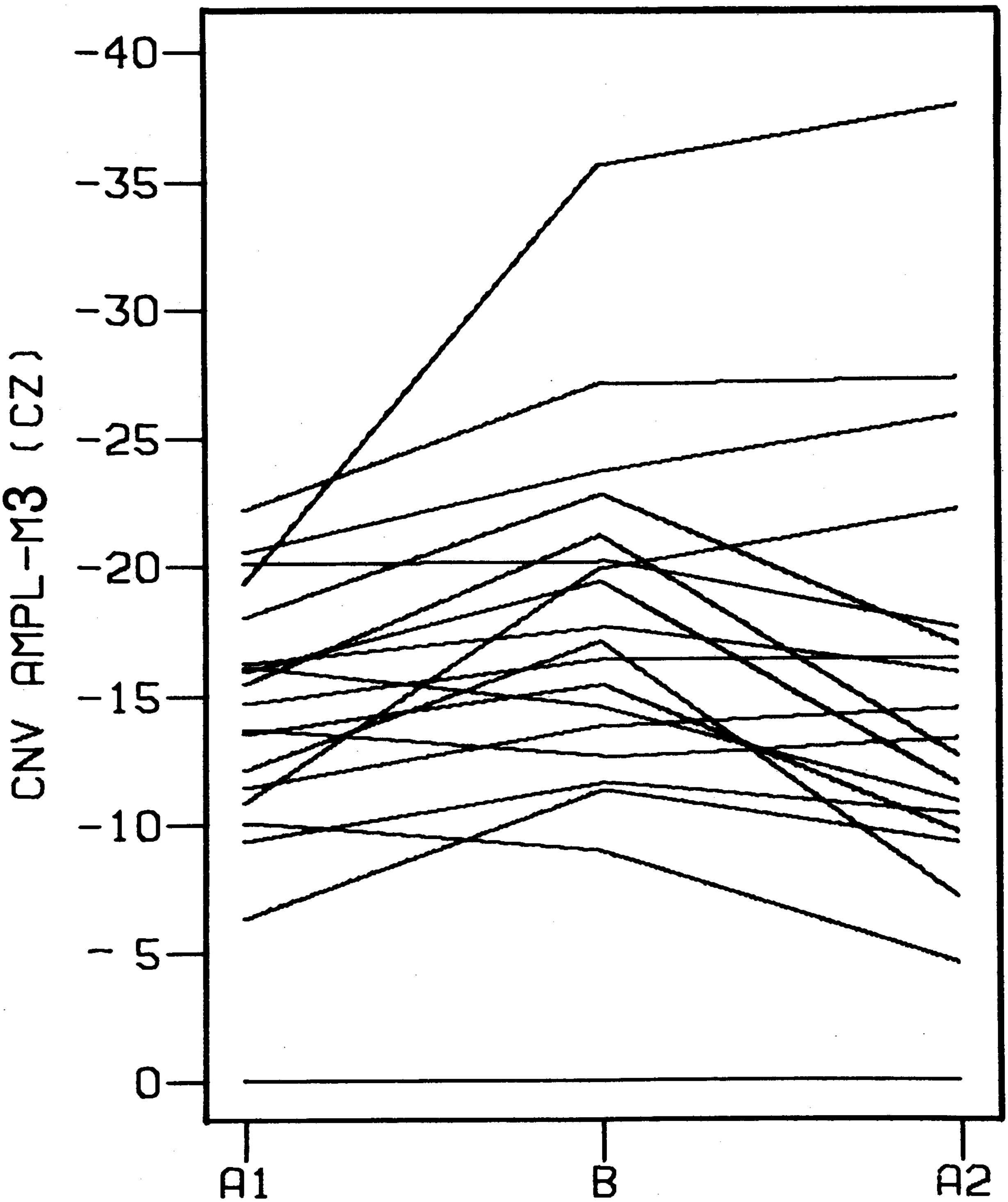

-40
-35
-30
-25
-20
-15
-10
- 5
0
CNV AMPL-M3 (CZ)
A1
B
A2
CONDITIONS

Figure 41

Mean CNV Integral Measure (M4) by
Condition for Each of the 18 Subjects

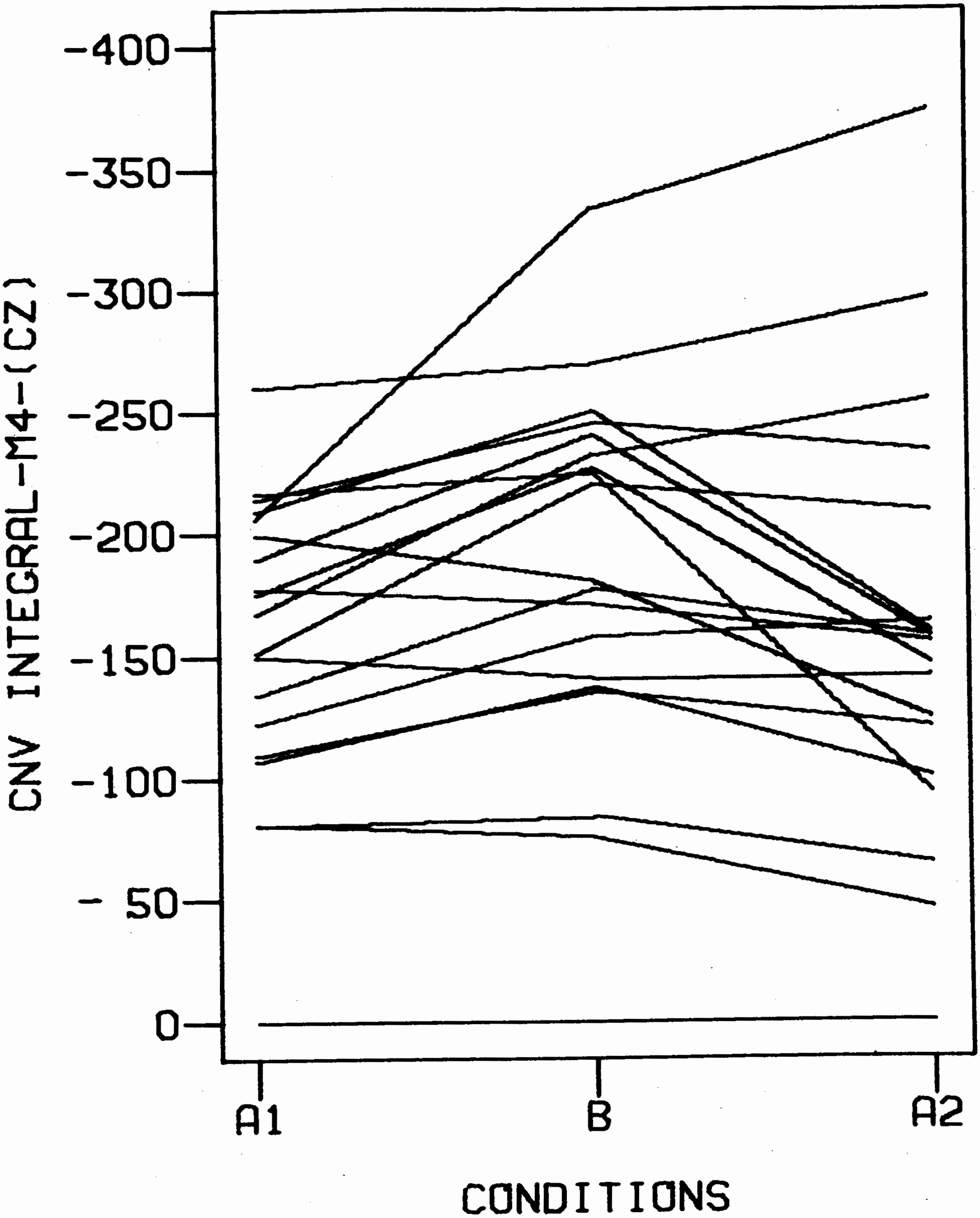

-400
-350
-300
-250
-200
-150
-100
- 50
0
CNV INTEGRAL-M4-(CZ)
A1
B
A2
CONDITIONS

Figure 42

Mean Reaction Time by Condition

for Each of the 18 Subjects

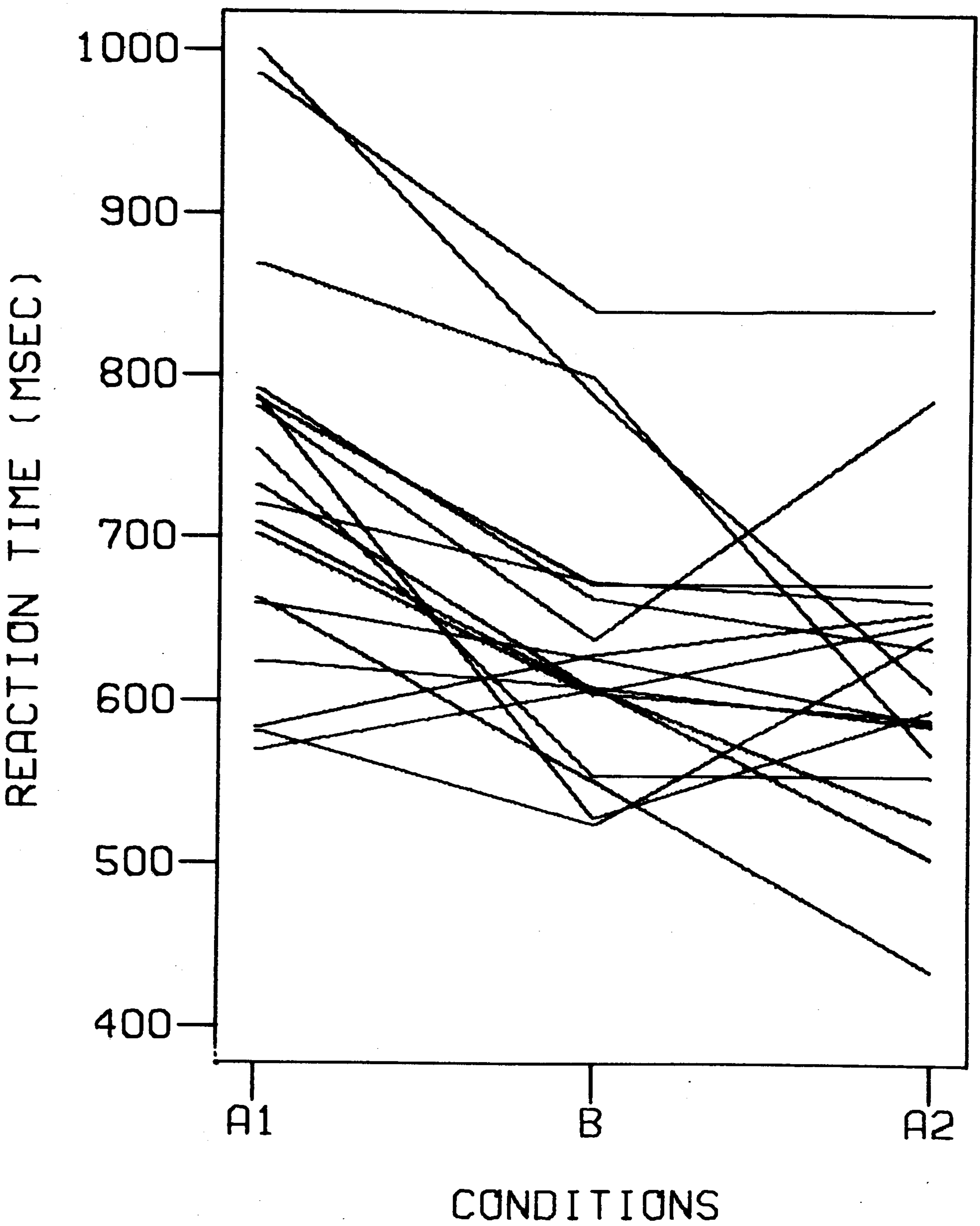
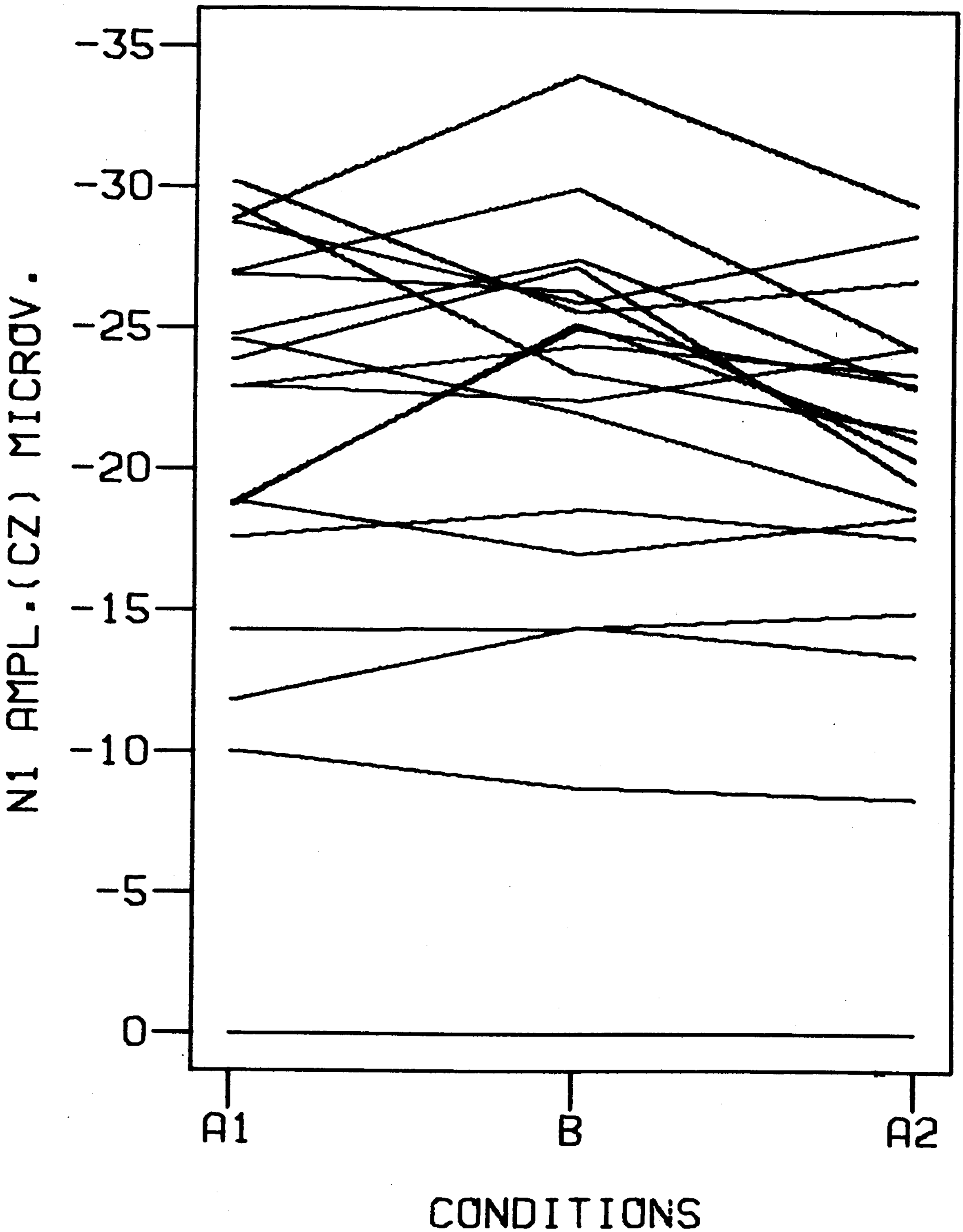

1000
900
800
700
600
500
400
REACTION TIME (MSEC)
A1
B
A2
CONDITIONS

Figure 43

Mean N1 Amplitude by Condition

for Each of the 18 Subjects

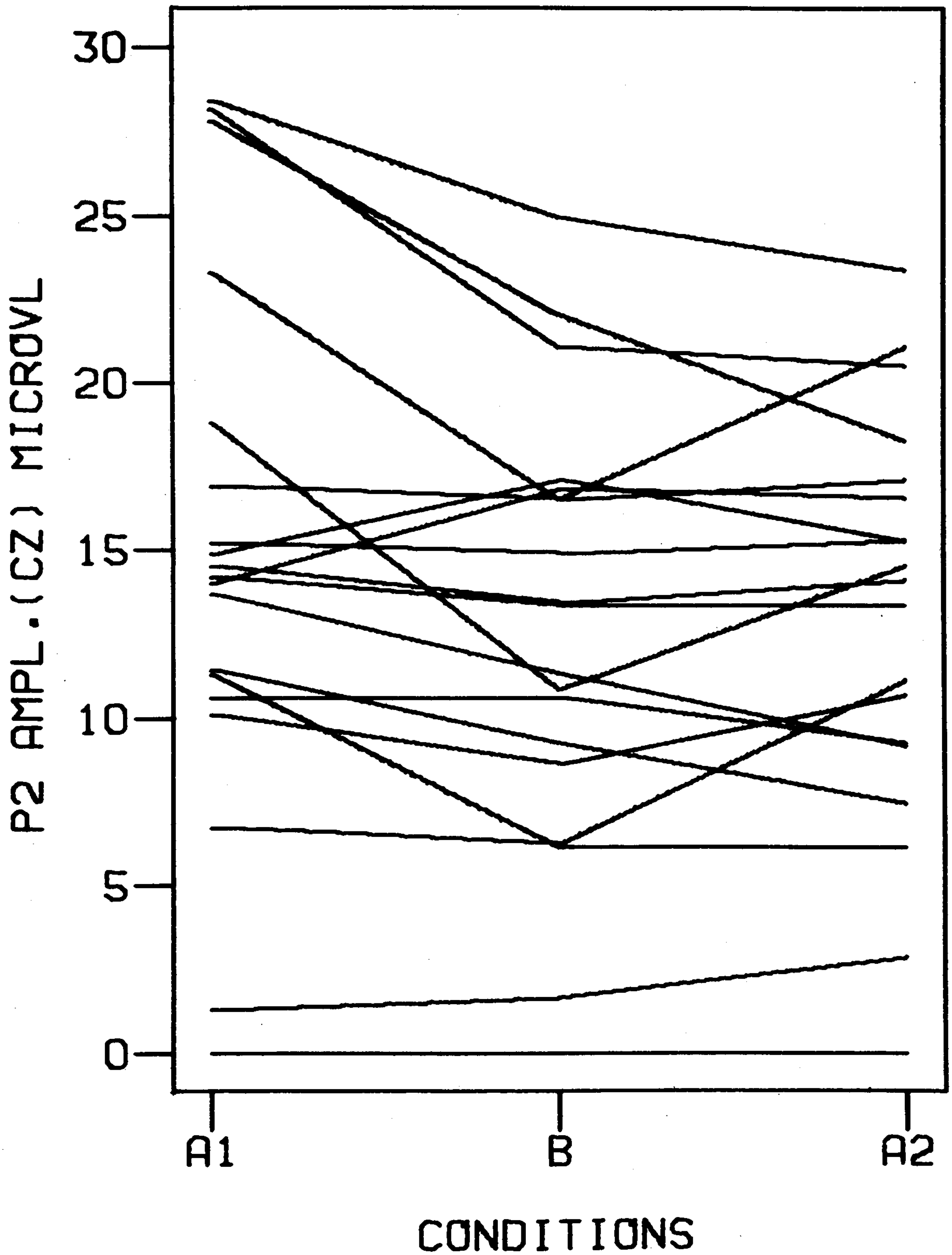


-35
-30
-25
-20
-15
-10
-5
0
N1 AMPL.(CZ) MICROV.
A1
B
A2
CONDITIONS

Figure 44

Mean P2 Amplitude by Condition

for Each of the 18 Subjects

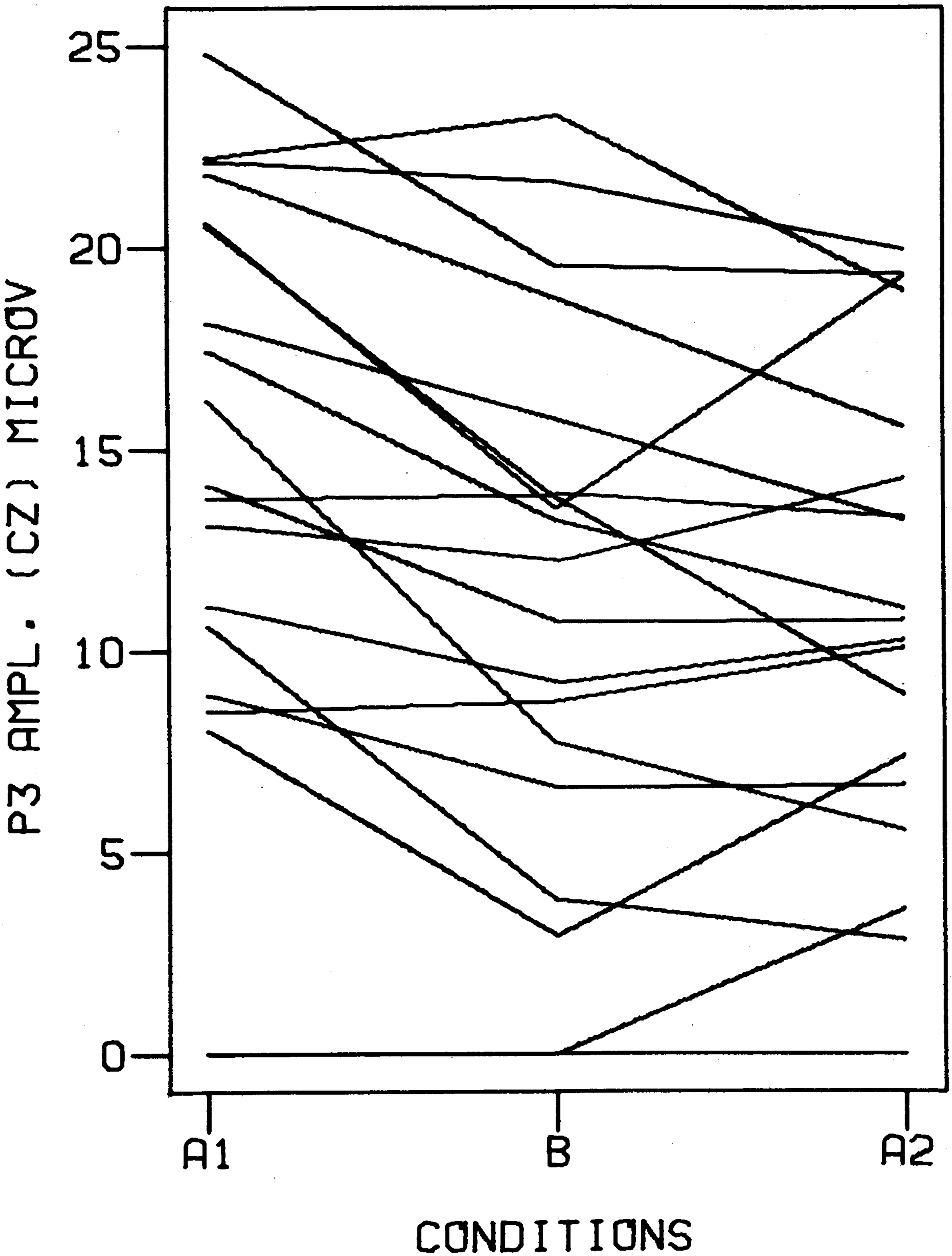


P2 AMPL.(CZ) MICROVL
30
25
20
15
10
5
0
A1
B
A2
CONDITIONS

Figure 45

Mean P3 Amplitude by Condition

for Each of the 18 Subjects



25
20
15
10
5
0
P3 AMPL. (CZ) MICROV
A1
B
A2
CONDITIONS

a one-way analysis of variance was used on each of the single-trial data sets. The results for each S are summarized in table XVII and Appendix D. As can be seen from table XVII reaction time and, to a lesser extent, CNV amplitude both showed somewhat consistent significant ($p<.05$) condition effects. For 10 of the Ss reaction time was found to decrease overall; particularly between the "A1" and "B" conditions. The significant M3 and M4 condition effects found for one third of the Ss reflects the greatly increased CNV amplitude during the "B" condition relative to the "A" condtions. N1 amplitude was significantly affected by conditions for only 4 of the Ss. Of these 4 two show a decrease, one an increase and one no change in N1 amplitude between the "A1" and "B" conditions. The observed condition effects for P2 and P3 amplitude are somewhat more consistent as each of the significant effects reflects decrease in the amplitude of these components during the "B" condition.

These within-S analyses of variance for condtions do not at all support the primary hypothesis that the effect of the "B" or "stressful" condition would be a decrease in CNV amplitude. On the contrary, the CNV was either not affected or significantly increased by the addition of "punishment." The EP

Summary Table of Significant (p<.05) Condition
Effect for the Single Trial Data

ject	RT	M3	M4	N1 Amp	P2 Amp	P3 Amp
--Male	X	X	X	X	X	X
--Male	X					
--Male	X				X	X
--Male	X				X	
--Male				X		
--Male						
--Male			X			
--Female						
1-Female		X	X			X
2-Female						
3-Female	X	X	X			
4-Female	X	X	X		X	X
5-Female	X					X
-Female				X		
-Female	X					
-Female					X	
-Female	X			X		
-Female	X	X	X			
Males	X	X			X	X
Females	X	X	X	X		X
Ss	X	X	X	X	X	X

TABLE XVII

changes over conditions are not as easily interpreted since the conditions are confounded with time; and habituation is known to produce decrements in the amplitudes of all scalp-recorded EP components (Regan 1972). However, the P2 and P3 changes are in the opposite direction to the CNV changes which confirm the relationships observed in the correlation data.

The effect of S1 tone intensity was examined with one-way analyses of variance using each of the S's single-trial data. These results are summarized in table XVIII and Appendix D. As can be seen from table XVIII there were no significant tone effects for either of the CNV measures (M3 or M4). Neither was there a consistent pattern of tone effects for the EP components. N1 appears to have been most sensitive to tone intensity although the relationship does not appear to be at all linear (see Appendix D). The same pattern was found for the scattering of significant P2 and P3 tone effects.

Pooled S Analyses of Variance (Single-Trial Data)

To examine the consistency of the condition and tone effects the single trial data pooled over all males, over all females and over all Ss were examined with one-way analyses of

Summary Table of Significant ($p<.05$) Tone
Effects for the Single Trial Data

bject	RT	M3	M4	N1 Amp	P2 Amp	P3 Amp
1--Male						
3--Male						
4--Male						
5--Male						
6--Male					X	
7--Male						
8--Male				X		
9--Female				X		X
11-Female		X		X		
12-Female					X	
13-Female				X		
14-Female						
15-Female				X		
16-Female						
18-Female						
19-Female						
20-Female						
21-Female						
l Males						
l Females	X	X	X	X		
l <u>S</u>s	X			X		

TABLE XVIII

variance. These results are presented in tables XVII and XVIII and Appendix F. Additionally the means for all the pooled single-trial measures are tabled in Appendix C. Table XVII demonstrates that the pattern of variables showing condition effects was substantially different for males than for females. For both males and females reaction time, CNV amplitude (M3) and P3 amplitude displayed significant ($p \leq .05$) condition differences. However, reaction time decreased steadily over conditions for the females whereas for the males there was an initial decrease from the "A1" to "B" conditions and no further change from the "B" to "A2" conditions. CNV amplitude (M3) was increased during the "B" condition for both groups and then declined to "A1" levels for the females. For males the CNV stayed elevated during the "A2" condition. P3 amplitude for the males declined steadily over conditions. For the females the "B" condition produced a significant P3 decrement and no further change was observed between the "B" and "A2" conditions. In addition P2 amplitude was sensitive to conditions for the males only. For the male data P2 amplitude was decreased in the B condition. In contrast, for the females, the CNV integral (M4) and N1 amplitude both displayed significant condition effects. For both of these measures transient increases were observed over the "B" condition. For the single-trial data pooled overall Ss all of the measures displayed significant condition effects. Reaction time decreased continuously over conditions. The CNV measures (M3 and M4) and N1 amplitude were increased by "stress." This enhancement was transient as the A1 and A2 conditions did not differ. P2 and P3 amplitudes were similarly decreased over the "B" and "A2" conditions.

The results of the pooled analyses of variance for tone intensity effects are presented in table XVIII. Examination of this table shows that there were substantial sex differences in the measures showing the effect of tone intensity. For the pooled male data none of the measures showed tone effects whereas for the female data significant effects for reaction time, CNV amplitude (M3 and M4) and N1 amplitude were found. For the single-trial data pooled over all Ss significant tone differences were found only for reaction time and N1 amplitude. Examination of Appendix F reveals that only the N1 results are really interpretable. The amplitude of this component was found to be directly related to the intensity of the tone.

Pooled S Analyses of Variance (Averaged Data)

For each S the single-trial data at Fz, Cz and Pz were averaged by condition subset (4 subsets per condition) and by S1 tone intensity. CNV and EP amplitude measures were obtained as for the single-trial data with the addition of two measures (M1 and M2) of the early and middle segments of the CNV waveform (see figure 3). Additionally the latencies of the EP components N1, P2 and P3 were obtained. The 10 measures obtained from each averaged waveform were pooled over all Ss to form condition and tone intensity data sets. Analyses of variance were used on each data set to examine electrode, sex and either tone or condition effects. The results of these analyses are illustrated in figures 46-65 and summarized in tables XIX to XXII and Appendix E.

Initially a sex (X) condition (X) electrode analysis of variance was applied to the condition data set to examine possible interactions. No significant interactions were found so separate one-way analyses of variance for sex, electrode and condition effects were employed. Table XIX shows that significant sex differences (overall electrodes and conditions) were obtained for all but one of the dependent measures (P2

Figure 46

CNV and EP Amplitude Measures for Males and Females (Overall Conditions and Electrodes)

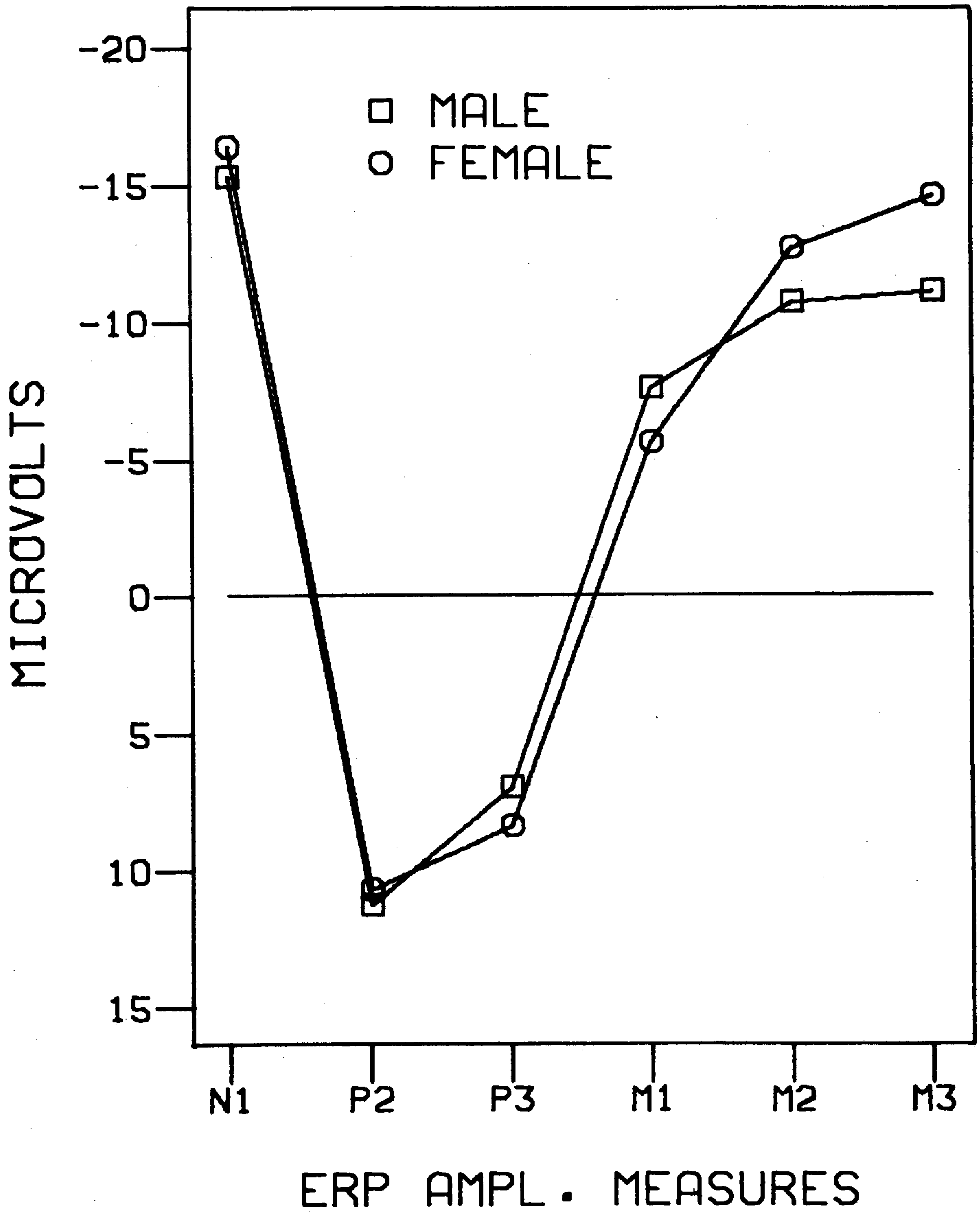
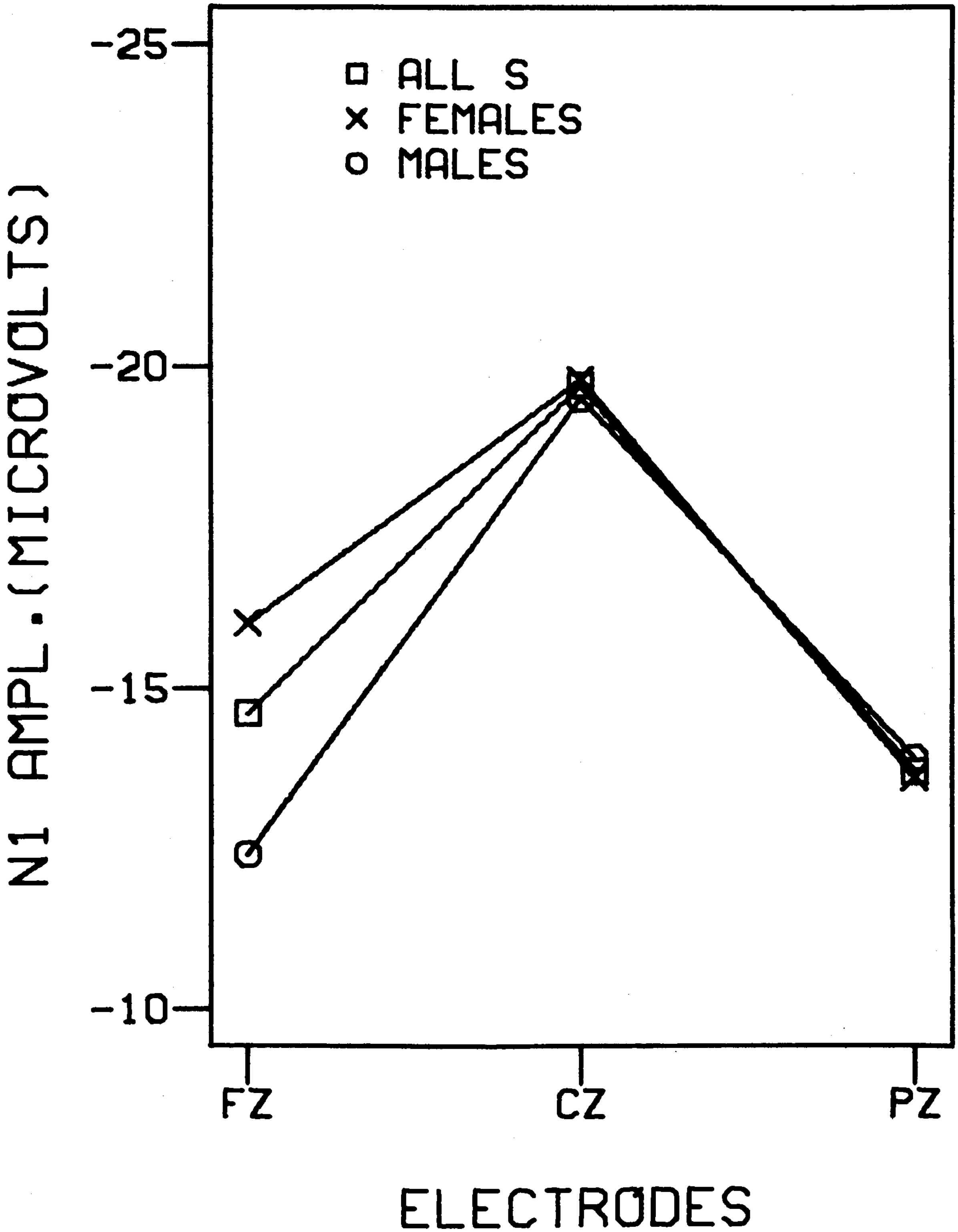

MALE
FEMALE
-20
-15
-10
-5
0
5
10
15
MICROVOLTS
N1
P2
P3
M1
M2
M3
ERP AMPL. MEASURES

Figure 47

Anterior-Posterior Distribution of N1 Amplitude

for Males, Females and All Ss



-25
-20
-15
-10
N1 AMPL.(MICROVOLTS)
ALL S
FEMALES
MALES
FZ
CZ
PZ
ELECTRODES

Figure 48

Anterior-Posterior Distribution of P2 Amplitude

for Males, Females and All Ss

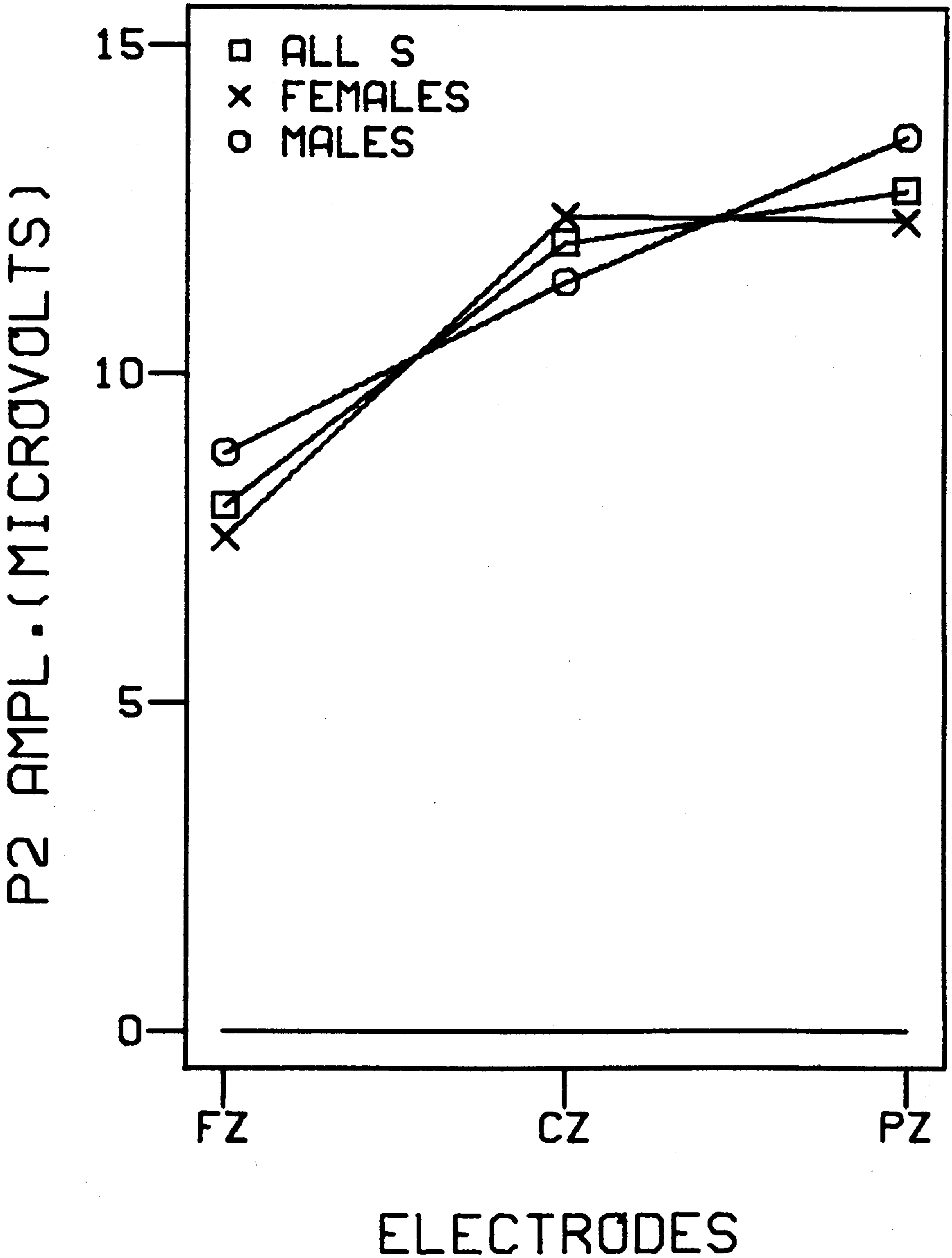

15
10
5
0
ALL S
FEMALES
MALES
P2 AMPL.(MICROVOLTS)
FZ
CZ
PZ
ELECTRODES

Figure 49

Anterior-Posterior Distribution of P3 Amplitude

for Males, Females and All Ss

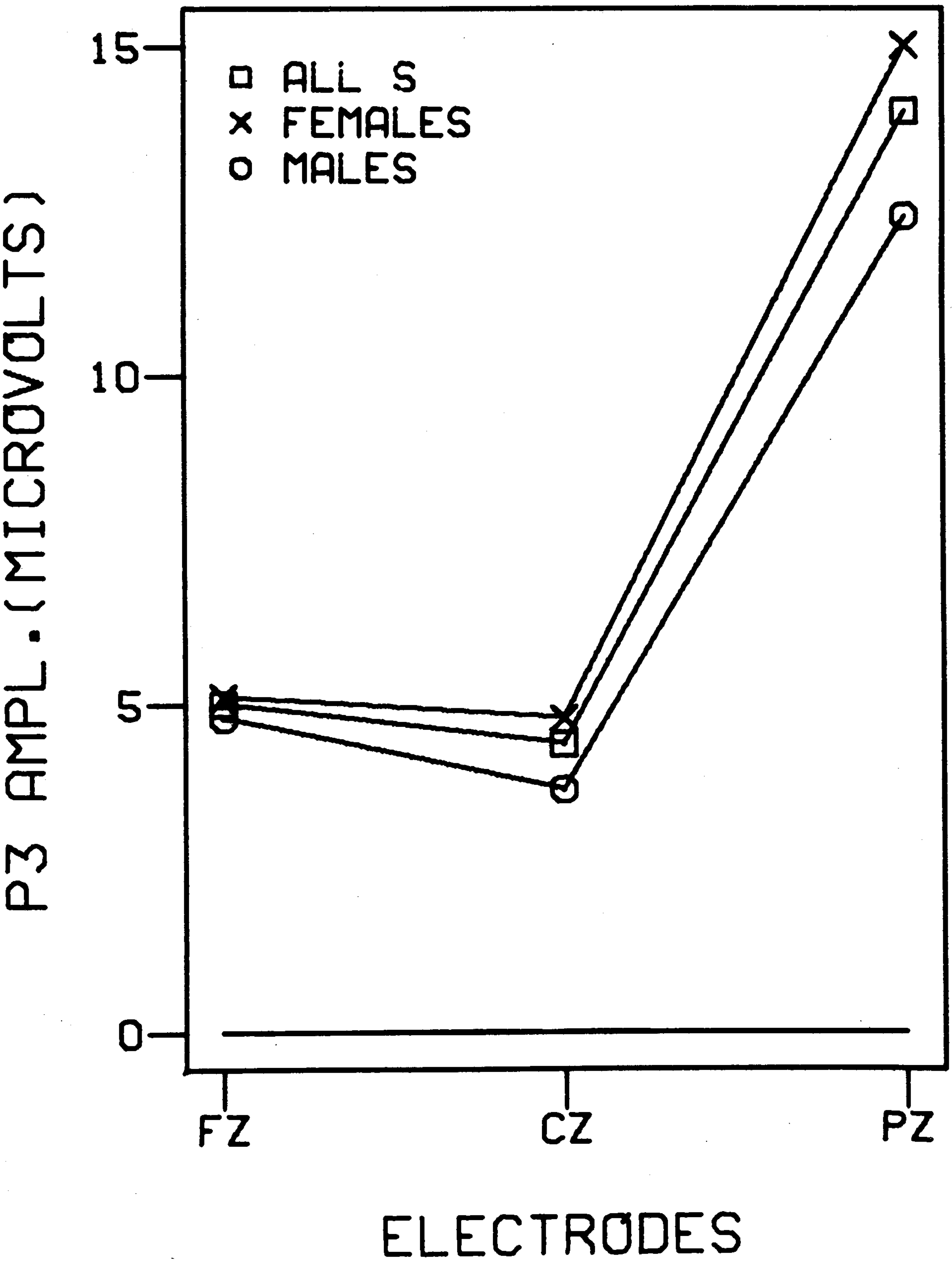

ALL S
FEMALES
MALES
15
10
5
0
P3 AMPL.(MICROVOLTS)
FZ
CZ
PZ
ELECTRODES

Figure 50

Anterior-Posterior Distribution of EP Latencies

for Males, Females and All Ss

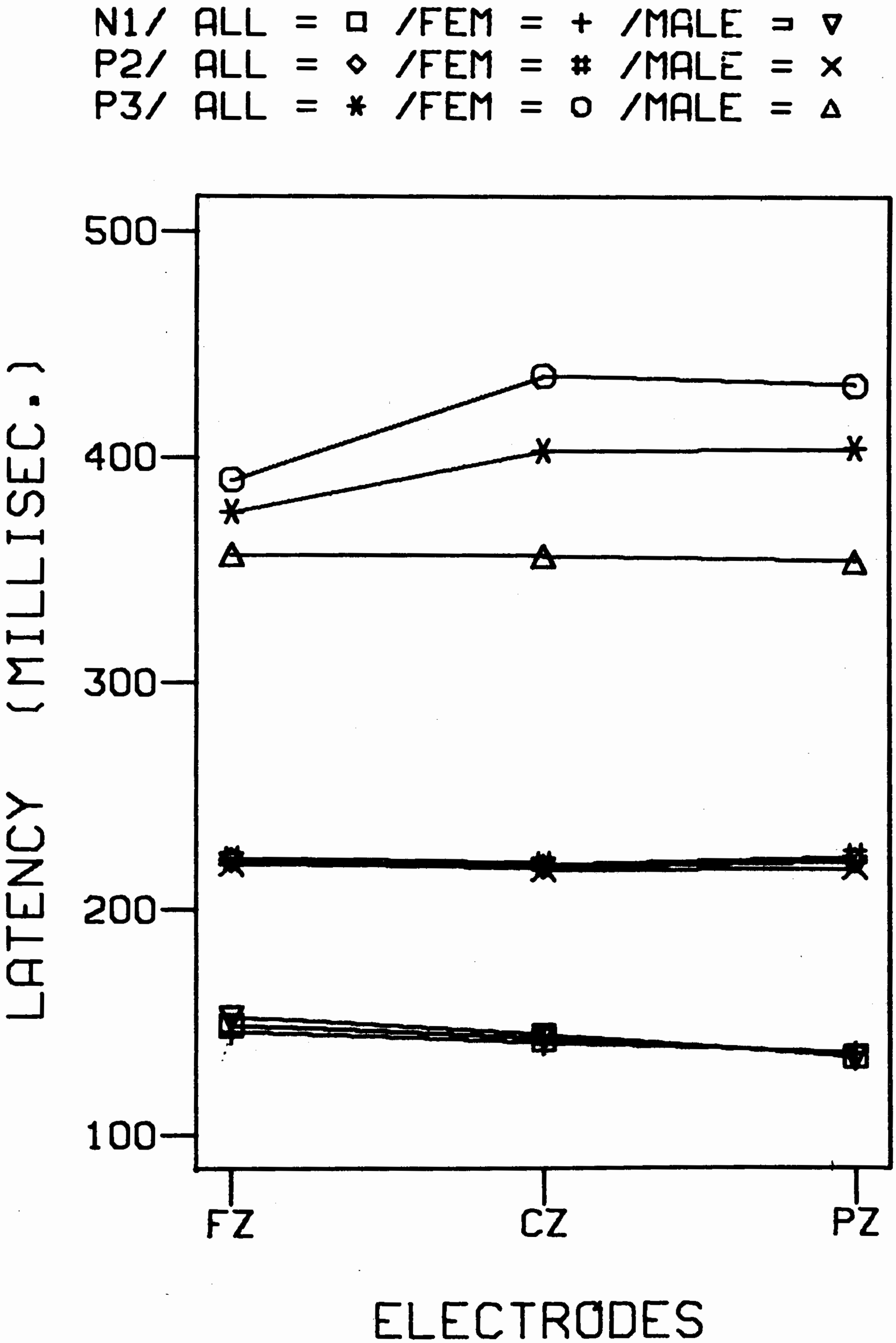

N1/ ALL = □ /FEM = + /MALE = ▽
P2/ ALL = ◇ /FEM = # /MALE = ×
P3/ ALL = * /FEM = ○ /MALE = △
500
400
300
200
100
LATENCY (MILLISEC.)
FZ
CZ
PZ
ELECTRODES

Figure 51

Anterior-Posterior Distribution of CNV-M1

for Males, Females and All <u>S</u>s

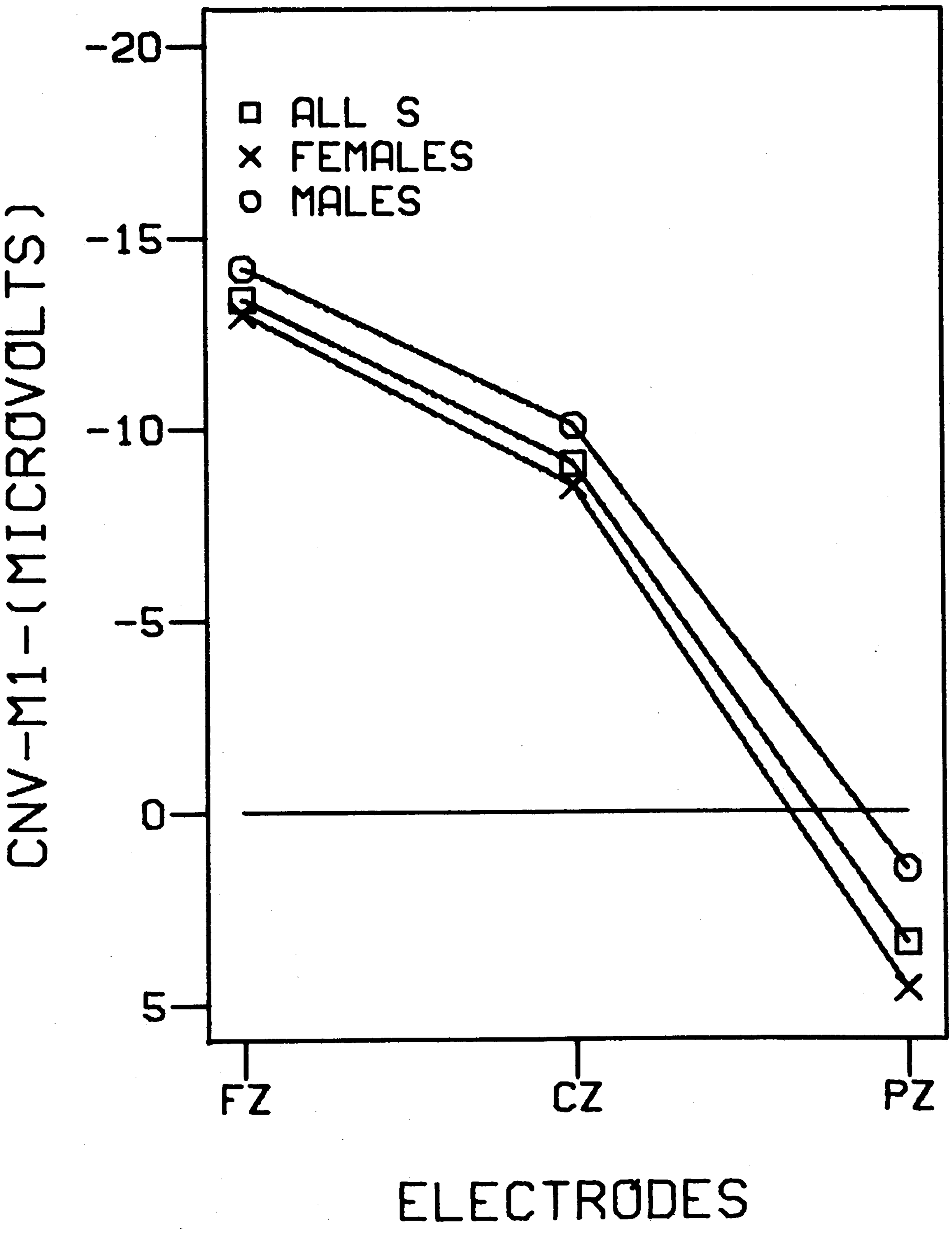
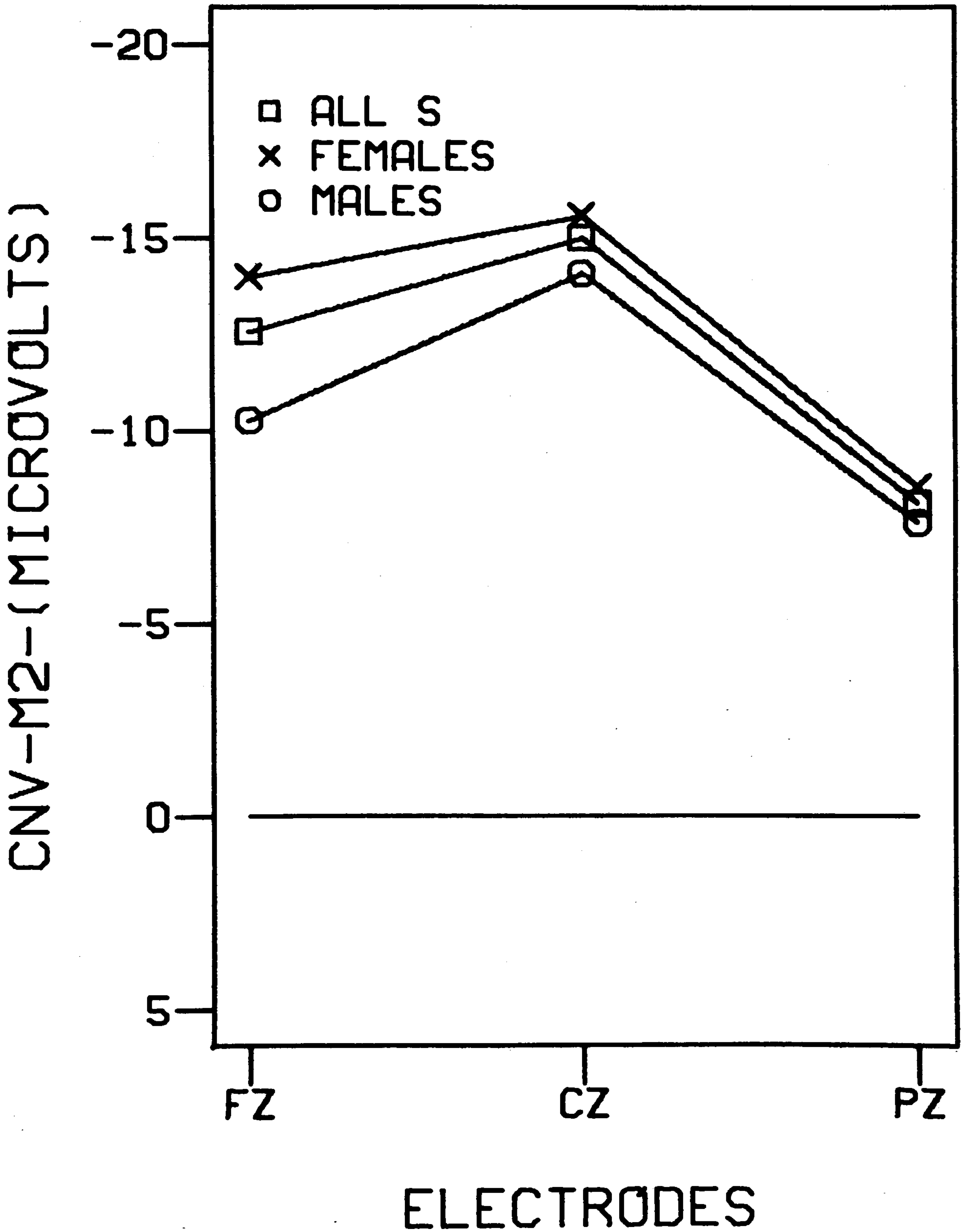

-20
-15
-10
-5
0
5
ALL S
FEMALES
MALES
CNV-M1-(MICROVOLTS)
FZ
CZ
PZ
ELECTRODES

Figure 52

Anterior-Posterior Distribution of CNV-M2

for Males, Females and All Ss

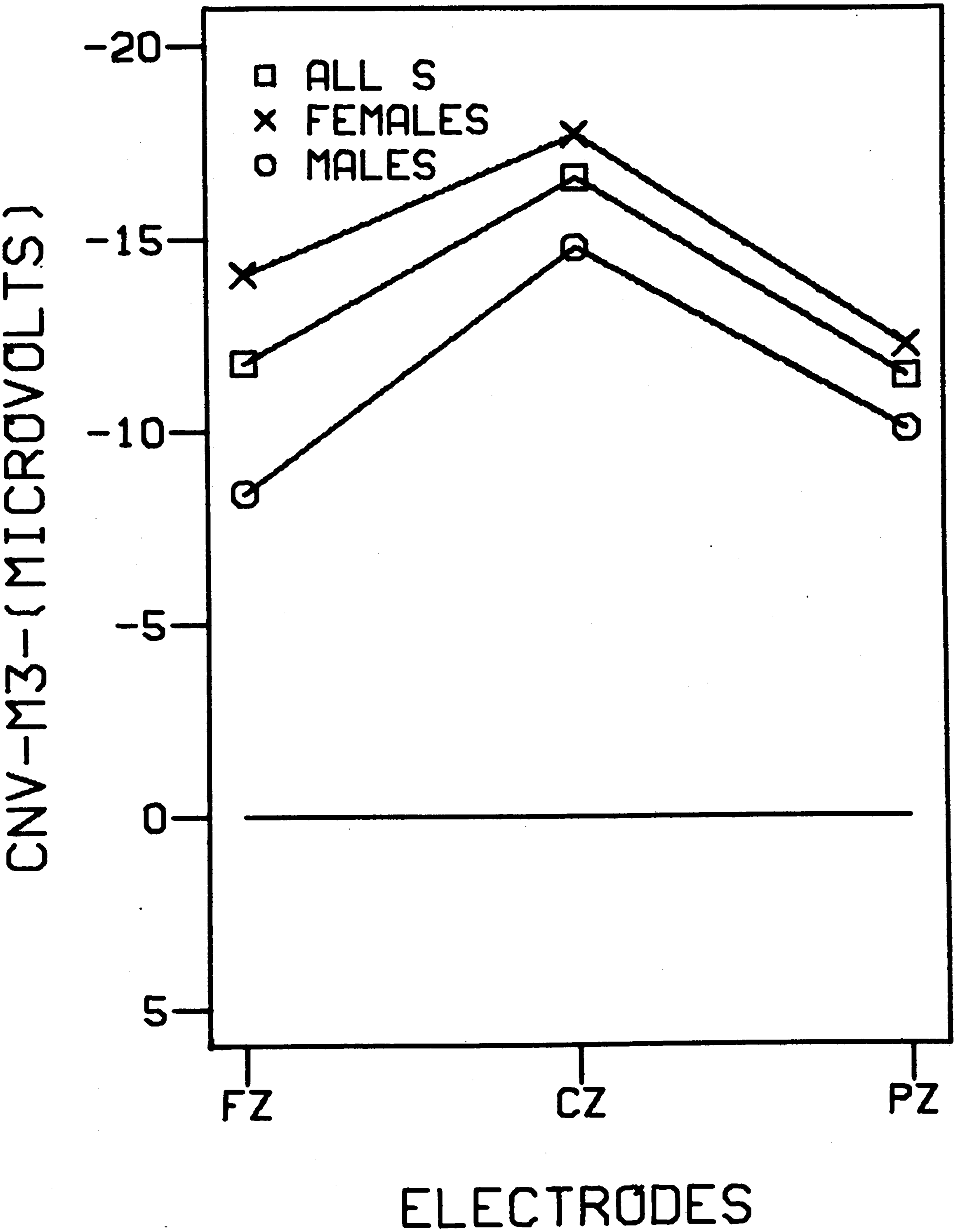


-20
-15
-10
-5
0
5
CNV-M2-(MICROVOLTS)
ALL S
FEMALES
MALES
FZ
CZ
PZ
ELECTRODES

Figure 53

Anterior-Posterior Distribution of CNV-M3

for Males, Females and All Ss



ALL S
FEMALES
MALES
-20
-15
-10
-5
0
5
CNV-M3-(MICROVOLTS)
FZ
CZ
PZ
ELECTRODES

Figure 54

Anterior-Posterior Distribution of CNV-M4

for Males, Females and All Ss

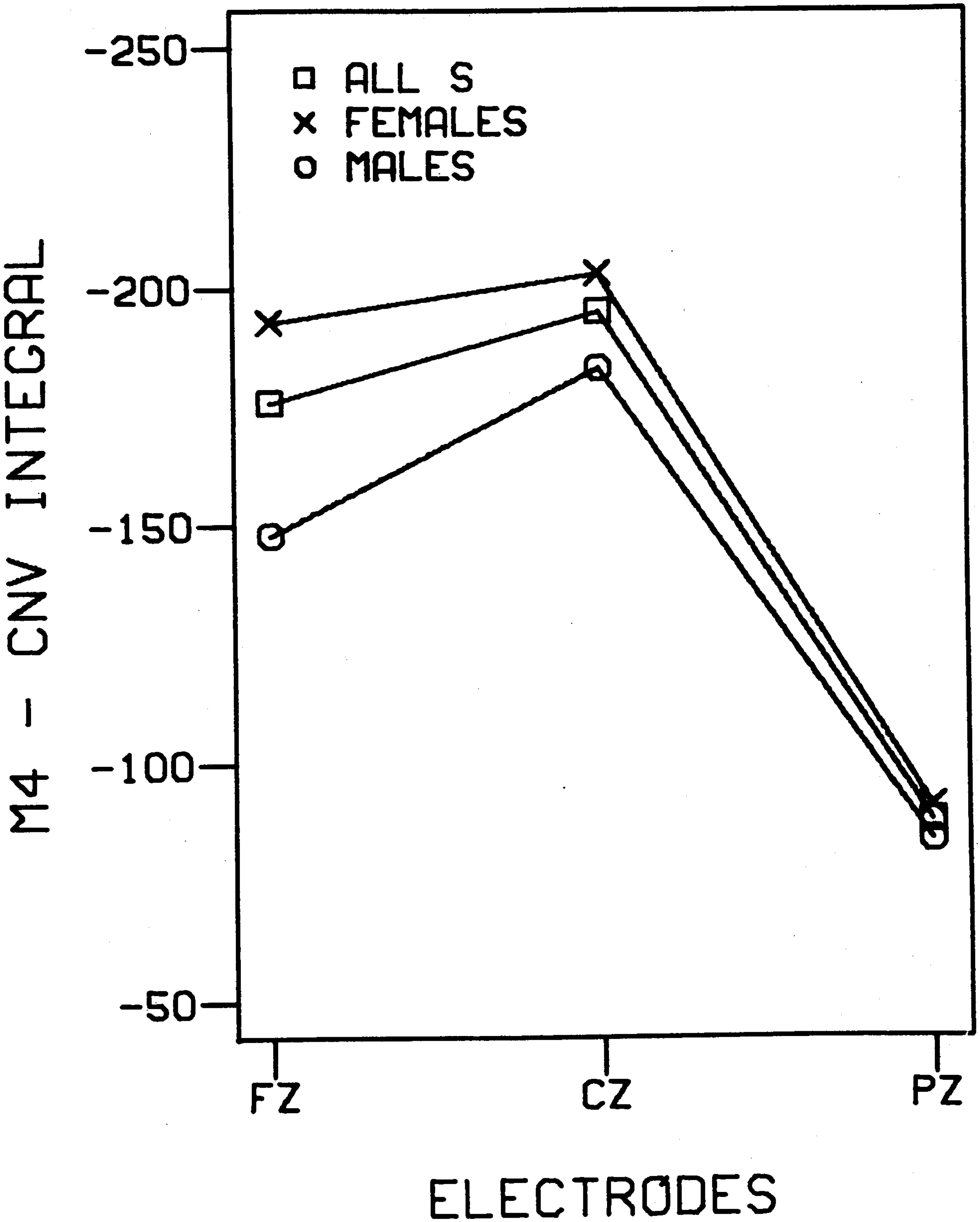
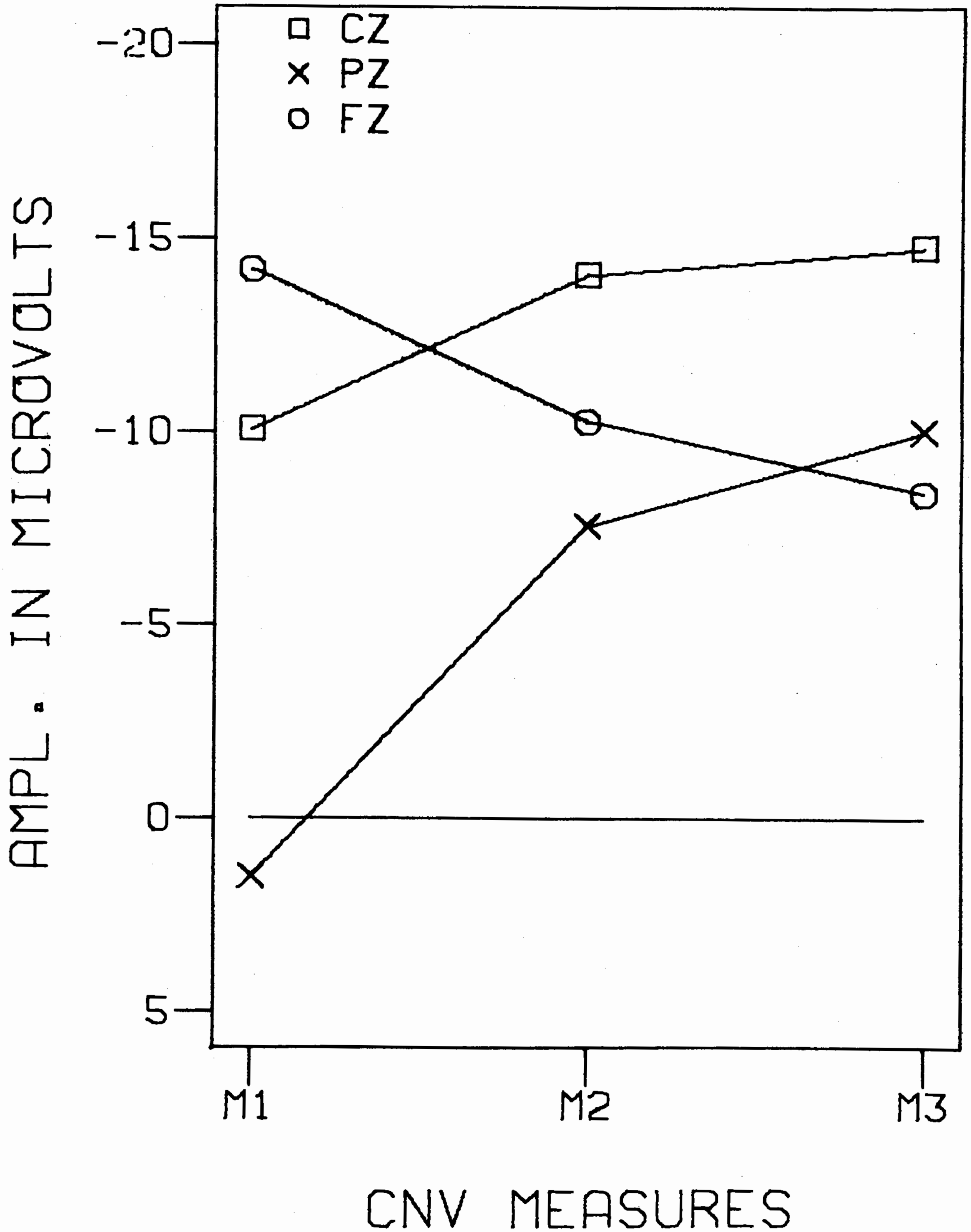

ALL S
FEMALES
MALES
-250
-200
-150
-100
-50
M4 - CNV INTEGRAL
FZ
CZ
PZ
ELECTRODES

Figure 55

Spatial-Temporal CNV Distributions for Males



CZ
PZ
FZ
-20
-15
-10
-5
0
5
AMPL. IN MICROVOLTS
M1
M2
M3
CNV MEASURES

Figure 56

Spatial-Temporal CNV Distributions for Females

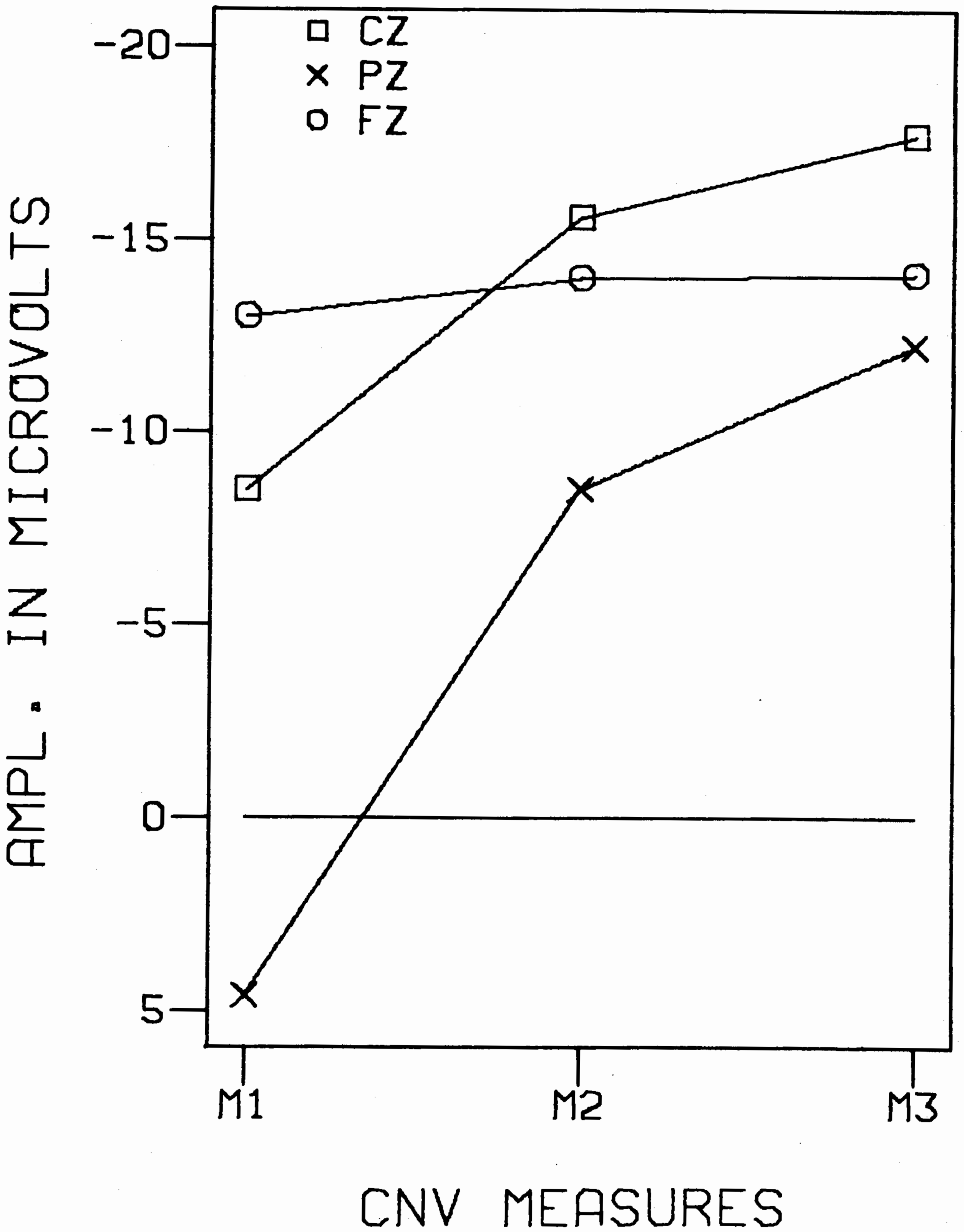
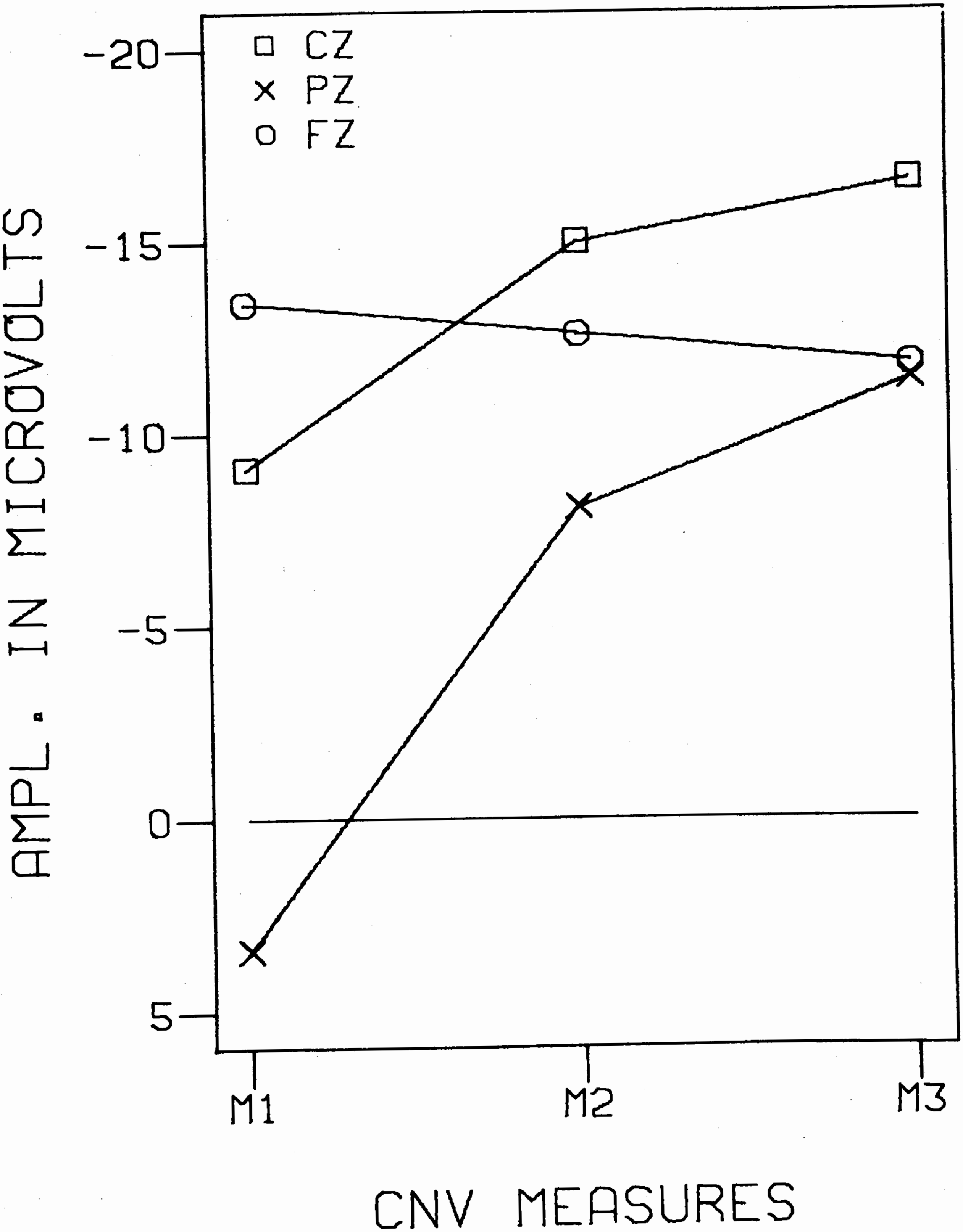

CZ
PZ
FZ
-20
-15
-10
-5
0
5
AMPL. IN MICROVOLTS
M1
M2
M3
CNV MEASURES

Figure 57

Spatial-Temporal CNV Distributions for All Ss



□ CZ
× PZ
○ FZ
-20
-15
-10
-5
0
5
AMPL. IN MICROVOLTS
M1
M2
M3
CNV MEASURES

Figure 58

Mean N1 Amplitude by Condition

for Males, Females and All Ss

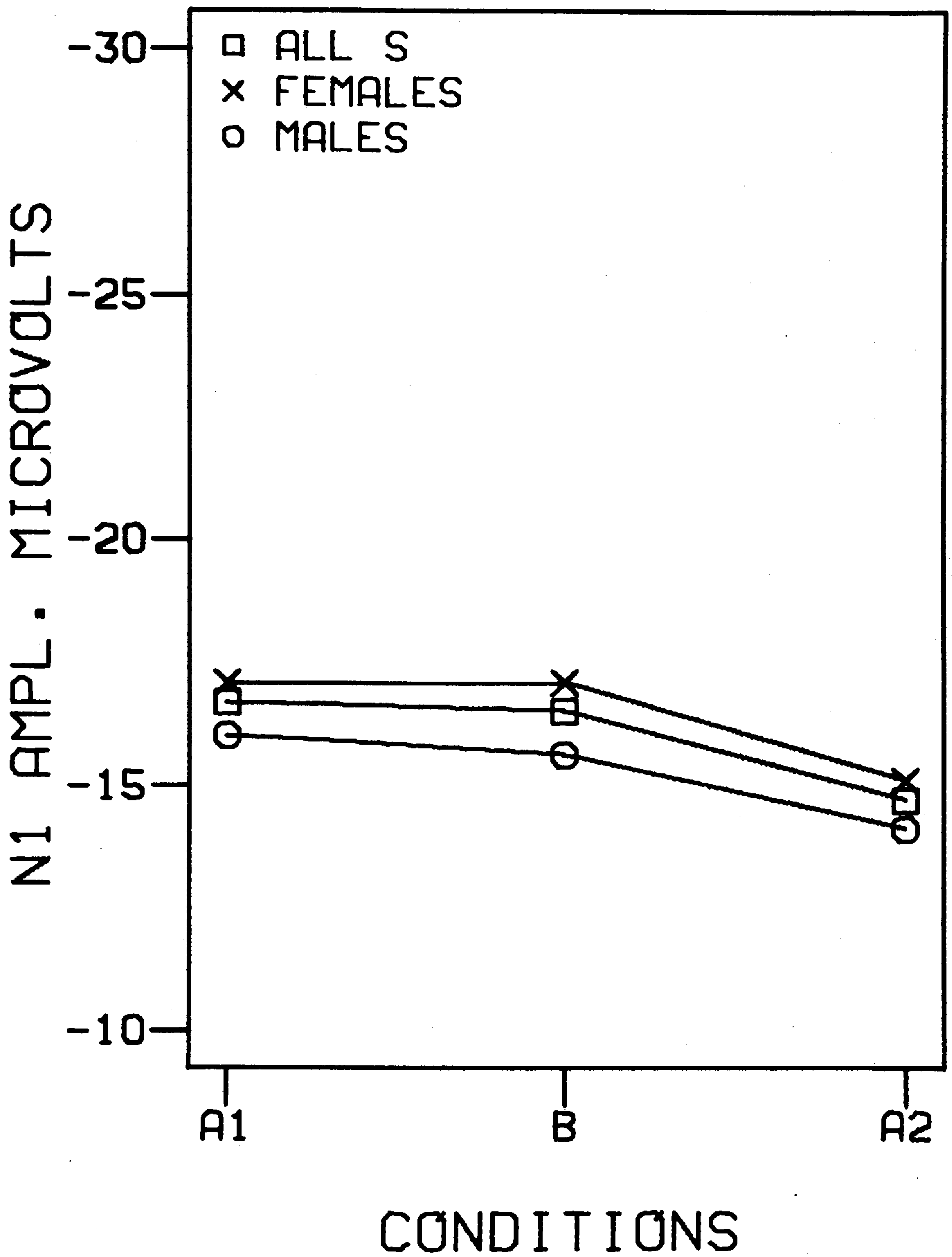

ALL S
FEMALES
MALES
N1 AMPL. MICROVOLTS
-30
-25
-20
-15
-10
A1
B
A2
CONDITIONS

Figure 59

Mean P2 Amplitude by Condition

for Males, Females and All Ss

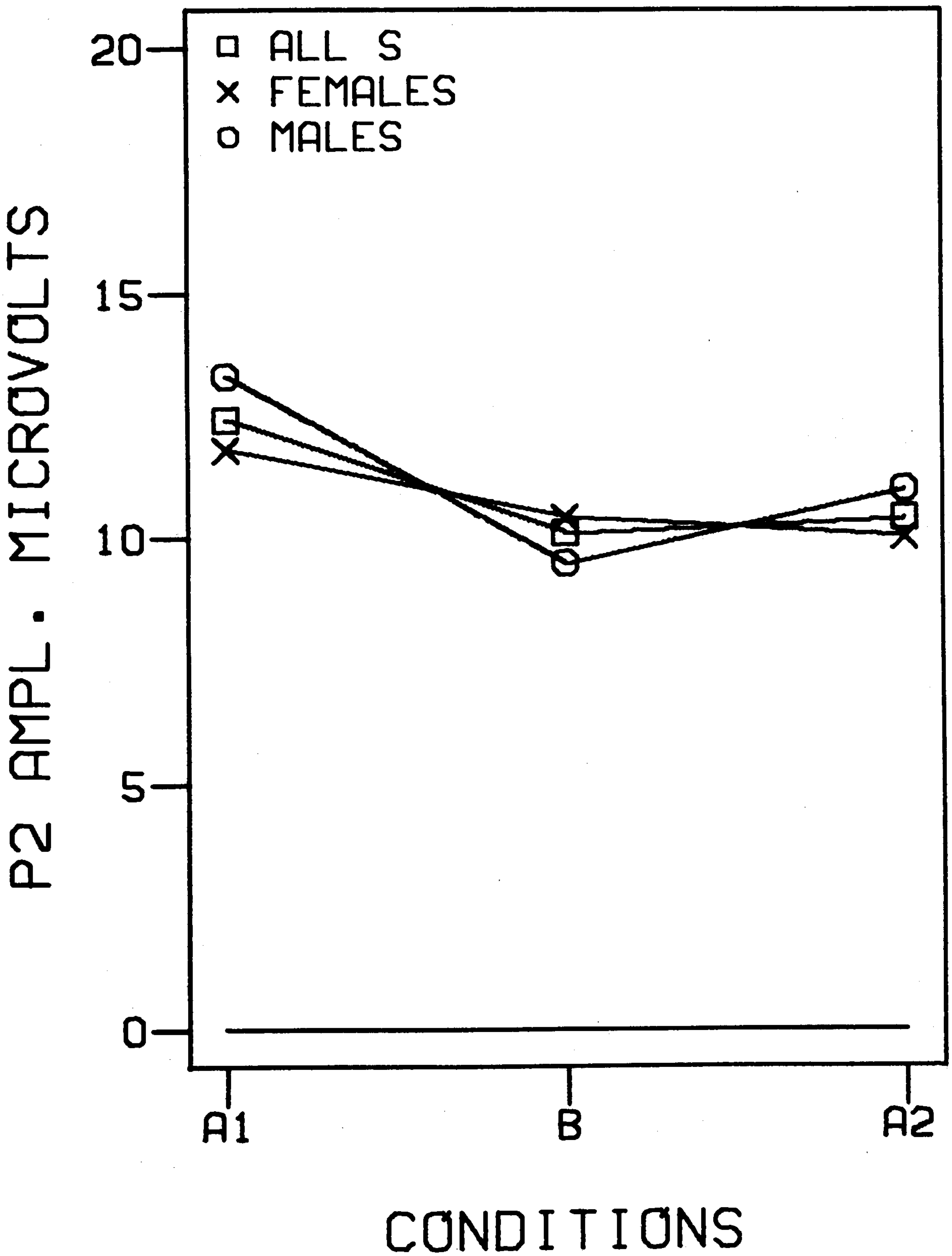
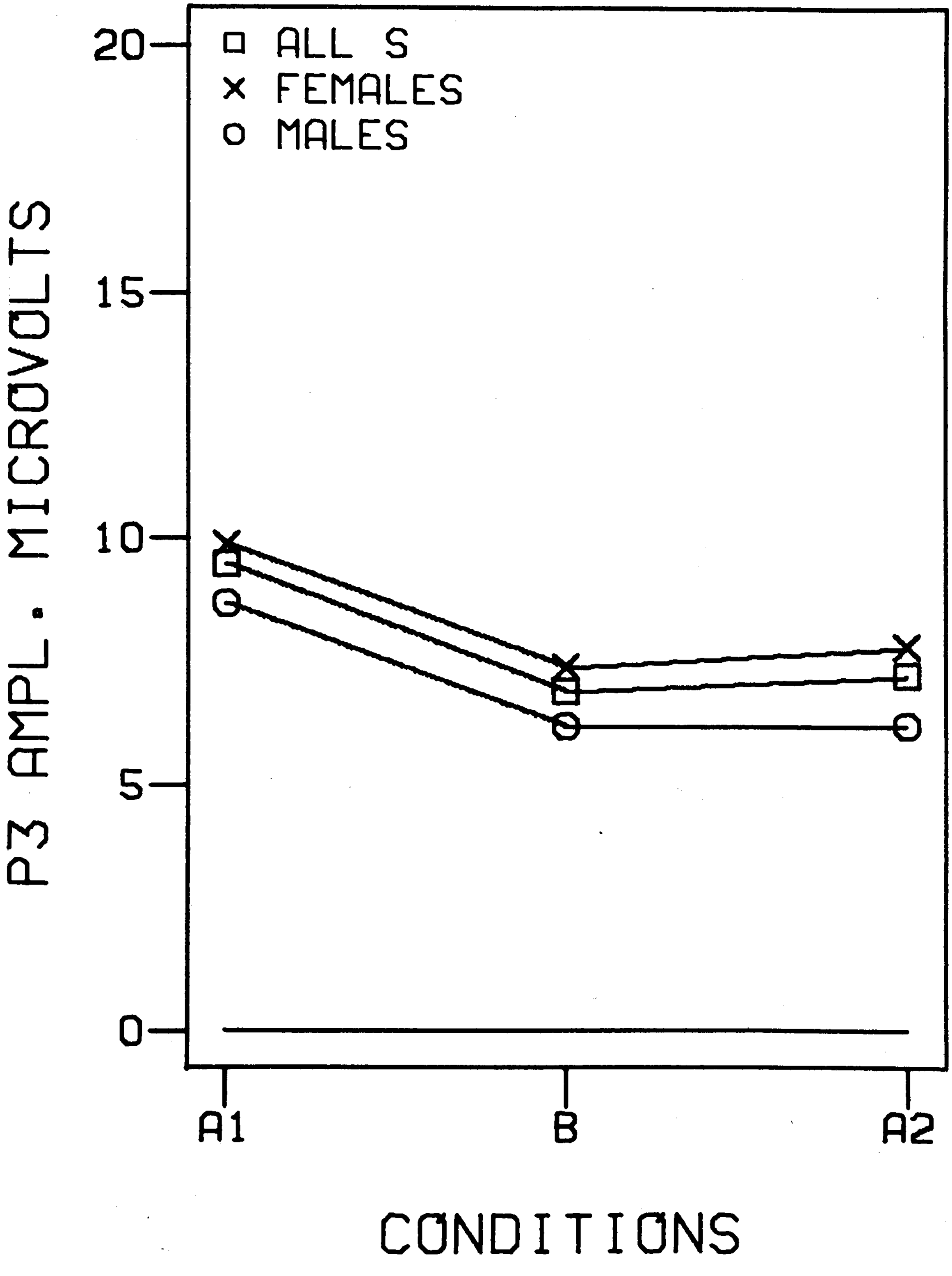

ALL S
FEMALES
MALES
20
15
10
5
0
P2 AMPL. MICROVOLTS
A1
B
A2
CONDITIONS

Figure 60

Mean P3 Amplitude by Condition

for Males, Females and All Ss



20
15
10
5
0
P3 AMPL. MICROVOLTS
ALL S
FEMALES
MALES
A1
B
A2
CONDITIONS

Figure 61

Mean EP Latencies by Condition

for Males, Females and All Ss

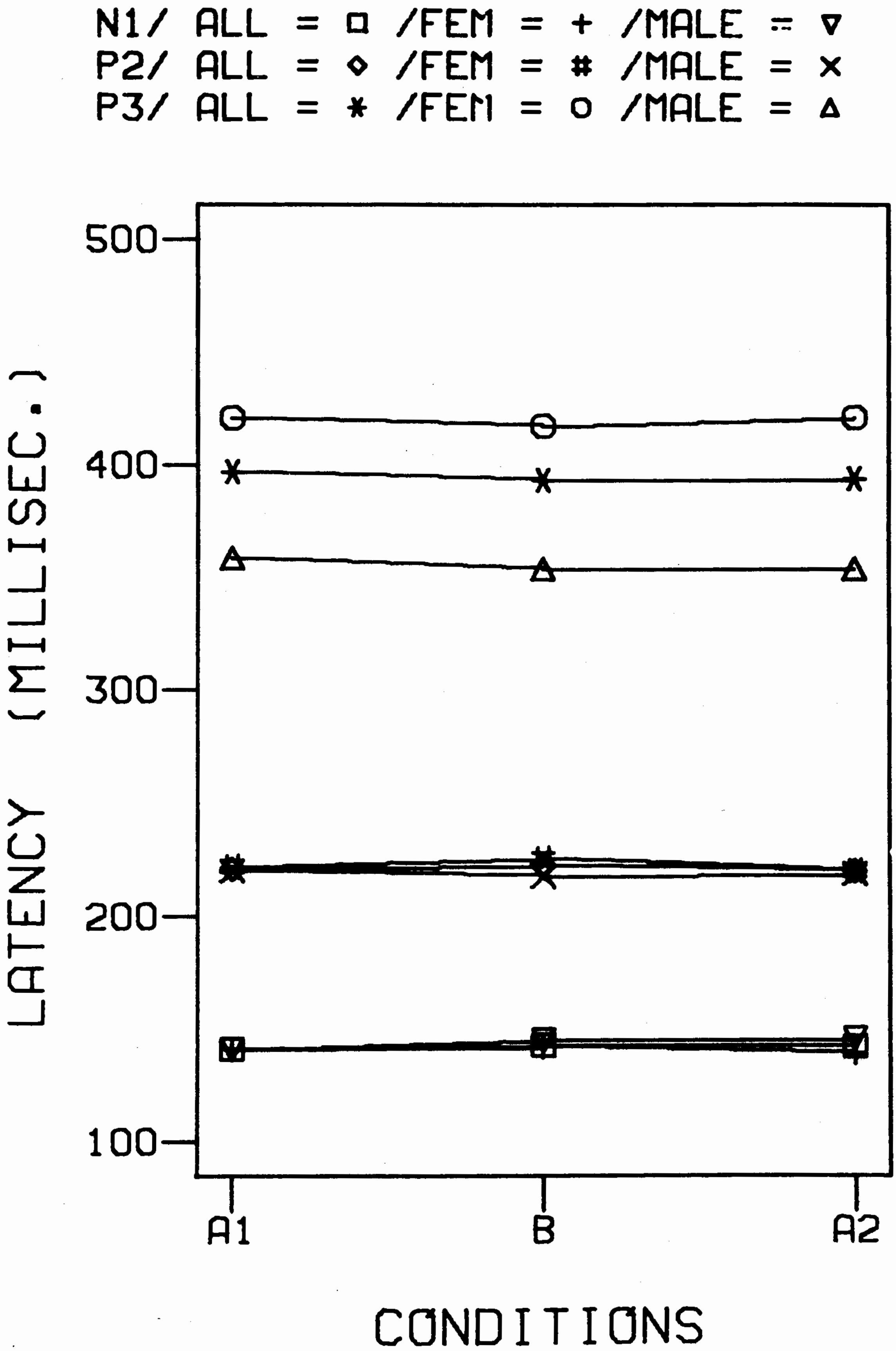

N1/ ALL = □ /FEM = + /MALE = ▽
P2/ ALL = ◇ /FEM = # /MALE = ×
P3/ ALL = * /FEM = ○ /MALE = △
500
400
300
200
100
LATENCY (MILLISEC.)
A1
B
A2
CONDITIONS

Figure 62

Mean CNV-M1 Amplitude by Condition

for Males, Females and All Ss

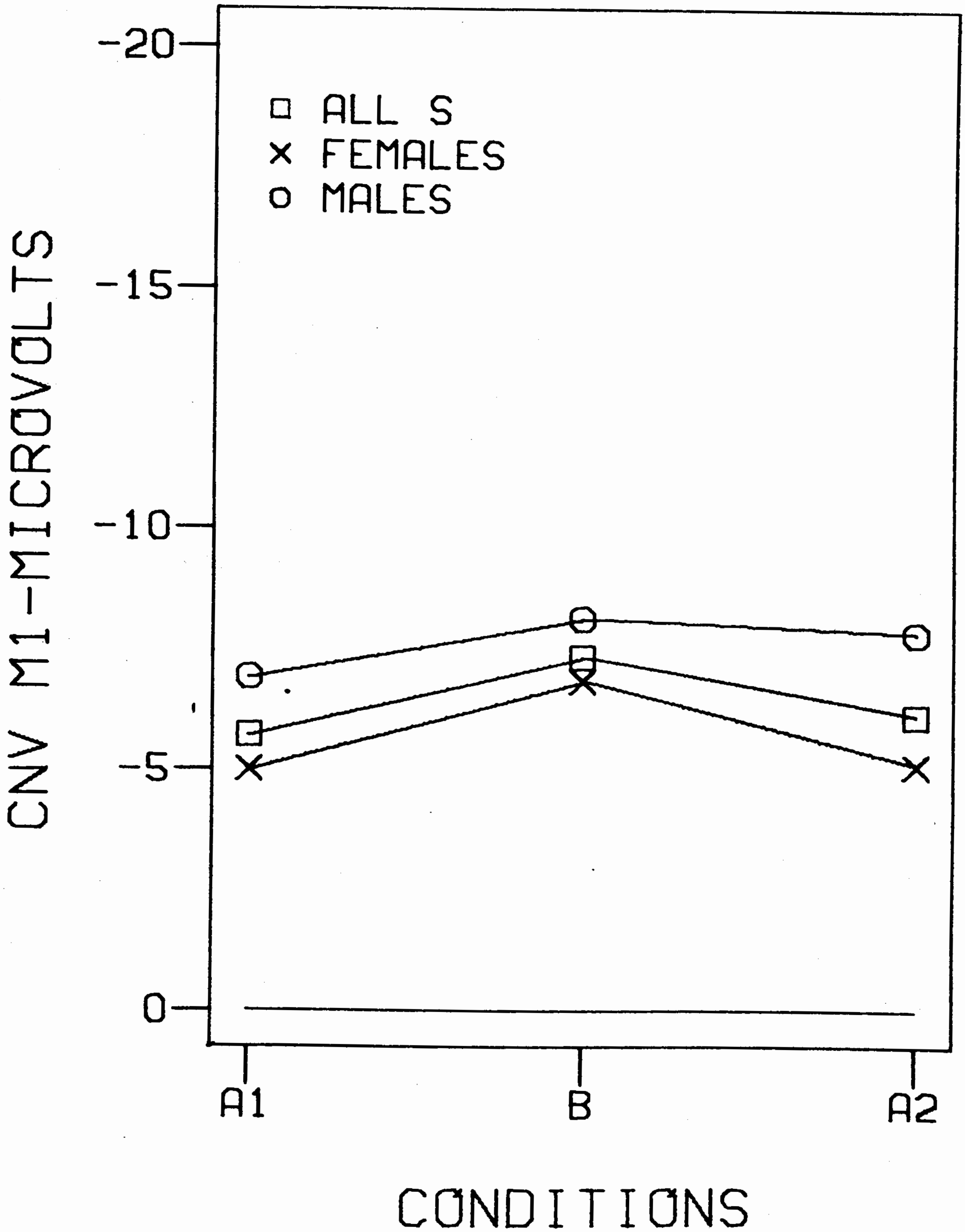

□ ALL S
× FEMALES
○ MALES
-20
-15
-10
-5
0
CNV M1-MICROVOLTS
A1
B
A2
CONDITIONS

Figure 63

Mean CNV-M2 Amplitude by Condition

for Males, Females and All Ss

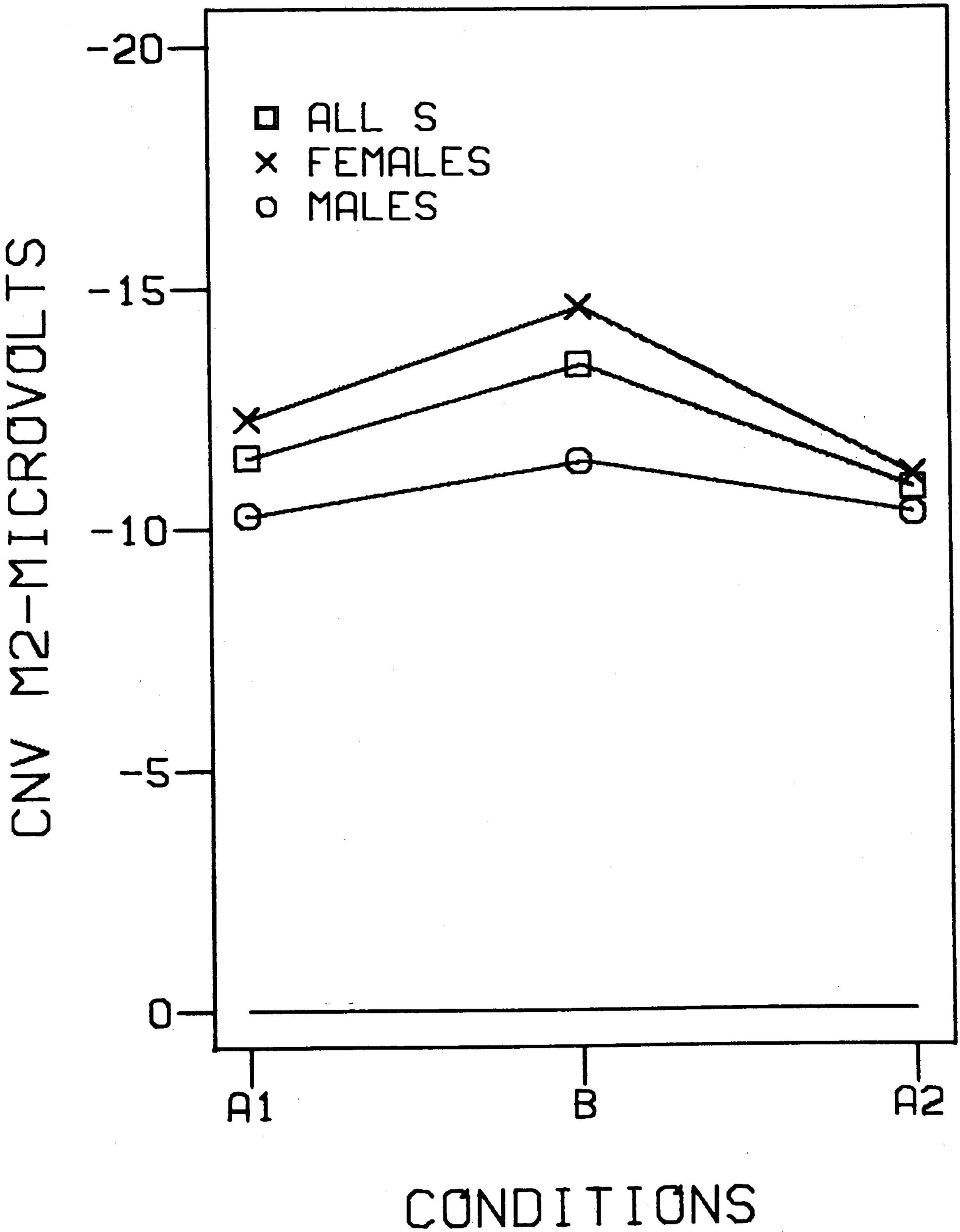

-20
-15
-10
-5
0
ALL S
FEMALES
MALES
CNV M2-MICROVOLTS
A1
B
A2
CONDITIONS

Figure 64

Mean CNV-M3 Amplitude by Condition

for Males, Females and All $\underline{S}$s

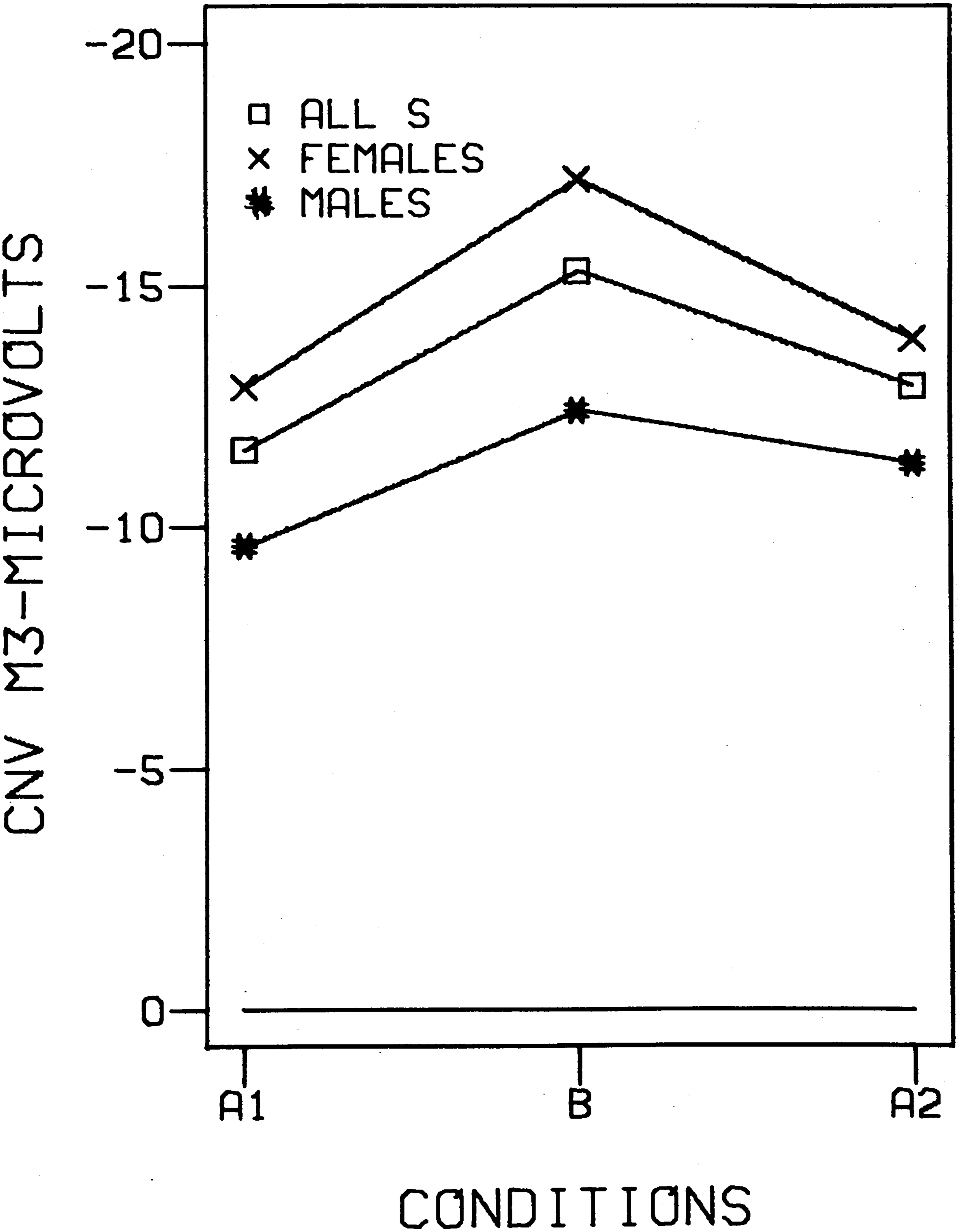
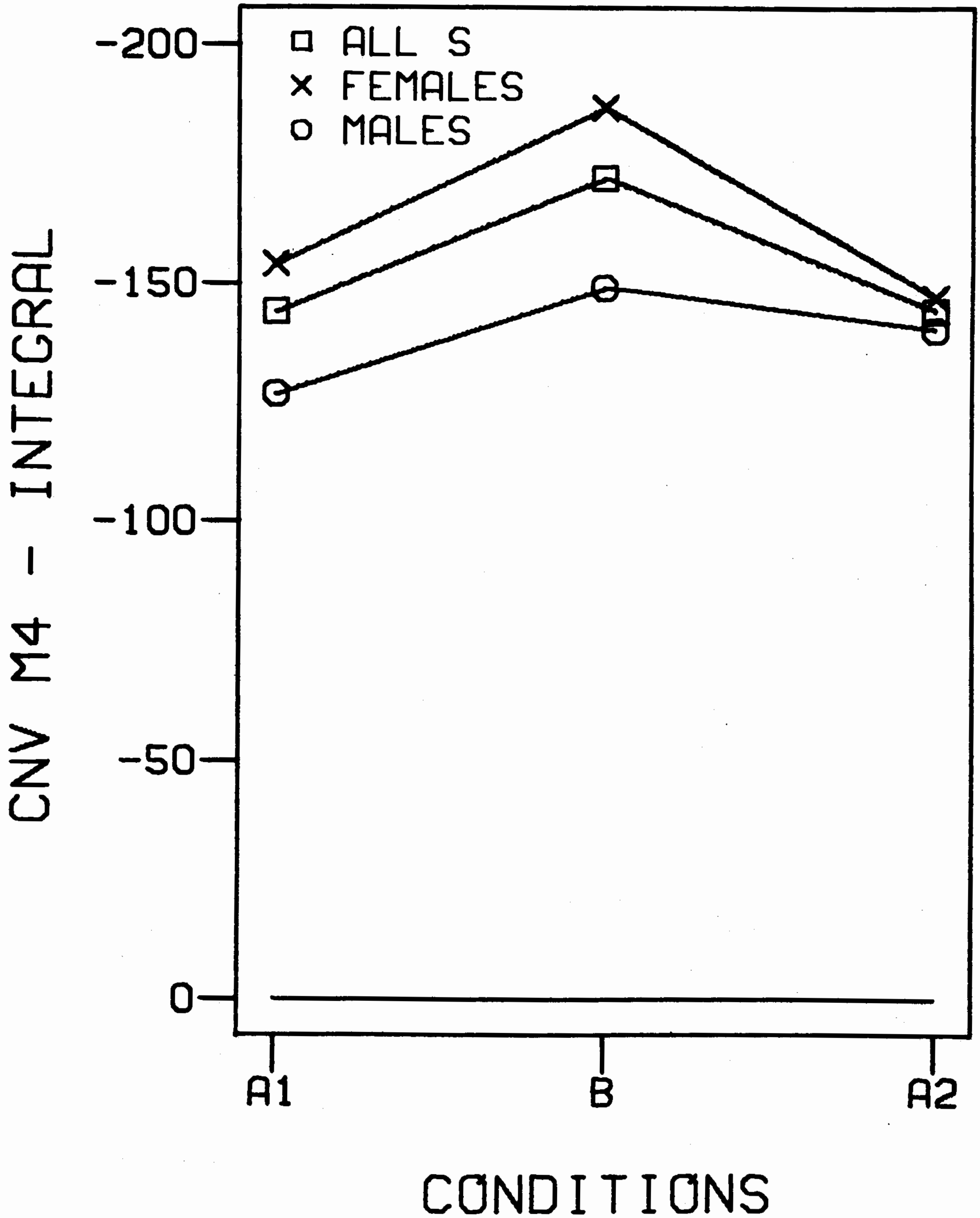

-20
-15
-10
-5
0
CNV M3-MICROVOLTS
ALL S
FEMALES
MALES
A1
B
A2
CONDITIONS

Figure 65

Mean CNV-M4 Integral by Condition

for Males, Females and All $\underline{S}$s



ALL S
FEMALES
MALES
-200
-150
-100
-50
0
CNV M4 - INTEGRAL
A1
B
A2
CONDITIONS

Summary Table of Significant (p<.05) Sex
Effects for the Pooled Averaged Data

	CNV M1	CNV M2	CNV M3	CNV M4	N1 AMP	N1 LAT	P2 AMP	P2 LAT	P3 AMP	P3 LAT
...ificant ...Effect	X	X	X	X	X	X		X	X	X

TABLE XIX

Summary Table of Significant ($p<.05$) Electrode Effects for the Pooled Averaged Data

	CNV M1	CNV M2	CNV M3	CNV M4	N1 AMP	N1 LAT	P2 AMP	P2 LAT	P3 AMP	P3 LAT
s	X	X	X	X	X	X	X		X	
les	X	X	X	X	X	X	X		X	X
Ss	X	X	X	X	X	X	X		X	X

TABLE XX

Summary Table of Significant ($p<.05$) Condition Effects at Each Electrode and Over all Electrodes for the Pooled Averaged Data

	CNV M1	CNV M2	CNV M3	CNV M4	N1 AMP	N1 LAT	P2 AMP	P2 LAT	P3 AMP	P3 LAT
- Males										
- Females		X	X	X						
- All Ss		X	X	X					X	
- Males			X							
- Females			X							
- All Ss		X	X							
- Males							X			
- Females										
- All Ss										
l Electrodes - Males			X			X	X		X	
l Electrodes - Females		X	X	X	X					
l Electrodes - All Ss		X	X	X	X		X		X	

Table XXI

Summary Table of Significant (p<.05) Tone Effects
At Each Electrode and Over All Electrodes for the
Pooled Averaged Data

	CNV M1	CNV M2	CNV M3	CNV M4	N1 AMP	N1 LAT	P2 AMP	P2 LAT	P3 AMP	P3 LAT
- Males										
- Females										
- All Ss					X					
- Males										
- Females										
- All Ss										
- Males										
- Females										
- All Ss										
Electrodes - Males										
Electrodes - Females					X					
Electrodes - All Ss					X					

Table XXII

amplitude). These results are depicted graphically in figure 46 for each of the amplitude measures. As can be seen from an examination of this figure the amplitude of N1, P3 and the two later CNV measures (M2 and M3) were significantly greater for females than for males. This trend was particularly evident for M2 and M3 of the CNV. For M1 this situation was reversed as the males produced larger amplitude early negativity. This inconsistent finding is probably due to the larger amplitude and longer latency of the P3 component in females as M1 started only 500 msec after S1 and would have included some late positivity.

Significant ($p \leq .05$) electrode effects overall conditions are summarized in table XX for males, females and all Ss. These findings are also displayed graphically in figures 47-57. Figure 47 presents the topographical distribution of the N1 EP component. As can be seen N1 is largest at the vertex and of about equal amplitude at Fz and Pz. This figure illustrates the pronounced sex differences for N1 observed only at Fz. At this one electrode N1 was significantly larger for females than for males.

Figure 48 displays the anterior-posterior distribution of

P2 amplitude which was parietally dominant with Cz larger than Fz. This figure also illustrates an interesting although non-significant interaction between sex and P2 topography.

The P3 distribution is depicted in figure 49 which clearly shows that the maximum amplitude was at Pz and the Fz was slightly larger than Cz. Maximum sex differences for P3 were observed at Pz although at all electrodes the females had larger amplitude P3 components.

The latency of the EP components at each of the electrodes is illustrated in figure 50. N1 latency is significantly decreased from Fz to Pz for both males and females. The latency of P2 showed no topographic or sex differences. P3 latency for males showed no topographic distribution. However, for females P3 latency was significantly longer than for males and additionally, showed shorter latency at Fz than at either Cz or Pz.

The frontally dominant distribution of the early CNV component (M1) is clearly displayed in figure 51. The finding of larger amplitude of this component for males is seen uniformly at all electrodes.

Figure 52 shows the topographical distribution of M2, the "middle" CNV measure. This measure was largest at the vertex, not much smaller frontally and quite a bit smaller parietally. The M2 measure was found to be larger for females at each of the electrodes although the difference was more pronounced at Fz.

The distribution of CNV M3 was centrally dominant as can be seen in figure 53. For this measure Fz and Pz displayed very similar amplitudes. Examination of this figure also shows that the sex differences at all of the electrodes were particularly pronounced for M3 although the differences were once again larger at Fz. The direction of the sex differences was such that the females displayed significantly larger CNV values.

The topography of the CNV integral measure (M4) is presented in table 54. This measure of overall negativity showed a prominant frontal-central dominance for the CNV obtained in this discrimination task. The Pz integral is greatly reduced relative to Fz and Cz. The females demonstrated greater negativity at all electrodes although the differences were again accentuated at Fz.

Figures 55-57 present the spatial-temporal distribution of the CNV for the males (figure 55), for the females (figure 56) and for all Ss (figure 57). Examination of these figures clearly demonstrates the frontal dominance of the early CNV measure (M1) and the central dominance of the later CNV measres. These spatial-temporal distributions also show sex differences which are most pronounced for Fz. For the males Fz amplitude is largest at M1 and then rapidly declines over the CNV interval so that by M3 it is of lower amplitude than Pz. In contrast, for the females Fz amplitude increases slightly over the CNV interval so that M3 is larger than M1.

The significant condition effects at each and overall electrodes are summarized in table XXI. Additionally the condition effects overall electrodes are illustrated in figures 58-65. From examination of table XXI it can be seen that generally the females were more influenced by the conditions than were the males. Furthermore it can be seen that the Cz and Pz measures were far more sensitive to condition effects than were the Fz measures. Maximum sex differences for condition effects were seen at Cz. None of the Cz measures for the males were significant whereas the M2, M3 and M4 CNV measures for the females all reached significance.

Figure 58 depicts the condition effects on N1 amplitude for males, for females and for all Ss. The amplitude of N1 was seen to remain relatively constant between the "A1" and the "B" conditions but to decrease significantly between the "B" and "A2" conditions. This trend was observed for both males and females. It can be seen that N1 amplitude was slightly larger for females than for males for each of the conditions.

P2 amplitude was seen to decrease during the "B" condition and then to increase slightly during the "A2" condition (figure 59). This figure reveals that an interesting non-significant interaction was obtained between sex and condition because the males demonstrated a more pronounced decrement in P2 during the "stressful" condition.

Figure 60 illustrates the condition effects on P3 amplitude. Examination of this figure clearly shows the decrement in amplitude between "A1" and "B" and the stabilization between "B" and "A2". This effect was consistent for both males and females although the females demonstrated larger P3 amplitudes for all conditions.

The mean latency of the EP components by condition is presented in figure 61. This figure clearly shows that the latency of the EP components was not significantly affected by condition. However, a significant sex difference for P3 latency was observed. In each of the conditions longer latency P3 components were obtained from the females.

Figure 62 illustrates the non-significant condition effect for the M1 CNV measure. However, it can be seen that there was a trend for greater negativity during the "B" condition. This figure also shows the previously observed sex differences of larger amplitude M1 measures for the males over each of the conditions.

CNV M2 condition effects are presented in figure 63. The increase in CNV amplitude as a result of the "B" condition is seen to be larger for females than for males. The condition effect for males was not significant whereas for females it was. There was also an observed difference in amplitude between the males and the females (females more negative) that interacted a bit with conditions. The sex differences increased between the "A1" and "B" conditions and then decreased to almost nothing during the "A2" condition.

Figure 64 depicts the CNV M3 condition effects. Examination of this figure shows the significant increases in M3 for both males and females during the "B" condition. Furthermore the sex differences in M3 amplitude are extremely pronounced. In each of the conditions the females displayed significantly greater negativity.

Condition effects for the CNV integral measure (M4) are presented in figure 65. It can be seen that the increase in negativity over the "stress" condition was much more pronounced for females than for males. In all conditions the females displayed greater negativity although the sex difference was greatly reduced over the "A2" condition.

Table XXII summarizes the significant tone effects. As can be seen from this rather sparse table only N1 amplitude was at all related to tone intensity. The relationship between tone intensity and N1 amplitude is relatively direct in that the more intense tones produced larger N1 amplitudes.

Discussion

The primary aim of this thesis was to determine the relationship(s) between SPL fluctuations and EP and CNV amplitude in an experimental situation similar to those that have previously been shown to produce decrements in CNV amplitude due to induced "stress." The selected paradigm was a 3 condition auditory discrimination task that required the S to merely decide if the two tones presented as S1 and S2 were of equal or different intensity. The 3 conditions were presented in an "A1-B-A2" format with the "B" or stressful condition differing from the "A" conditions only in that negative reinforcement, in the form of a 95 db blast of white noise, was administered for incorrect or delayed chice. Similar paradigms have been used previously by Knott and Peters (1974) and Peters and Knott (1976) to investigate the effect of situational anxiety on the CNV. These authors have reported that noxious feedback produced a decrement in CNV amplitude for female Ss. No such effect was observed for the males. The finding of a reduced CNV in females was ascribed to an increased level of anxiety induced by the noxious feedback. Previous reports by on of the authors (Knott 1972; Knott and Irwin 1967, 1968) have attributed such decrements to situation-induced negative SPL shifts. In the 1972 article Knott posits that there is an overall limit to cortical negativity (the "ceiling") and consequently any sustained negative shift limits the maximum amplitude of any further negative slow activity. The closer the SPL is to the ceiling, the less the amplitude of any additional negativity that can be expressed fully. This hypothetical statement of an inverse relationship between the CNV and SPL has been labelled the "ceiling hypothesis" (Knott 1972) and has occasionally been cited to explain otherwise inexplicable situation-specific CNV decrements (Poon, Thompson and Marsh 1976) as well as subject-specific CNV anomalies (Knott and Irwin 1967, 1968; Low and Swift 1971).

The research described in this thesis was intended to be the first attempt at subjecting the "ceiling hypothesis" to direct experimental test. The expected CNV decrements during the "stressful" condition were to be accompanied by negative SPL changes reflecting increased arousal levels. Observation of this sort of relationship would have been considered as confirmation of the "ceiling hypothesis." Alternatively, if the CNV changes could have been dissociated from the SPL fluctuations this would have been interpreted as disconfirmation of the relationship. Unfortunately the totally unexpected results of increased CNV amplitude during the "stressful" condition makes it impossible to relate this data to the "ceiling hypothesis" per se.

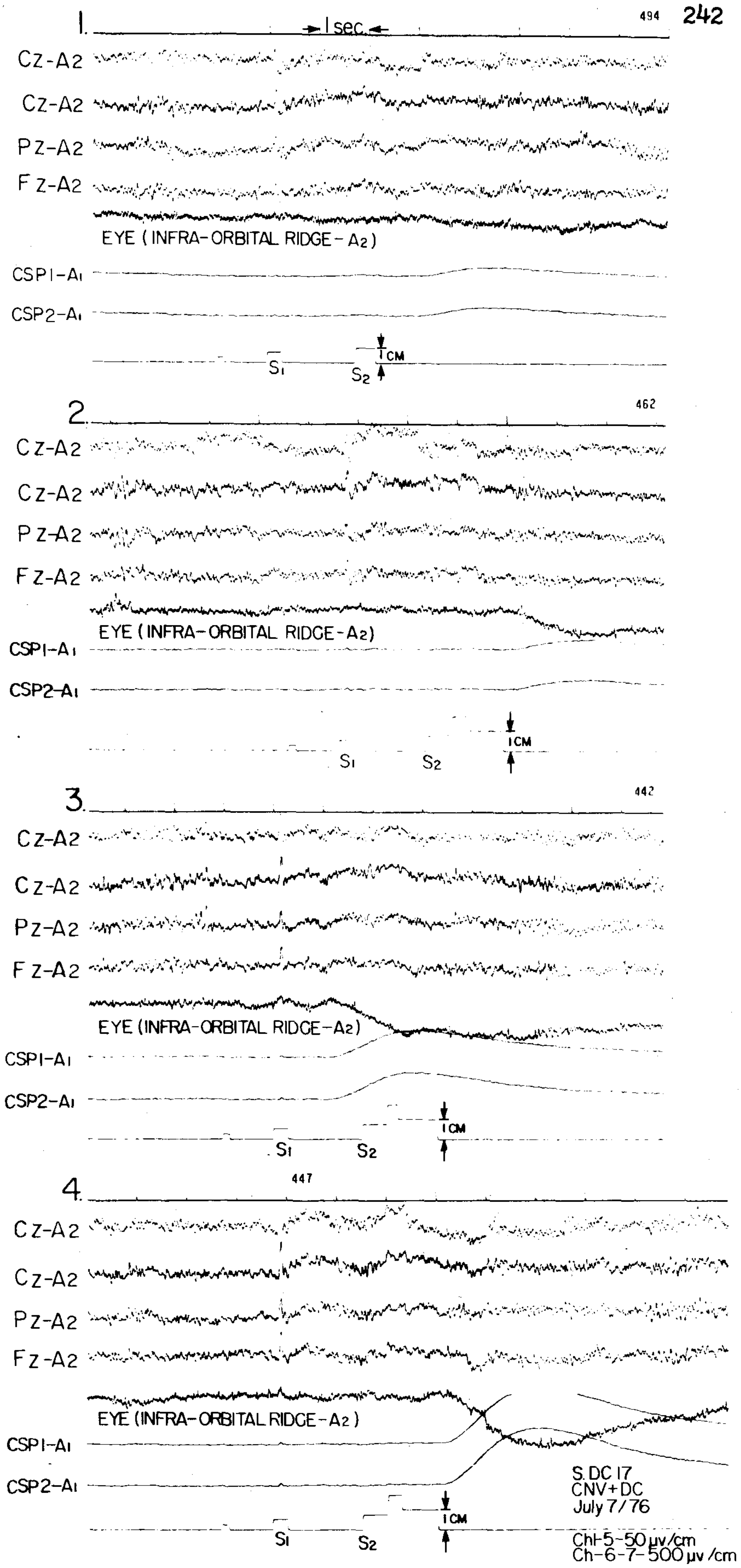
Nonetheless there are certain consistencies in the SPL data and in the observed relationships between the SPL and the CNV and EP data that are of interest. First of all, for 13 of the 18 Ss the SPL shifted predominantly positively over the course of the experimental session (see figures 4-21). The significance of these positive shifts is of course open to multiple interpretations. The most obvious one is that these SPL shifts are predominantly artifactual and consequently bear little, if any, relationship to neural processes. The relatively insignificant patterns of relation between SPL and the CNV and EP would indirectly support such an interpretation. On the other hand, there are several points that strongly argue against any simple equation of the SPL data with artifact. As mentioned previously there are two major potential sources of artifact in DC scalp recording - the electrodes and the skin. The elaborate procedures employed to minimize electrode and skin problems are detailed elsewhere. Suffice it to say that all conceivable precautions were taken prior to data collection to insure that minimal artifact would be introduced at this stage. Additionally, the consistency of the SPL data in as far as the direction of the shift argues against the electrodes as being the source. The two selected SPL electrodes were alternated across Ss as to which electrode was applied to the vertex and which to the reference site. If the electrodes themselves were unbalanced the direction of drift would have alternated over Ss. No such consistent pattern was observed between SPL and the specific electrode configuration. A further argument against the electrodes being solely or primarily responsible for the recorded shifts is the non-linear nature of the SPL data for the majority of Ss. Electrode drift tends to be uni-directional as the drift is a reflection of decreasing electrode potential difference. Therefore this author maintains that the electrodes are an unlikely source for the recorded SPL fluctuations.

The degree to which the SPL measures are contaminated by cephalic GSP activity is more difficult to assess. Two investigations (Picton and Hillyard 1972; Corby, Roth and Kopell 1974) have recently examined the contribution of GSP activity to scalp recorded CNVs. Picton and Hillyard (1972) found that following sensory stimulation a surface negative transepidermal slow potential of several millivolts may be superimposed upon the resting potential. This shift presumably reflects sweat gland activity (Venables and Cristie, 1973). CNVs recorded through intact skin were seen to contain these phasic mastoid positive waves which artifactually augmented the later components of the CNV and altered its waveform. Such electrodermal contamination of CNV recordings was more prevalent in warm and drowsy subjects, especially where the CNV task was particularly demanding. Corby et al. (1974) studied the prevalence and methods of eliminating GSP during a CNV task. These authors found significant stimulus-induced GSP artifact in the EEG of 10 of their 21 Ss. However, both studies found that puncturing the skin, either before electrode application, or by the use of subdermal pin electrodes, eliminated the GSP "contamination".

Based on these findings, both dermabrasion and skin lesioning were used in this study to minimize GSP artifact in the SPL and CNV data. To assess the efficacy of these skin preparation techniques simultaneous recordings of GSP were obtained from two differently prepared "active" scalp electrodes referenced to the same lesioned site. One of the scalp sites was prepared as for the SPL electrodes. The second site was prepared to record GSP activity so care was taken to avoid damaging the outer skin layers. It was expected that the differing amounts of recorded GSP activity in the two channels would indicate the success of skin penetration as a means of reducing GSP artifact. Additionally the one channel of "true" GSP was to provide an independent measure of the "anxiety" or "arousal" produced by the experimental manipulations. However, in all Ss but one (figure 66) there was no sign of any GSP activity in either of the two GSP channels. This finding demonstrated that skin lesioning is usually an effective technique for eliminating or reducing GSP artifact. Furthermore the similar patterns of activity recorded from the lesioned-lesioned pair and the non-lesioned-lesioned pair suggests that most reports of GSP contamination are probably due to skin activity at the reference. This suggestion is supported by figure 66 which illustrates the one instance of recorded GSP activity. This figure presents four trials selected to show succesively larger GSP responses. From examination of this figure it can be seen that the activity from the two GSP channels (7 and 8; labelled CSP1 and 2) was nearly identical despite the different electrode-skin preparations. Additionally the large amplitude (up to several millivolts) skin potentials were not reflected at all in the EEG channels. In concert these two observations demonstrate

Figure 66

Sample Records of GSP Activity from DC 17 (S Discarded Due to Excessive GSP Activity)


1.
→ I sec. ←
494
CZ-A2
CZ-A2
PZ-A2
FZ-A2
EYE (INFRA-ORBITAL RIDGE-A2)
CSP1-A1
CSP2-A1
S1
S2
1 CM
2.
462
CZ-A2
CZ-A2
PZ-A2
FZ-A2
EYE (INFRA-ORBITAL RIDGE-A2)
CSP1-A1
CSP2-A1
S1
S2
1 CM
3.
442
CZ-A2
CZ-A2
PZ-A2
FZ-A2
EYE (INFRA-ORBITAL RIDGE-A2)
CSP1-A1
CSP2-A1
S1
S2
1 CM
4.
447
CZ-A2
CZ-A2
PZ-A2
FZ-A2
EYE (INFRA-ORBITAL RIDGE-A2)
CSP1-A1
CSP2-A1
S.DC 17
CNV+DC
July 7/76
S1
S2
1 CM
Ch1-5-50 µv/cm
Ch-6-7-500 µv/cm

that the skin potential activity was originating at the left mastoid. This electrode site was apparently improperly prepared as was also the eye electrode as the EOG channel displayed skin potential activity of opposite polarity. In fact the data from this S was discarded from the analysis due to the excessive GSP activity recorded at the eye lead. As this was the only S who showed any skin potential response at all the evidence for differential susceptibility of the two reference sites to skin potential contamination is rather sparse. However, it seems that with careful skin preparations both the mastoids and earlobes can be used successfully.

In general the GSP data is significant in that it provides indirect evidence that the SPL recordings were not contaminated with the phasic type of skin potential activity. Nonetheless it is still possible that tonic changes in skin potential level (of which very little is known; see Venables and Christie 1973) may have been a source of artifact. The inconsistent patterns of relationship between the 2 GSP channels and the SPL data (see Appendix G) do not provide evidence one way or the other. However the substantially lower potential differences recorded between the lesioned GSP pair than between the intact-lesioned pair (see Appendix B) suggest that the skin potential level was probably not contributing to any observed potentials between lesioned sites. This ten-fold difference in initial potential indicates that with skin penetration the skin potential level can be greatly reduced if not eliminated.

The consistent polarity of the SPL changes makes it difficult to attribute these slow changes to some of the other possible artifactual sources as it becomes necessary to postulate processes that affect one electrode more than the other. Any temperature differences between the electrodes and the skin would have been minimized over the 45 minute period between the time of electrode application and the start of data collection. Further electrode-skin temperature differences due to fluctuations in body and/or ambient temperature should have affected both electrodes equally. Similarly, changes in electrolyte concentration at the electrode-skin interface due to tissue damage should have occurred equally at both electrode sites as the preparations were identical. Therefore it is considered improbable that the SPL data were primarily a reflection of physical, non-biological processes.

Despite the recognized uncertainties involved in DC scalp recording, it is tentatively concluded that the SPL data primarily reflected a neural change occurring at the cortical surface. The physiological and/or psychological significance of these slow changes can only be speculated as the direction of change was predominantly counter to expectations. However, there are several plausible interpretations that can be given to the SPL findings that are equally congruent with the obtained CNV data. If it is assumed that the relationship between arousal levels and SPL is such that increased arousal is associated with negative shifts and conversely, decreased arousal is accompanied by positive shifts, the SPL and CNV data can be put into a perspective compatible with the "ceiling hypothesis." In fact, if one is willing to conjecture that the arousal level of the Ss decreased uniformly over the experimental session somewhat independently of the conditions, an argument can be made that this data is not only compatible with, but indirectly supportive of the "ceiling hypothesis." It may very well be that for the naive S the most "stressful" or "arousing" part of the experiment concerns the initial preparations and set-up. The uncertainties of the naive S with respect to the procedures involved, the task requirements and their subsequent performance may create a very stressful situation. This may be particularly true in recording situations necessitating stable electrodes as the procedure often employed to allow the electrodes time to stabilize is to leave the S alone and inactive in the recording situation for some period of time to ostensibly "relax." If the S was already apprehensive about the situation this period of inactivity may actually heighten rather than decrease the anxiety level. Therefore if the assumption about increased anxiety and arousal leading to prolonged surface negativity is correct, it is possible that the Ss may have been close to the "ceiling," the point of maximum possible negativity, at the start of data collection. Familiarization with the experimental situations and its demand would quickly reduce the overall level of arousal producing a sustained positive SPL shift. That this shift was not reactive to the "stressful" condition may be a reflection of experimenter naivete in designing "stressful" situations.

The SPL data obtained in this study are basically compatible with such a view. For 13 of the 18 Ss SPL did shift predominantly positively over the course of the experimental session (see figures 4-21). Furthermore, for approximately half of these Ss CNV amplitude did increase concomitantly with the positive SPL shifts (see table I). These findings do provide some evidence that the relationship between SPL and the

CNV is inverse; and as this relationship is a necessary component of the "ceiling hypothesis," these data could be interpreted as indirectly supporting this viewpoint.

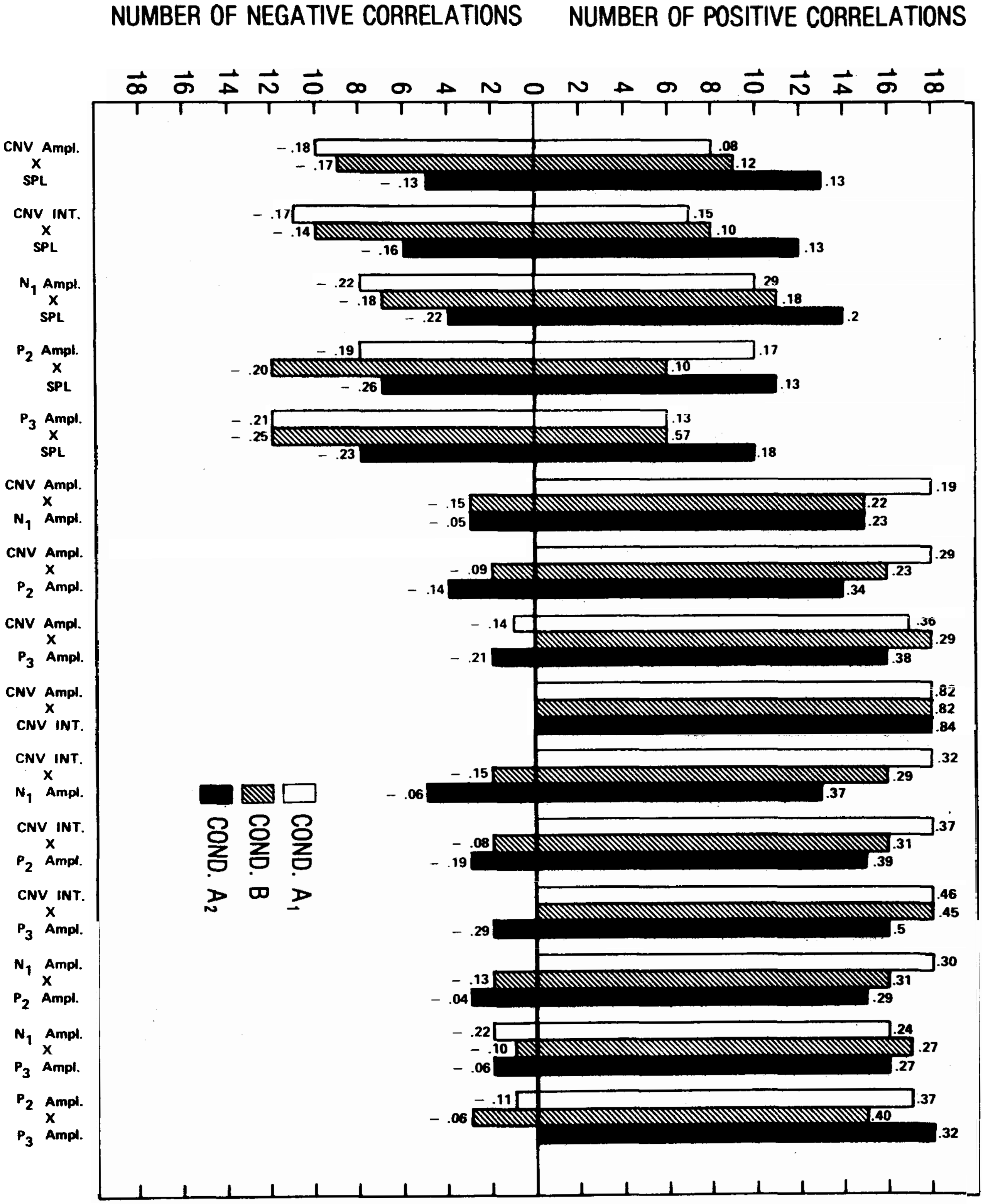
An alternative interpretation of the SPL results is based partly on pilot work done by this author on the relationship between scalp recorded SPL fluctuations and the stages of sleep. In this research one of the more consistent findings has been surface positive SPL shifts with the transition from slow-wave to REM sleep and from sleep to wakefulness (see also Starobinetz' 1966 report of REM "electro-positvity"). This is in marked contrast to the bulk of animal research that has consistently reported surface negativity during these same transitions. As all of these investigations had used trans-cortical recording, it is of interest that Wurtz (1965), using an extra-cerebral reference, reported surface positivity upon awakening and during the transition from slow-wave to REM sleep. It is tempting to postulate that the steady potential field is such that transcortical positivity is equivalent to negativity recorded between the cortical surface and an extra-cerebral reference or between two extracerebral electrodes. Accepting this postulate, the SPL data can then be viewed as generally indicating INCREASED arousal over the experimental session. This is somewhat more in agreement with the reaction time data which generally decreased over conditions and subjective reports gathered at the end of the data session. Additionally it has been demonstrated that the effect of increasing levels of arousal (up to a point) is to increase CNV amplitude (Tecce 1972) so the CNV data are equally compatible with this interpretation. However, the lack of SPL change to the "B" or "stressful" condition is still troublesome.

Perhaps the latency of situation-induced SPL change is sufficiently long that the relationship is obscured due to the lack of temporal contiguity. The Aldajolova (1964) data on infra slow potentials in rats supports the idea of such a long latency reaction to stress. On the other hand, perhaps there is no direct relationship between transient alterations in arousal and SPL. The data obtained on SPL changes during the sleep-wakefulness cycle reflects potential change due primarily to endogenous metabolic processes which are regulated by a plethora of internal mechanisms. The susceptibility of these processes to transient external modification has not really been demonstrated. It is apparent that much further research needs to be done to determine both the spatial and temporal patterns of SPL change and the relationships these changes have to heuristic physiological and psychological constructs such as arousal.

Whatever the underlying significance of the SPL data there are nonetheless some mildly interesting patterns of correlation between SPL and the amplitude of the event-related potentials. Figure 67 illustrates the pattern of correlation obtained between SPL, CNV, N1, P2 and P3 for each of the conditions. The bars indicate the number of Ss showing a positive and the number of Ss showing a negative correlation (total = 18) for any of the correlated pairs of variables in each condition. The numbers above and below the bars are the mean positive and negative correlations. It can be seen that the first (left) part of the figure shows a relatively equal number of positive and negative correlations. This part of the graph depicts the relationships between SPL values and CNV, N1, P2 and P3 amplitudes. This lack of consistency in the direction of relation is paralleled by the generally low correlation coefficients. Comparison of this figure with tables I - V which present the correlation coefficients for each S over all conditions and within conditions demonstrates that the overall correlations were equally inconsistent. However, there is a trend for the significant correlations between SPL and the CNV, P2 and P3 to be negative in sign which is in the direction

Figure 67

Number of positive and negative correlations for each of the pairs of variables. Mean positive and negative correlations are above and below the bars.


NUMBER OF NEGATIVE CORRELATIONS
NUMBER OF POSITIVE CORRELATIONS
18 16 14 12 10 8 6 4 2 0 2 4 6 8 10 12 14 16 18
CNV Ampl. X SPL
CNV INT. X SPL
N1 Ampl. X SPL
P2 Ampl. X SPL
P3 Ampl. X SPL
CNV Ampl. X N1 Ampl.
CNV Ampl. X P2 Ampl.
CNV Ampl. X P3 Ampl.
CNV Ampl. X CNV INT.
CNV INT. X N1 Ampl.
CNV INT. X P2 Ampl.
CNV INT. X P3 Ampl.
N1 Ampl. X P2 Ampl.
N1 Ampl. X P3 Ampl.
P2 Ampl. X P3 Ampl.
COND. A1
COND. B
COND. A2

hypothesized. As the SPL shifted positively it was expected to be related to both increased CNV and N1 amplitudes and decreased P2 and P3 amplitudes. As can be seen from tables I - V there is some scant evidence for this relationship holding between SPL and the CNV and the positive EP components. However the significant N1 correlations are positive indicating decreased N1 amplitude with positive SPL change. This reversed finding is probably due to the effects of habituation on this EP component independent of the SPL. Unfortunately the significant findings for P2 and P3 could possibly be explained similarly. Therefore it is difficult to come to any conclusions about the relationship between the tonic steady potential level and the observed amplitudes of the CNV and EP components. These findings can be interpreted in one of two ways. The first is that the SPL data is sufficiently contaminated with extraneous artifact that the "true" relationship is obscured in different Ss to varying degrees depending on the amount of contamination. If this is true then further refinement in methodology should be expected to produce more consistent results. The second possibility is that there really are no direct relationships between these types of brain activity so the few significant results are solely due to chance. The only, and admittedly rather indirect evidence to argue against this second possibility is the consistent pattern of relationships observed between the CNV and the EP components. This general pattern indicates a reciprocal relationship between expressed positivity and expressed negativity.

These findings are illustrated in the second half of figure 67. The consistency of these interrelationships is apparent in the overwhelming percentage of positive correlations (see also tables VI - XV). One interesting trend apparent in this figure is the somewhat decreasing consistency of the relationships between CNV amplitude and the EP components over conditions. As mentioned previously this appears to be due to the effect of habituation differentially affecting the CNV and EP. Nonetheless for any one condition and overall conditions there are very significant interrelationships between these event-related potentials. Large amplitude CNVs tend to be associated with large amplitude N1 and decreased P2 and P3 components. Conversely, lower amplitude CNVs tend to be associated with smaller N1 and larger P2 and P3 amplitudes.

These findings are of interest since previous studies investigating the relationship between the EP to S1 and CNV amplitude have reported rather inconsistent results. Several invesitgations have reported weak positive correlations (Walter 1964c; Wazak and Obrist 1969; McCallum and Walter 1968; Cohen 1969) whereas others (Cohen and Walter 1966; Hillyard 1969a) have reported no consistent relations whatever. However, as most of their studies examined "averaged" waveforms, the differences in results may be due to the method of analysis. It is expected that single-trial analysis would be a more sensitive measure of the patterns of covariation.

The unexpected effects of stress on CNV measures observed in this research (see figures 22-41 and 62-65; tables XVII and XXI) are difficult to reconcile with the results reported by Knott and Peters (1974) and Low and Swift (1971) of decreased CNV amplitude with increased situational stress. Part of the discrepancy may be due to a confounding of discrimination difficulty with the induced-stress as the paradigms used by these investigators have employed successively more difficult discriminations with consequently more errors. Each error produced some negative reinforcement which acted as a stresser. The amount of stress was equated with the number of errors. However, Delse et al. (1972) have shown that increasingly difficult auditory discrimination with non-noxious feedback produces CNV decrements proportional to the task difficulty so that the "stress" effects may be due primarily to task difficulty. The same objection cannot be raised for the Peters and Knott (1976) study in which the same discrimination paradigm was employed with and without negative feedback. Although this paradigm is very similar to the one used in this report, Peters and Knott found decreased CNV amplitude with noxious or stressful feedback. The noxiousness of the negative reinforcers used in the studies was probably comparable as the intensity of the different sounds was equal (95 db). Additionally one investigator was exposed to both situations and found them equally obnoxious (Peters, personal communications 1976). Therefore the probability of the discrepant results being due to different amounts of induced stress seems somewhat remote. An alternative explanation has to do with the different task requirements. In the Peters and Knott study the S was required to make a discrimination at S1 as to whether or not a response should be made to S2. In this task all the information necessary for the discrimination is in S1. The ISI would probably be used by the S to decide whether or not to respond. The reduced CNV with stressful feedback in this situation might be a reflection of the additional effort in information processing and decision-making necessary to minimize errors. In contrast, the discrimination task in this study required the S to compare the intensity of the tone pips presented as S1 and S2. Therefore the information required to successfully make this discrimination was equally in the two stimuli. The decision to respond in one manner or the other could not be made until the presentation of S2 so that over the ISI the S was merely required to "remember" the intensity of S1. In this paradigm the increased CNV is probably due to increased attentional or motivational factors as both have been shown to produce increases in amplitude (Tecce 1972). Whether or not this is identical to a "stress" effect remains to be seen. The lack of an independent measure of autonomic reactivity further confounds the problem of interpretation.

Another discrepancy between these results and what was expected is the lack of significant interaction between sex and "stress." Knott and Peters (1974) had demonstrated a strong interaction such that the CNV in females was greatly attenuated whereas the CNVs in males showed no stress effect at all. However the Peters and Knott (1976) study found no significant interaction between sex and stress. The results of this present research are in agreement with the later study. For both groups the CNV showed increased amplitude during the "B", or allegedly stressful condition although there was a definite trend for the effect to be more pronounced in females (see table XXI and figures 62-65).

Despite the lack of interaction between sex and the conditions, there were pronounced sex differences observed for almost all of the CNV and EP measures (see table XIX and figures 46-65). In general the amplitudes of both the EP components and the CNV were larger for females than for males. Additionally the females had larger latencies for the EP components. This finding is particularly evident for P3. Sex differences in CNVs and EPs have not often been reported. However, a series of recent studies by Nakamura _et al_. (1975, 1976 II, III) have reported that CNV amplitude for females was consistently larger than for males. The EP literature is somewhat inconsistent. In general it appears that reported sex differences in both amplitude and latency are small, if present (Shagass 1972). Males have occasionally been reported to have lower amplitudes for particular components (Shagass 1972; Straumanis _et al_. 1965; Buchsbaum _et al_. 1974). However the latency of any component has not consistently been shown to be different for males than for females. Since sex differences in electrophysiology are rather difficult to interpret, several investigations have attempted to assess the contribution of physical differences to observed amplitude differences. Quoting from Buchsbaum et al. (1974):

> Anatomical differences in the skulls of men and women do not appear to explain the observed sex differences in AER (auditory evoked response). Although thicker cranial bone or soft tissues might be expected to attenuate the AER amplitude in adult males, no correlation between thickness and AER amplitude was observed. Similarly, Dustman and Beck (1965) found no correlation between anthropometric skull measurements and AER characteristics. Larger brain weight might also be associated with larger AER amplitude; however, women tend to have smaller brain weight than men, yet exhibit larger AER amplitude.

The sex differences reported in this study are even more difficult to explain on the basis of differential physical brain, skull and tissue parameters as there are more pronounced CNV and N1 sex differences at Fz than at either Pz or Cz. On the other hand the positive EP components showed maximal sex differences at Pz. Although this interaction between electrode and sex was not statistically significant, examination of figures 47-57 illustrate the trends.

Figures 55-57 illustrate the spatial-temporal pattern of the CNVs obtained in this study for males, females and all Ss. It can be seen that the early component of the CNV (M1) is maximal at Fz. The middle and late components (M2 and M3) are maximal at the vertex. For males (figure 55) the acitivity at Fz shows greatest negativity in the early part of the CNV and then drops off sharply over the CNV interval. In contrast the female Fz data (figure 56) show a sustained slightly increasing negative shift throughout the interval. Cz and Pz both show similar waveforms although both are consistently larger for M2 and M3 in females than in males.

The topographical data indicate several interesting points. The first is that overall Ss the CNV amplitude distribution was shifted frontally. In males peak amplitude was at Fz and for females Fz amplitude was only slightly less negative than at Cz. Similar findings of frontally distributed CNVs have been reported by Jarvilehto and Fruhstorfer (1970) in an auditory discrimination task. This finding is in contrast to the usual CNV topography which has been reported as centrally dominant (Cohen 1974; Tecce 1972; Weinberg and Papakostopoulos

1975). The Weinberg and Papakostopulos paper observed that not only are CNVs smaller at frontal sites than central but they are also of different shape. These results support the observation of shape differences at Fz but, since these frontal waveforms are apparently sex and task dependent it is as rash to speak of <u>the frontal</u> CNV as of <u>the</u> CNV in general.

The topographical distribution of the early and late CNV components is interpreted as support for the fashionable idea of a non-unitary CNV (Loveless and Sanford 1973, 1974, 1975). The early component was frontally dominant and is presumed to reflect stimulus orientation. The later components were centrally dominant and are presumed to reflect preparation to respond.

The observed sex differences at the frontal electrode can perhaps be interpreted as a reflection of sex-related stimulus orientation processes. The sex differences in CNV amplitude were most pronounced frontally. The amplitude of the N1 component of the EP which has been related to selective attention (Tueting 1976) also showed the largest sex differences at Fz. Additionally a shorter latency P3 was observed at Fz for females. For males P3 latency showed no spatial differences. This shorter latency frontal P3 (a) has been recently related to stimulus novelty and orientation (Tueting 1976). Taken together these findings seem to indicate that orientation for the females was more intense and/or prolonged than in the males. The results of the analyses for the effect of tone intensity do not provide much support for this notion although no single-trial analyses of Fz were undertaken. The only consistent effects observed were changes in N1 amplitude directly related to tone intensity.

In conclusion it seems that this thesis has raised more questions and possible controversy than it has settled. Looking to the future it seems clear that the validity and physiological/psychological significance of SPL data recorded from the scalp needs to be established by either simultaneous recording from the cortex and scalp or by observation of extremely consistent changes in SPL due to changes in, for example, the sleep-wakefulness cycle. The related question of a proper reference for SPL recording needs to be considered carefully. Additionally the topography of SPL fluctuations should be examined since the evidence for topographical CNV differences might be related to local SPL change. The relationship between SPL and the CNV can perhaps be more meaningfully examined if CNV trials are presented during various induced or spontaneous SPL fluctuations rather than modifying the CNV to determine if SPL changes were the underlying mechanism for the modification. A study in which CNV trials are presented contingent on negative or positive pre-S1 SPL change might be of interest. Alternatively, a study similar to the Salamy et al (1975) study of the CNV during sleep but using DC recording might be successful.

The relationship between the amplitude of the EP components to S1 and the CNV also needs to be examined carefully. The results from this research demonstrate a significant reciprocal relationship between positivity and negativity in single trial ERPs. The relationship of these findings to some sort of "ceiling" effect needs to be investigated.

The relationship between situational stress and the CNV obviously needs reappraisal. Of primary importance is the adoption of some standardized definition and paradigms for eliciting stress that are as free of confounding influences as possible. Additionally an independent autonomic measure of the effects of "stress" should be obtained in all situations to ensure that the experimental operations were indeed stressful.

The observed sex differences are another demonstration that males and females should not be indiscriminantly combined in electrophysiological research. The determination of the relationship between sex and the specific task requirements on event-related brain activity needs to be undertaken.

The topographical data is hopefully one more nail in the coffin of the CNV as this research has again shown the scalp distribution to be influenced by both sex and the task requirements. Much further research needs to be done to delineate the intricate relationships between these and other factors known to influence CNV amplitude and/or waveform.

Appendix A

Specification and Sequencing of Tonal Stimuli

TABLE A

Sound Levels of 1000 Hz Tones Used as Stimuli

tone 0	90 db.
tone 1	88 db.
tone 2	80 db.
tone 3	75 db.
tone 4	68 db.
tone 5	54 db.
tone 6	48 db.

Sound level was measured by a General Radio (Type 1551- C) Sound-Level Meter positioned in place of the subjects' head. Background noise level was approximately 44 db.

TABLE A

Sequence of Tone Presentation

TRIAL#	S1 - S2 COND.A	COND.B	COND.A
1	0-0	0-2	0-0
2	2-1	1-1	2-1
3	5-5	5-0	5-5
4	0-0	4-4	0-0
5	4-4	0-0	4-4
6	0-0	0-0	0-0
7	0-0	0-0	0-0
8	0-2	2-0	2-2
9	0-0	5-4	0-5
10	5-4	3-1	4-4
11	3-1	6-6	3-3
12	6-0	0-0	1-6
13	0-0	0-0	0-0
14	0-0	0-0	0-0
15	2-2	2-1	2-2
16	1-5	5-5	1-5
17	0-0	0-4	0-0
18	4-4	0-0	4-0
19	0-0	0-0	0-0
20	0-0	2-2	0-0
21	2-0	0-0	2-2
22	5-5	5-5	0-5
23	4-3	4-3	4-4
24	1-1	1-6	3-1
25	6-0	0-0	6-0
26	0-0	0-0	0-0
27	0-0	0-0	0-0
28	2-2	2-2	0-2
29	1-1	1-1	1-5
30	5-0	5-5	0-0
31	4-0	0-4	4-0
32	0-0	0-0	0-0
33	0-0	0-0	0-0
34	2-0	0-2	2-2
35	5-5	0-0	0-0
36	4-3	5-4	5-4
37	1-1	3-1	3-1
38	6-6	6-6	6-0

TABLE A (cont.)

39	0-0	0-0	0-0
40	0-0	0-0	0-0
41	0-2	0-2	0-2
42	1-5	1-5	1-1
43	0-0	0-0	5-5
44	4-0	4-0	0-4
45	0-0	0-0	0-0
46	0-0	0-2	0-0
47	2-0	0-0	0-0
48	5-5	5-5	1-1
49	4-4	4-4	0-5
50	3-3	3-3	4-3

Although tones were of identical intensity S had to respond as though they were different to be "correct".

Appendix B

Tables of Means and Standard Deviations for Individual *S*s

Table B1

Mean Reaction Time in Msec for
Individual Ss in Each Condition

S	Cond.A1	Cond.B	Cond.A2
01-Male	Mean=663.3	551.5	435.5
	SD=147.4	242.6	228.6
03-Male	787.1	529.3	595.4
	213.1	249.3	297.8
04-Male	781.7	638.5	785.5
	162.2	235.7	177.8
05-Male	792.3	663.5	632.7
	172.9	265.0	224.7
06-Male	570.4	609.7	504.3
	231.5	281.1	255.9
07-Male	581.1	524.7	640.7
	284.9	268.0	277.6
08-Male	584.6	629.2	655.8
	274.7	215.2	196.2
09-Female	721.2	673.5	661.2
	214.2	217.0	216.2
11-Female	710.7	611.7	644.5
	221.0	274.5	267.4
12-Female	624.6	608.1	585.4
	281.9	224.2	249.9
13-Female	785.6	667.0	673.4
	234.0	261.0	266.9
14-Female	733.8	607.9	527.8
	262.3	313.1	247.0
15-Female	755.3	555.6	554.3
	230.8	295.0	252.7
16-Female	702.9	604.0	589.7
	237.3	286.7	293.0
18-Female	1000.0	792.6	599.2
	0.0	235.3	231.1
19-Female	660.5	619.0	592.6
	242.4	291.8	264.6
20-Female	868.9	798.8	568.6
	185.1	236.0	261.8
21-Female	986.5	840.8	842.6
	79.6	157.3	195.1

Table B2

Mean CNV Amplitude (Cz)-M3 in Microvolts
for Individual Ss in Each Condition

S		Cond.A1	Cond.B	Cond.A2
01-Male	Mean=	-10.8	-19.9	-22.2
	SD=	11.4	10.7	13.5
03-Male		-9.3	-11.6	-10.3
		7.6	6.7	5.0
04-Male		-16.2	-17.6	-15.8
		10.8	15.5	12.6
05-Male		-20.5	-23.7	-25.8
		13.3	18.8	10.6
06-Male		-6.3	-11.3	-9.2
		8.0	9.9	9.8
07-Male		-13.6	-12.6	-13.3
		8.3	10.7	8.9
08-Male		-16.0	14.5	-10.8
		10.3	9.0	11.1
09-Female		-11.4	-13.8	-14.5
		9.9	10.9	11.4
11-Female		-15.9	-19.5	-11.5
		14.5	10.1	12.3
12-Female		-10.0	-8.9	-4.5
		7.6	8.4	9.3
13-Female		-12.1	-17.3	-7.1
		12.3	14.1	13.4
14-Female		-19.3	-35.6	-37.9
		12.0	11.6	13.0
15-Female		-14.7	-16.4	-16.4
		17.5	18.8	14.6
16-Female		-22.2	-27.1	-27.2
		13.7	14.1	15.9
18-Female		-18.0	-22.5	-17.0
		14.8	14.3	16.9
19-Female		-13.5	-15.7	-9.1
		12.8	12.2	14.0
20-Female		-20.1	-20.2	-17.5
		13.5	12.1	14.7
21-Female		-15.4	-21.2	-12.6
		11.5	13.4	13.0

Table B3

Mean CNV Integral (Cz)-M4 for
Individual Ss in Each Condition

S		Cond.A1	Cond.B	Cond.A2
01-Male	Mean=	-167.6	-232.8	-255.7
	SD=	118.0	126.1	145.6
03-Male		-80.0	-84.7	-64.4
		82.8	67.6	67.4
04-Male		-151.7	-220.7	-209.0
		134.9	158.3	155.9
05-Male		-260.4	-270.8	-297.8
		151.3	212.7	133.5
06-Male		-109.2	-135.1	-120.6
		75.5	113.7	104.5
07-Male		-149.3	-140.2	-142.6
		75.3	105.3	89.1
08-Male		-199.1	-180.7	-124.8
		108.3	98.7	108.1
09-Female		-122.3	-158.4	-165.0
		135.6	111.1	131.6
11-Female		-175.4	-227.8	-147.9
		148.9	105.6	117.0
12-Female		-80.3	-75.6	-46.7
		99.2	98.0	83.5
13-Female		-216.7	-231.7	-94.8
		116.9	137.2	153.8
14-Female		-206.5	-330.9	-374.9
		132.8	126.6	151.4
15-Female		-134.1	-177.8	-157.1
		174.8	179.3	154.0
16-Female		-214.2	-245.2	-233.8
		121.1	131.7	131.0
18-Female		-189.2	-237.9	-157.8
		180.9	152.4	183.0
19-Female		-107.8	-141.0	-96.9
		122.1	134.1	156.8
20-Female		-177.9	-170.9	-155.6
		133.9	106.1	174.0
21-Female		-209.1	-249.9	-159.4
		126.4	141.1	151.9

Table B4

Mean N1 Amplitude (Cz) in Microvolts
for Individual Ss in Each Condition

S	Cond.A1	Cond.B	Cond.A2
01-Male	Mean=-18.8	-25.0	-23.0
	SD= 11.9	13.4	13.9
03-Male	-10.0	-8.7	-8.3
	5.8	5.4	6.2
04-Male	-24.8	-27.5	-22.9
	10.3	10.0	12.0
05-Male	-28.7	-25.9	-28.4
	11.1	11.5	10.5
06-Male	-26.9	-26.3	-20.4
	10.5	8.1	6.8
07-Male	-17.6	-18.6	-17.6
	8.3	9.7	9.2
08-Male	-30.2	-25.6	-26.8
	13.6	11.4	12.5
09-Female	-14.3	-14.4	-15.0
	6.9	7.1	8.6
11-Female	-27.0	-29.9	-24.6
	15.2	10.5	10.9
12-Female	-18.7	-25.2	-21.1
	12.3	8.4	8.7
13-Female	-22.9	-25.4	-23.4
	11.7	15.2	14.6
14-Female	-11.8	-14.4	-13.4
	7.9	8.9	9.1
15-Female	-28.9	-34.0	-29.4
	15.0	14.6	10.6
16-Female	-29.3	-23.4	-21.4
	14.5	10.5	11.3
18-Female	-24.6	-22.0	-18.6
	13.6	12.6	12.5
19-Female	-18.8	-17.3	-18.2
	12.3	11.6	9.3
20-Female	-23.9	-27.2	-19.6
	11.4	9.2	12.0
21-Female	-22.9	-22.4	-24.4
	11.2	10.6	13.3

Table B5

Mean P2 Amplitude (Cz) in Microvolts
for Individual Ss in Each Condition

S	Cond.A1	Cond.B	Cond.A2
01-Male	Mean=27.8	22.0	18.2
	SD=10.8	12.1	13.9
03-Male	10.6	10.6	9.2
	5.9	7.2	5.8
04-Male	23.3	16.5	21.0
	10.3	12.4	10.9
05-Male	18.8	10.8	14.5
	10.2	10.3	11.9
06-Male	1.3	1.7	2.8
	7.7	7.4	7.1
07-Male	14.5	13.4	14.1
	8.3	7.3	7.9
08-Male	10.1	8.6	10.7
	10.8	11.0	10.2
09-Female	13.7	11.3	9.1
	8.2	8.4	7.4
11-Female	15.2	15.1	15.1
	10.4	11.3	9.9
12-Female	14.2	17.6	15.1
	14.4	13.3	13.3
13-Female	14.0	16.3	16.5
	11.5	14.9	13.8
14-Female	11.3	6.1	6.1
	8.4	8.1	9.1
15-Female	11.4	9.2	7.4
	12.8	12.5	12.0
16-Female	14.9	17.1	15.2
	13.7	10.0	9.3
18-Female	16.9	16.5	17.1
	11.6	10.2	12.6
19-Female	28.2	20.5	20.8
	13.3	11.1	11.3
20-Female	28.4	24.9	23.3
	10.2	10.3	14.2
21-Female	6.7	6.2	11.1
	9.4	13.2	8.7

Table B6

Mean P3 Amplitude (Cz) in Microvolts
for Individual Ss in Each Condition

S	Cond.A1	Cond.B	Cond.A2
01-Male	Mean=16.2	7.7	5.5
	SD=11.8	9.3	10.5
03-Male	8.5	8.8	10.1
	7.7	5.5	5.6
04-Male	20.5	13.8	8.9
	9.8	11.6	9.1
05-Male	-0.9	-0.2	3.6
	8.4	8.3	10.4
06-Male	8.9	6.6	6.7
	6.2	6.0	5.8
07-Male	13.8	13.9	13.3
	7.7	8.6	8.2
08-Male	11.1	9.2	10.3
	9.4	9.0	8.8
09-Female	14.1	10.7	10.8
	8.1	7.6	7.1
11-Female	20.6	13.7	19.0
	10.1	11.3	11.4
12-Female	24.8	19.5	19.3
	12.1	9.1	9.5
13-Female	13.1	11.3	14.3
	12.1	11.0	13.6
14-Female	10.6	3.8	2.8
	6.2	7.6	7.8
15-Female	17.4	13.2	11.0
	12.1	11.2	10.1
16-Female	18.1	15.7	13.2
	9.4	8.9	10.5
18-Female	22.2	23.3	18.9
	11.4	12.5	13.2
19-Female	22.1	21.6	19.9
	10.8	7.7	11.8
20-Female	21.8	18.7	15.5
	12.2	11.0	12.2
21-Female	8.0	2.9	7.4
	8.4	6.3	11.9

Table B7

Mean SPL in Microvolts for
Individual Ss in Each Condition

S		Cond.A1	Cond.B	Cond.A2
01-Male	Mean=	-186.7	-60.9	437.4
	SD=	27.8	71.9	61.7
03-Male		482.9	1109.0	2035.1
		121.5	159.6	160.4
04-Male		70.3	312.8	434.9
		31.1	32.8	34.4
05-Male		-156.2	416.6	999.0
		117.6	121.1	173.4
06-Male		683.3	1153.2	1473.5
		106.0	95.9	54.0
07-Male		-250.4	83.8	638.7
		39.7	111.9	79.8
08-Male		67.2	483.0	968.8
		68.8	115.6	112.6
09-Female		433.7	1006.8	1293.1
		127.4	125.2	69.3
11-Female		-886.6	-1225.6	-1196.0
		160.9	25.4	53.6
12-Female		295.1	303.0	196.4
		49.4	43.4	31.9
13-Female		-653.4	-939.3	-853.3
		104.3	31.8	75.3
14-Female		-9.4	560.0	1003.0
		102.2	130.5	43.2
15-Female		-607.8	-877.7	-1116.8
		51.9	134.7	55.7
16-Female		-285.9	-832.7	-1016.3
		82.6	65.8	58.4
18-Female		19.1	371.7	648.4
		125.5	86.2	49.4
19-Female		205.2	688.9	1112.0
		83.6	157.1	62.4
20-Female		15.1	705.5	1399.1
		156.3	144.6	104.0
21-Female		-196.9	-279.5	78.2
		43.8	97.5	44.5

Table B8

Mean GSP1 Level in Microvolts for Individual Ss in Each Condition

S	Cond.A1	Cond.B	Cond.A2
01-Male	Mean=22586.0	15569.0	9679.0
	SD= 117.9	84.0	12.9
03-Male	17906.7	25964.5	37505.6
	1344.9	2108.4	1019.0
04-Male	-32213.0	-31298.0	-31143.0
	60.7	885.4	35.5
05-Male	30963.0	43441.0	49675.0
	7175.7	1303.7	2960.6
06-Male	-18439.0	-14373.0	-9010.0
	27.2	1142.2	1921.0
07-Male	-40382.0	-45104.0	-42513.0
	71.7	891.4	1536.0
08-Male	-5064.0	-5908.0	-7733.0
	25.5	1418.3	568.0
09-Female	-193711.0	-195875.0	-190180.0
	900.8	301.6	154.6
11-Female	-32970.0	-37570.0	-42599.0
	1471.3	1474.8	1837.9
12-Female	35354.0	32179.0	33759.0
	14611.6	14961.7	92.7
13-Female	-39391.0	-28630.0	-19726.0
	1902.5	1656.8	83.5
14-Female	-8558.0	-3006.0	-1851.0
	3048.3	921.7	829.9
15-Female	-1965.0	-1801.0	2996.0
	34.6	138.8	51.8
16-Female	-29094.0	-30065.0	-29189.0
	78.8	37.4	50.8
18-Female	-44167.0	-45765.0	-49170.0
	279.6	7517.8	94.6
19-Female	11861.0	7582.0	5985.0
	1070.4	392.1	40.9
20-Female	-38260.0	-47302.0	-49274.0
	164.7	2777.3	35.3
21-Female	9953.0	10990.0	19110.0
	160.0	268.3	2805.2

Table B9

Mean GSP2 Level in Microvolts for
Individual Ss in Each Condition

S		Cond.A1	Cond.B	Cond.A2
01-M	Mean=	-108500.0	-123518.0	-136370.0
	SD=	25.1	19.8	90.8
03-Male		-174555.0	-174927.0	-173106.0
		877.4	1595.3	179.2
04-Male		-321072.0	-332760.0	-346354.0
		5397.6	2352.7	26.4
05-Male		-226490.0	-249380.0	-265024.0
		11796.1	4641.7	2678.4
06-Male		-235000.0	-247392.0	-249223.0
		4130.8	2302.3	1346.3
07-Male		-206532.0	-235556.0	-251300.0
		11772.1	3806.5	2684.7
08-Male		-3469.0	-1801.0	169.0
		18.2	2414.3	2106.5
09-Female		-29885.0	-22056.0	-13230.0
		64.6	2683.9	896.5
11-Female		-50031.0	-47063.0	-42438.0
		125.8	983.4	1300.9
12-Female		-75243.0	-77803.0	-76216.0
		3532.3	863.1	103.9
13-Female		-181294.0	-197684.0	-197256.0
		54570.7	1886.4	835.0
14-Female		-69524.0	-83498.0	-94292.0
		3793.4	2298.2	448.7
15-Female		-146279.0	-159163.0	-169148.0
		3511.4	1811.7	112.0
16-Female		-132748.0	-153354.0	-161534.0
		5127.6	3043.6	1384.6
18-Female		-222929.0	-254332.0	-264258.0
		14100.1	2718.7	197.2
19-Female		43956.0	43869.0	48989.0
		773.8	976.8	1235.8
20-Female		23982.0	21187.0	19782.0
		41.8	1222.2	76.7
21-Female		48153.0	53511.0	58772.0
		159.1	692.0	1633.9

Appendix C

Means Overall Single Trial Data by Condition and by Tone

C.1
Means by Condition Overall Single Trial Data

Cond.		RT	M3	M4	N1 AMP	P2 AMP	P3 AMP
A1	Mean=	739.5	-14.8	-166.7	-22.4	15.8	15.5
	SD=	245.1	12.7	135.6	13.0	12.8	11.4
B		635.6	-18.6	-198.8	-23.3	13.6	12.2
		269.8	14.1	144.5	12.1	12.2	10.9
A2		614.5	-15.6	-165.7	-21.0	13.8	12.1
		261.4	14.6	155.7	12.0	12.1	11.3
Total		661.2	-16.3	-177.0	-22.2	14.4	13.3
		264.7	14.0	146.6	12.4	12.4	11.3

C.2
Means by Condition for all Females (Single-trial Data)

Cond.		RT	M3	M4	N1 AMP	P2 AMP	P3 AMP
A1	Mean=	781.3	-15.8	-170.0	-22.5	15.9	17.6
	SD=	240.3	13.5	144.4	13.4	12.9	11.5
B		663.3	-20.4	-210.0	-23.5	14.7	14.3
		275.1	14.7	144.8	12.7	12.5	11.3
A2		623.0	-15.9	-162.9	-21.0	14.5	14.6
		261.4	16.1	165.6	12.0	12.4	12.1
Total		687.6	-17.3	-180.7	-22.3	15.0	15.6
		267.8	15.0	153.5	12.7	12.6	11.7

C.3
Means by Condition for all Males (Single-trial Data)

Cond.		RT	M3	M4	N1 AMP	P2 AMP	P3 AMP
A1	Mean=	667.0	-13.0	-160.9	-22.3	15.6	12.0
	SD=	236.9	10.9	118.9	12.3	12.6	10.6
B		590.9	-15.8	-180.8	-22.9	11.9	9.0
		255.4	12.7	142.5	11.7	11.6	9.4
A2		600.9	-15.0	-170.1	-21.1	12.8	8.6
		261.4	11.9	138.4	12.0	11.5	9.0
Total		617.9	-14.6	-170.9	-22.1	13.4	9.8
		253.9	11.9	134.2	12.0	12.0	9.8

C.4
Means by Tones Overall Single-Trial Data

Tone		RT	M3	M4	N1 AMP	P2 AMP	P3 AMP
00	Mean=	659.3	-16.6	-184.1	-23.8	14.8	13.4
	SD=	275.4	13.8	147.2	13.0	13.2	11.5
01		628.0	-14.5	-164.6	-21.3	14.7	12.0
		229.4	12.8	140.1	12.0	11.7	10.5
02		683.1	-16.4	-178.6	-22.9	13.8	13.5
		263.9	12.8	142.6	12.4	12.0	12.0
03		636.2	-15.3	-162.9	-20.7	13.4	11.8
		248.0	16.4	162.5	12.1	11.3	11.7
04		680.8	-15.3	-162.7	-21.0	14.4	14.0
		262.8	14.6	153.7	11.4	11.8	11.4
05		694.3	-18.0	-183.5	-20.0	14.5	13.5
		262.2	14.0	141.1	11.1	11.1	10.4
06		604.3	-17.3	-167.1	-18.3	11.0	12.5
		239.2	14.5	140.0	11.4	11.5	12.1
Total		661.1	-16.3	-177.1	-22.4	14.4	13.2
		264.7	14.0	146.7	12.5	12.4	11.4

C.5
Means by Tones for all Females (Single-trial Data)

Tone		RT	M3	M4	N1 AMP	P2 AMP	P3 AMP
00	Mean=	684.1	-17.5	-189.6	-24.3	15.5	15.9
	SD=	281.2	14.8	153.6	13.5	13.2	11.9
01		663.4	-15.0	-166.1	-22.1	15.0	13.6
		225.4	14.4	148.6	12.3	11.9	10.8
02		696.9	-17.8	-187.6	-23.3	13.7	15.8
		267.9	14.2	152.4	13.1	12.3	12.9
03		652.6	-15.8	-156.0	-21.0	14.9	14.4
		258.9	16.4	156.2	11.2	11.9	12.0
04		711.0	-15.5	-152.7	-20.4	15.3	16.3
		261.3	15.5	159.4	11.9	12.0	11.6
05		738.9	-20.6	-200.4	-18.6	15.2	15.4
		256.9	15.2	150.4	10.0	12.3	10.9
06		612.1	-18.9	-168.1	-16.3	11.5	15.0
		247.7	15.4	150.7	11.0	11.6	12.2
Total		687.4	-17.3	-181.0	-22.3	15.0	15.5
		267.8	15.0	153.7	12.8	12.6	11.8

C.6
Means by Tones for all Males (Single-trial Data)

Tone		RT	M3	M4	N1 AMP	P2 AMP	P3 AMP
00	Mean=	621.3	-15.4	-175.6	-23.0	13.8	10.0
	SD=	262.2	12.3	136.6	12.3	13.2	10.0
01		566.9	-13.8	-162.0	-20.1	14.0	9.5
		224.9	9.4	124.9	11.3	11.4	9.6
02		658.1	-13.8	-162.5	-22.1	14.0	9.8
		256.4	9.6	122.1	11.2	11.4	9.5
03		605.5	-14.5	-175.8	-20.2	10.6	6.6
		226.2	16.6	175.1	13.7	9.6	9.3
04		626.9	-15.0	-180.4	-22.0	13.0	9.9
		258.3	12.8	142.3	10.5	11.4	10.0
05		619.4	-13.6	-155.2	-21.0	13.5	10.6
		255.4	10.6	119.3	12.6	8.7	9.0
06		590.6	-14.6	-165.3	-21.4	10.1	8.6
		226.0	12.6	120.8	11.4	11.3	10.9
Total		617.9	-14.6	-170.9	-22.1	13.4	9.8
		253.9	11.9	134.2	12.0	12.0	9.8

Appendix D

Within-S Analysis of Variance and Duncan Multiple Range Test Summary Tables for Single Trial Data.

Table D.1

Oneway Analysis of Variance For Conditions For DC1

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	1206352.0	603176.0	13.77	.000
Within Groups	133	5822832.0	43780.7		
Total	135	7029184.0			

Mean A1 = 663.3
Mean B = 551.5
Mean A2 = 435.5
Mean Overall = 550.9

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: A1
Subset 2: B
Subset 3: A2

CNV Amp(Cz) - M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	3385.3	1692.7	11.85	.000
Within Groups	133	18998.7	142.8		
Total	135	22384.0			

Mean A1 = -10.8
Mean B = -19.9
Mean A2 = -22.2
Mean Overall = -17.5

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: B; A2
Subset 2: A1

CNV INT(Cz) - M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	194419.0	97209.5	5.71	.004
Within Groups	133	2263064.0	17015.5		
Total	135	2457483.0			

Mean A1 = -167.6
Mean B = -232.8
Mean A2 = -255.7
Mean Overall = -218.0

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: B; A2
Subset 2: A1

N1 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	906.1	453.0	2.65	.073
Within Groups	133	22745.6	171.0		
Total	135	23651.8			

Mean A1 = -18.8
Mean B = -25.0
Mean A2 = -23.0
Mean Overall = -22.2

P2 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	2188.1	1094.1	7.19	.001
Within Groups	133	20243.9	152.2		
Total	135	22432.0			

Mean A1 = 27.8
Mean B = 22.0
Mean A2 = 18.2
Mean Overall = 22.7

Significant ($p<.05$) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: A1
Subset 2: B; A2

P3 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	2953.4	1476.7	13.06	.000
Within Groups	133	14924.3	113.1		
Total	135	17877.8			

Mean A1 = 16.2
Mean B = 7.7
Mean A2 = 5.5
Mean Overall = 9.9

Significant ($p<.05$) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: A1
Subset 2: B; A2

Table D.2

Oneway Analysis of Variance For Conditions For DC3

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	1007504.0	503752.0	7.36	.001
Within Groups	92	6291904.0	68390.3		
Total	94	7299408.0			

Mean A1 = 787.1
Mean B = 529.3
Mean A2 = 595.4
Mean Overall = 629.7

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: B; A2
Subset 2: A1

CNV Amp(Cz) - M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	69.7	34.9	.86	.428
Within Groups	92	3713.1	40.4		
Total	94	3782.8			

Mean A1 = -9.3
Mean B = -11.6
Mean A2 = -10.3
Mean Overall = -10.4

CNV INT(Cz) - M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	7779.2	3889.6	.75	.481
Within Groups	92	478962.5	5206.1		
Total	94	486741.7			

Mean A1 = -80.0
Mean B = -84.78
Mean A2 = -64.4
Mean Overall = -75.1

N1 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	47.6	23.8	.69	.508
Within Groups	89	3057.2	34.4		
Total	91	3104.7			

Mean A1 = -10.0
Mean B = -8.7
Mean A2 = -8.3
Mean Overall = -8.9

P2 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	44.4	22.2	.56	.577
Within Groups	89	3514.5	39.5		
Total	91	3558.9			

Mean A1 = 10.6
Mean B = 10.6
Mean A2 = 9.2
Mean Overall = 10.0

P3 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	42.2	21.1	.54	.589
Within Groups	82	3188.8	38.9		
Total	84	3231.0			

Mean A1 = 8.5
Mean B = 8.8
Mean A2 = 10.1
Mean Overall = 9.2

Table D.3

Oneway Analysis of Variance For Conditions For DC4

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	498864.0	249432.0	6.40	.003
Within Groups	99	3857472.0	38964.4		
Total	101	4356336.0			

Mean A1 = 781.7
Mean B = 638.5
Mean A2 = 785.5
Mean Overall = 731.2

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset: B
Subset 2: B

CNV Amp(Cz) - M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	72.5	36.3	.21	.815
Within Groups	99	17498.8	176.8		
Total	101	17571.3			

Mean A1 = -16.2
Mean B = -17.6
Mean A2 = -15.8
Mean Overall = -16.5

CNV INT(Cz) - M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	79530.0	39765.0	1.73	.181
Within Groups	99	2279689.0	23027.2		
Total	101	2359219.0			

Mean A1 = -151.7
Mean B = -220.7
Mean A2 = -208.9
Mean Overall = -198.6

N1 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	393.3	196.6	1.67	.192
Within Groups	99	11684.6	118.0		
Total	101	12077.8			

Mean A1 = -24.8
Mean B = -27.5
Mean A2 = -22.9
Mean Overall = -25.0

P2 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	786.7	393.4	3.08	.049
Within Groups	99	12637.1	127.6		
Total	101	13423.9			

Mean A1 = 23.3
Mean B = 16.5
Mean A2 = 21.0
Mean Overall = 20.0

P3 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	1969.0	984.5	9.32	.000
Within Groups	92	9714.0	105.6		
Total	94	11682.9			

Mean A1 = 20.5
Mean B = 13.8
Mean A2 = 8.9
Mean Overall = 13.9

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: B; A2
Subset 2: A1

Table D.4

Oneway Analysis of Variance For Conditions For DC5

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	455920.0	227960.0	4.52	.013
Within Groups	93	4688128.0	50410.0		
Total	95	5144048.0			

Mean A1 = 792.3
Mean B = 663.5
Mean A2 = 632.7
Mean Overall = 696.5

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: B; A2
Subset 2: A1

CNV Amp(Cz) - M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	455.1	227.5	1.05	.356
Within Groups	93	20167.5	216.9		
Total	95	20622.6			

Mean A1 = -20.5
Mean B = -23.7
Mean A2 = -25.8
Mean Overall = -23.3

CNV INT(Cz) - M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	23385.0	11692.5	.40	.674
Within Groups	93	2691706.0	2894301		
Total	95	2715091.0			

Mean A1 = -260.4
Mean B = -270.8
Mean A2 = -297.8
Mean Overall = -276.1

N1 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	154.2	77.1	.63	.540
Within Groups	93	11382.3	122.4		
Total	95	11536.5			

Mean A1 = -28.7
Mean B = -25.9
Mean A2 = -28.4
Mean Overall = -27.6

P2 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	1039.8	519.9	4.46	.014
Within Groups	93	10839.5	116.6		
Total	95	11879.3			

Mean A1 = 18.8
Mean B = 10.8
Mean A2 = 14.5
Mean Overall = 14.7

P3 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	273.0	136.5	1.65	.199
Within Groups	65	5388.7	82.9		
Total	67	5661.8			

Mean A1 = -.9
Mean B = -.2
Mean A2 = 3.6
Mean Overall =.9

Table D.5

Oneway Analysis of Variance For Conditions For DC6

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	256816.0	128408.0	1.92	.149
Within Groups	124	8313376.0	67043.3		
Total	126	8570192.0			

Mean A1 = 570.4
Mean B = 609.7
Mean A2 = 504.3
Mean Overall = 561.0

CNV Amp(Cz) - M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	513.8	256.9	2.93	.056
Within Groups	124	10864.4	87.6		
Total	126	11378.2			

Mean A1 = -6.3
Mean B = -11.3
Mean A2 = -9.2
Mean Overall = -9.2

CNV INT(Cz) - M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	13846.0	6923.0	.681	.513
Within Groups	124	1261194.0	10170.9		
Total	126	1275040.0			

Mean A1 = -109.2
Mean B = -165.1
Mean A2 = -120.6
Mean Overall = -122.6

N1 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	1103.0	551.5	7.68	.001
Within Groups	124	8905.1	71.8		
Total	126	10008.1			

Mean A1 = -26.9
Mean B = -26.3
Mean A2 = -20.4
Mean Overall = -24.4

Significant ($p<.05$) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: A1; B
Subset 2: A2

P2 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	51.4	25.7	.47	.632
Within Groups	124	6797.5	54.8		
Total	126	6849.0			

Mean A1 = 1.3
Mean B = 1.7
Mean A2 = 2.8
Mean Overall = 2.0

P3 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	112.5	56.3	1.56	.214
Within Groups	100	3606.9	36.1		
Total	101	3719.4			

Mean A1 = 8.9
Mean B = 6.6
Mean A2 = 6.7
Mean Overall = 7.3

Table D.6

Oneway Analysis of Variance For Conditions For DC7

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	295968.0	147984.0	1.93	.147
Within Groups	129	9893408.0	76693.1		
Total	131	10189376.0			

Mean A1 = 581.1
Mean B = 524.7
Mean A2 = 640.7
Mean Overall = 582.2

CNV Amp(Cz) - M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	23.8	11.9	.14	.870
Within Groups	129	11321.1	87.8		
Total	131	11345.0			

Mean A1 = -13.6
Mean B = -12.6
Mean A2 = -13.3
Mean Overall = -13.2

CNV INT(Cz) - M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	1978.0	989.0	.12	.882
Within Groups	129	1062065.0	8233.1		
Total	131	1064043.0			

Mean A1 = -149.3
Mean B = -140.2
Mean A2 = -142.6
Mean Overall = -144.0

N1 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	28.9	14.4	.18	.838
Within Groups	125	10264.6	82.1		
Total	127	10293.5			

Mean A1 = -17.6
Mean B = -18.6
Mean A2 = -17.6
Mean Overall = -17.9

P2 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	26.3	13.1	.21	.809
Within Groups	120	7393.6	61.6		
Total	122	7419.9			

Mean A1 = 14.5
Mean B = 13.4
Mean A2 = 14.1
Mean Overall = 14.0

P3 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	6.1	3.0	.05	.945
Within Groups	118	7835.4	66.4		
Total	120	7841.4			

Mean A1 = 13.8
Mean B = 13.9
Mean A2 = 13.3
Mean Overall = 13.7

Table D.7

Oneway Analysis of Variance For Conditions For DC8

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	94800.0	47400.0	.91	.410
Within Groups	108	5650400.0	52318.5		
Total	110	5745200.0			

Mean A1 = 584.6
Mean B = 629.2
Mean A2 = 655.8
Mean Overall = 625.4

CNV Amp(Cz) - M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	546.1	273.1	2.60	.077
Within Groups	108	11337.0	105.0		
Total	110	11883.1			

Mean A1 = -16.0
Mean B = -14.5
Mean A2 = -10.8
Mean Overall = -13.6

CNV INT(Cz) - M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	114680.0	57340.0	5.18	.007
Within Groups	108	1195284.0	11067.4		
Total	110	1309964.0			

Mean A1 = -199.1
Mean B = -180.6
Mean A2 = -124.8
Mean Overall = -165.6

Significant ($p<.05$) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.

Subset 1: A1; B
Subset 2: A2

N1 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	395.3	197.6	1.26	.286
Within Groups	108	16886.2	156.4		
Total	110	17281.4			

Mean A1 = -30.2
Mean B = -25.6
Mean A2 = -26.8
Mean Overall = -27.4

P2 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	86.7	43.3	.38	.688
Within Groups	108	12211.7	113.1		
Total	110	12298.4			

Mean A1 = 10.1
Mean B = 8.6
Mean A2 = 10.7
Mean Overall = 9.8

P3 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	55.4	27.7	.34	.719
Within Groups	95	7799.1	82.1		
Total	97	7854.5			

Mean A1 = 11.1
Mean B = 9.2
Mean A2 = 10.3
Mean Overall = 10.2

Table D.8

Oneway Analysis of Variance For Conditions For DC9

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	76544.0	38272.0	.82	.446
Within Groups	109	5074288.0	46553.1		
Total	111	5150832.0			

Mean A1 = 721.2
Mean B = 673.5
Mean A2 = 661.0
Mean Overall = 684.6

CNV Amp(Cz) - M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	205.9	102.9	.80	.418
Within Groups	109	12678.1	116.3		
Total	111	12884.0			

Mean A1 = -11.4
Mean B = -13.8
Mean A2 = -14.5
Mean Overall = -13.3

CNV INT(Cz) - M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	39926.0	19963.0	1.23	.296
Within Groups	109	1767139.0	16212.3		
Total	111	1807065.0			

Mean A1 = -122.3
Mean B = -158.4
Mean A2 = -164.9
Mean Overall = -148.9

N1 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	9.7	4.9	.08	.912
Within Groups	98	5699.0	58.2		
Total	100	5708.7			

Mean A1 = -14.3
Mean B = -14.4
Mean A2 = -15.0
Mean Overall = -14.6

P2 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	375.9	184.9	2.95	.056
Within Groups	96	6127.0	63.8		
Total	98	6502.9			

Mean A1 = 13.7
Mean B = 11.3
Mean A2 = 9.1
Mean Overall = 11.3

P3 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	222.0	111.0	1.88	.157
Within Groups	80	4727.8	59.1		
Total	82	4949.8			

Mean A1 = 14.1
Mean B = 10.7
Mean A2 = 10.8
Mean Overall = 12.0

Table D.9

Oneway Analysis of Variance For Conditions For DC11

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	243424.0	121712.0	1.84	.160
Within Groups	135	8908800.0	65991.1		
Total	137	9152224.0			

Mean A1 = 710.7
Mean B = 606.8
Mean A2 = 650.4
Mean Overall = 652.5

CNV Amp(Cz) - M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	1519.3	759.6	5.01	.008
Within Groups	135	20470.6	151.6		
Total	137	21989.9			

Mean A1 = -15.9
Mean B = -19.4
Mean A2 = -11.5
Mean Overall = -15.6

CNV INT(Cz) - M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	164311.0	82155.5	5.38	.006
Within Groups	135	2059862.0	15258.2		
Total	137	2224173.0			

Mean A1 = -175.4
Mean B = -227.6
Mean A2 = -146.4
Mean Overall = -184.4

Significant ($p<.05$) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: B
Subset 2: A1; A2

N1 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	785.9	397.9	2.68	.070
Within Groups	134	19885.9	148.4		
Total	136	20681.8			

Mean A1 = -27.0
Mean B = -30.0
Mean A2 = -24.3
Mean Overall = -27.2

P2 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	3.9	2.0	.02	.971
Within Groups	125	14012.1	112.1		
Total	127	14016.0			

Mean A1 = 15.2
Mean B = 14.9
Mean A2 = 15.3
Mean Overall = 15.1

P3 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	1120.6	560.3	4.65	.011
Within Groups	112	13492.0	120.5		
Total	114	14612.7			

Mean A1 = 20.6
Mean B = 13.5
Mean A2 = 19.3
Mean Overall = 17.5

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: B
Subset 2: A1; A2

Table D.10

Oneway Analysis of Variance for Conditions For DC12

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	17664.0	8832.0	.14	.870
Within Groups	67	4358560.0	65053.1		
Total	69	4376224.0			

Mean A1 = 624.6
Mean B = 608.1
Mean A2 = 585.4
Mean Overall = 608.0

CNV Amp(Cz) - M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	366.3	183.2	2.61	.079
Within Groups	67	4696.6	70.1		
Total	69	5062.9			

Mean A1 = -10.0
Mean B = -8.9
Mean A2 = -4.5
Mean Overall = -8.0

CNV INT(Cz) - M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	14381.0	7190.5	.80	.455
Within Groups	67	599223.6	8943.6		
Total	69	613604.6			

Mean A1 = -80.3
Mean B = -75.6
Mean A2 = -46.7
Mean Overall = -69.1

N1 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	525.3	262.6	2.52	.087
Within Groups	65	6785.7	104.4		
Total	67	7311.0			

Mean A1 = -18.7
Mean B = -25.2
Mean A2 = -21.1
Mean Overall = -21.5

P2 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	149.8	74.9	.40	.679
Within Groups	65	12271.0	188.8		
Total	67	12420.8			

Mean A1 = 14.2
Mean B = 13.3
Mean A2 = 13.3
Mean Overall = 13.6

P3 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	462.6	231.3	2.10	.129
Within Groups	64	7065.8	110.4		
Total	66	7528.3			

Mean A1 = 24.8
Mean B = 19.5
Mean A2 = 19.3
Mean Overall = 21.6

Table D.11

Oneway Analysis of Variance For Conditions For DC13

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	406112.0	203056.0	3.14	.045
Within Groups	138	8913008.0	64587.0		
Total	140	9319120.0			

Mean A1 = 785.6
Mean B = 672.3
Mean A2 = 673.4
Mean Overall = 712.0

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: A1
Subset 2: B; A2

CNV Amp(Cz) - M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	2301.3	1150.6	6.48	.002
Within Groups	138	24498.6	177.5		
Total	140	26799.9			

Mean A1 = -12.1
Mean B = -17.1
Mean A2 = -7.1
Mean Overall = -12.0

CNV INT(Cz) - M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	498287.0	249143.5	13.75	.000
Within Groups	138	2500868.0	18122.2		
Total	140	2999155.0			

Mean A1 = -216.7
Mean B = -225.1
Mean A2 = -94.8
Mean Overall = -178.8

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: A1; B
Subset 2: A2

N1 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	58.6	29.3	.16	.849
Within Groups	132	23853.1	180.7		
Total	134	23911.7			

Mean A1 = -22.9
Mean B = -24.4
Mean A2 = -23.4
Mean Overall = -23.5

P2 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	206.1	103.1	.58	.569
Within Groups	128	22892.4	178.8		
Total	130	23098.6			

Mean A1 = 14.0
Mean B = 16.8
Mean A2 = 16.5
Mean Overall = 15.7

P3 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	77.3	38.6	.28	.762
Within Groups	108	15061.8	139.5		
Total	110	15139.0			

Mean A1 = 13.1
Mean B = 12.2
Mean A2 = 14.3
Mean Overall = 13.2

Table D.12

Oneway Analysis of Variance For Conditions For DC14

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	778528.0	389264.0	5.01	.008
Within Groups	114	8856064.0	77684.8		
Total	116	9634592.0			

Mean A1 = 773.8
Mean B = 607.9
Mean A2 = 527.8
Mean Overall = 622.0

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: A1
Subset 2: B; A2

CNV Amp(Cz) - M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	7563.3	3781.7	25.54	.000
Within Groups	114	16881.7	148.1		
Total	116	24445.0			

Mean A1 = -19.3
Mean B = -35.6
Mean A2 = -37.9
Mean Overall = -31.3

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: A1
Subset 2: B; A2

CNV INT(Cz) - M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	555197.0	277598.5	14.90	.000
Within Groups	114	2124684.0	18637.6		
Total	116	2679881.0			

Mean A1 = -206.5
Mean B = -330.9
Mean A2 = -374.9
Mean Overall = -306.2

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: A1
Subset 2: B; A2

N1 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	143.6	71.8	.95	.391
Within Groups	114	8594.5	75.4		
Total	116	8738.1			

Mean A1 = -11.8
Mean B = -14.4
Mean A2 = -13.4
Mean Overall = -13.3

P2 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	666.9	333.5	4.64	.012
Within Groups	111	7982.7	71.9		
Total	113	8649.6			

Mean A1 = 11.3
Mean B = 6.1
Mean A2 = 6.1
Mean Overall = 7.7

Significant ($p<.05$) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: A1
Subset 2: B; A2

P3 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	1026.7	513.3	9.69	.000
Within Groups	88	4662.0	53.0		
Total	90	5688.7			

Mean A1 = 10.6
Mean B = 3.8
Mean A2 = 2.8
Mean Overall = 5.6

Significant ($p<.05$) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: A1
Subset 2: B; A2

Table D.13

Oneway Analysis of Variance For Conditions For DC15

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	1172448.0	586224.0	8.55	.000
Within Groups	135	9254304.0	68550.4		
Total	137	10426752.0			

Mean A1 = 755.3
Mean B = 555.6
Mean A2 = 554.3
Mean Overall = 615.9

Significant ($p<.05$) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: A1
Subset 2: B; A2

CNV Amp(Cz) - M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	87.1	43.6	.15	.858
Within Groups	135	39108.2	289.7		
Total	137	39195.4			

Mean A1 = -14.7
Mean B = -16.4
Mean A2 = -16.4
Mean Overall = -15.9

CNV INT(Cz) - M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	42424.0	21212.0	.74	.483
Within Groups	135	3870403.0	28669.6		
Total	137	3912827.0			

Mean A1 = -134.1
Mean B = -177.8
Mean A2 = -157.1
Mean Overall = -157.2

N1 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	731.3	365.7	2.01	.136
Within Groups	133	24183.8	181.8		
Total	135	24915.1			

Mean A1 = -28.9
Mean B = -34.0
Mean A2 = -29.4
Mean Overall = -30.8

P2 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	352.2	176.1	1.14	.323
Within Groups	132	20339.2	154.1		
Total	134	20691.3			

Mean A1 = 11.4
Mean B = 9.2
Mean A2 = 7.4
Mean Overall = 9.3

P3 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	806.9	403.4	3.24	.042
Within Groups	108	13459.4	124.6		
Total	110	14266.3			

Mean A1 = 17.4
Mean B = 13.2
Mean A2 = 11.0
Mean Overall = 13.9

Table D.14

Oneway Analysis of Variance For Conditions For DC16

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	305088.0	152544.0	2.05	.131
Within Groups	117	8714144.0	74479.8		
Total	119	9019232.0			

Mean A1 = 702.9
Mean B = 604.0
Mean A2 = 589.7
Mean Overall = 633.4

CNV Amp(Cz) - M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	653.4	326.7	1.54	.217
Within Groups	117	24796.4	211.9		
Total	119	25449.8			

Mean A1 = -22.2
Mean B = -27.1
Mean A2 = -27.2
Mean Overall = -25.4

CNV INT(Cz) - M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	20394.0	10197.0	.62	.543
Within Groups	117	1915018.0	16367.7		
Total	119	1935412.0			

Mean A1 = -214.2
Mean B = -245.2
Mean A2 = -233.8
Mean Overall = -231.1

N1 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	1310.6	655.3	4.36	.015
Within Groups	113	16974.5	150.2		
Total	115	18285.1			

Mean A1 = -29.3
Mean B = -23.4
Mean A2 = -21.4
Mean Overall = -24.8

Significant ($p<.05$) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: A1
Subset 2: B; A2

P2 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	113.1	56.5	.45	.646
Within Groups	111	14032.4	126.4		
Total	116	14145.4			

Mean A1 = 14.9
Mean B = 17.1
Mean A2 = 15.2
Mean Overall = 15.7

P3 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	395.6	197.8	2.16	.118
Within Groups	97	8871.8	91.5		
Total	99	9267.4			

Mean A1 = 18.1
Mean B = 15.7
Mean A2 = 13.2
Mean Overall = 15.8

Table D.15

Oneway Analysis of Variance For Conditions For DC18

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	3537536.0	1768768.0	47.70	.000
Within Groups	129	4783312.0	37079.9		
Total	131	8320848.0			

Mean A1 = 1000.0
Mean B = 787.5
Mean A2 = 607.5
Mean Overall = 792.9

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: A1
Subset 2: B
Subset 3: A2

CNV Amp(Cz) - M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	833.8	416.9	1.76	.175
Within Groups	129	30622.0	237.4		
Total	131	31455.8			

Mean A1 = -18.0
Mean B = -22.8
Mean A2 = -16.9
Mean Overall = -19.0

CNV INT(Cz) - M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	148805.0	74402.5	2.48	.086
Within Groups	129	3870175.0	30001.4		
Total	131	4018980.0			

Mean A1 = -189.2
Mean B = -240.0
Mean A2 = -157.7
Mean Overall = -193.2

N1 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	763.1	381.6	2.29	.104
Within Groups	117	19531.3	166.9		
Total	119	20294.4			

Mean A1 = -24.6
Mean B = -22.0
Mean A2 = -18.6
Mean Overall = -21.8

P2 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	7.8	3.9	.03	.959
Within Groups	116	15587.3	134.4		
Total	118	15595.1			

Mean A1 = 16.9
Mean B = 16.5
Mean A2 = 17.1
Mean Overall = 16.9

P3 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	370.1	185.0	1.21	.302
Within Groups	103	15755.9	153.0		
Total	105	16126.0			

Mean A1 = 22.2
Mean B = 23.3
Mean A2 = 18.9
Mean Overall = 21.2

Table D.16

Oneway Analysis of Variance For Conditions For DC19

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	118272.0	59136.0	.83	.443
Within Groups	127	9080496.0	71499.9		
Total	129	9198768.0			

Mean A1 = 660.5
Mean B = 626.1
Mean A2 = 587.0
Mean Overall = 621.7

CNV Amp(Cz) - M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	814.8	407.4	2.36	.097
Within Groups	127	21939.9	172.8		
Total	129	22754.8			

Mean A1 = -13.5
Mean B = -15.4
Mean A2 = -9.6
Mean Overall = -12.6

CNV INT(Cz) - M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	3396.0	16968.0	.87	.426
Within Groups	127	2489656.0	19603.6		
Total	129	2523592.0			

Mean A1 = -107.8
Mean B = -137.8
Mean A2 = -100.6
Mean Overall = -114.8

N1 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	72.0	36.0	.30	.749
Within Groups	120	14660.0	122.2		
Total	122	14732.0			

Mean A1 = -18.8
Mean B = -17.0
Mean A2 = -18.4
Mean Overall = -18.1

P2 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	1481.6	740.8	5.24	.007
Within Groups	119	16823.4	141.4		
Total	121	18305.0			

Mean A1 = 28.2
Mean B = 21.0
Mean A2 = 20.4
Mean Overall = 23.0

Significant ($p<.05$) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: A1
Subset 2: B; A2

P3 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	105.4	52.7	.50	.614
Within Groups	109	11494.9	105.5		
Total	111	11600.3			

Mean A1 = 22.1
Mean B = 21.6
Mean A2 = 19.9
Mean Overall = 21.1

Table D.17

Oneway Analysis of Variance For Conditions For DC20

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	1968480.0	984240.0	18.22	.000
Within Groups	112	6049264.0	54011.3		
Total	114	8017744.0			

Mean A1 = 868.9
Mean B = 798.8
Mean A2 = 568.6
Mean Overall = 734.1

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: A1; B
Subset 2: A2

CNV Amp(Cz) - M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	191.2	95.6	.52	.601
Within Groups	112	20538.0	183.4		
Total	114	20729.2			

Mean A1 = -20.1
Mean B = -20.2
Mean A2 = -17.5
Mean Overall = -19.2

CNV INT(Cz) - M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	10325.0	5162.5	.25	.780
Within Groups	112	2286472.0	20414.9		
Total	114	2296797.0			

Mean A1 = -177.9
Mean B = -170.9
Mean A2 = -155.6
Mean Overall = -167.3

N1 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	1157.5	578.8	4.78	.010
Within Groups	112	13572.3	121.2		
Total	114	14729.8			

Mean A1 = -23.9
Mean B = -27.2
Mean A2 = -19.6
Mean Overall = -23.3

P2 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	522.9	261.4	1.84	.161
Within Groups	112	15876.9	141.8		
Total	114	16399.8			

Mean A1 = 28.4
Mean B = 24.9
Mean A2 = 23.3
Mean Overall = 25.3

P3 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	671.2	335.6	2.42	.092
Within Groups	100	13862.4	138.6		
Total	102	14533.7			

Mean A1 = 21.8
Mean B = 18.7
Mean A2 = 15.5
Mean Overall = 18.5

Table D.18

Oneway Analysis of Variance For Conditions For DC21

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	479056.0	239528.0	10.25	.000
Within Groups	98	2291168.0	23379.3		
Total	100	2770224.0			

Mean A1 = 986.5
Mean B = 840.8
Mean A2 = 842.6
Mean Overall = 892.0

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: A1
Subset 2: B; A2

CNV Amp(Cz) - M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	1219.5	609.7	3.83	.025
Within Groups	98	15596.2	159.1		
Total	100	16815.6			

Mean A1 = -15.4
Mean B = -21.2
Mean A2 = -12.6
Mean Overall = -15.9

CNV INT(Cz) - M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	134798.0	67399.0	3.41	.036
Within Groups	98	1934541.0	19740.2		
Total	100	2069339.0			

Mean A1 = -209.1
Mean B = -249.9
Mean A2 = -159.4
Mean Overall = -201.7

N1 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	61.7	30.9	.22	.802
Within Groups	87	12059.3	138.6		
Total	89	12121.0			

Mean A1 = -22.9
Mean B = -22.4
Mean A2 = -24.4
Mean Overall = -23.2

P2 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	408.1	204.0	1.88	.157
Within Groups	86	9358.4	108.8		
Total	88	9766.5			

Mean A1 = 6.7
Mean B = 6.2
Mean A2 = 11.1
Mean Overall = 7.9

P3 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	290.3	145.2	1.80	.172
Within Groups	57	4596.6	80.6		
Total	59	4887.0			

Mean A1 = 8.0
Mean B = 2.9
Mean A2 = 7.4
Mean Overall = 6.5

Table D.19

Oneway Analysis of Variance of DC1 Data For Tones

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	180848.0	30141.3	.57	.757
Within Groups	129	6848256.0	53087.3		
Total	135	7029104.0			

Mean Tone 0 = 553.9
Mean Tone 1 = 460.5
Mean Tone 2 = 556.3
Mean Tone 3 = 552.9
Mean Tone 4 = 585.5
Mean Tone 5 = 553.3
Mean Tone 6 = 640.3
Mean Overall = 550.9

CNV Amp(Cz) - M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	1918.7	319.8	2.02	.068
Within Groups	129	20465.3	158.6		
Total	135	22384.0			

Mean Tone 0 = -16.1
Mean Tone 1 = -15.5
Mean Tone 2 = -17.6
Mean Tone 3 = -30.8
Mean Tone 4 = -15.8
Mean Tone 5 = -17.0
Mean Tone 6 = -24.5
Mean Overall = -17.5

CNV INT(Cz) - M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	282070.0	47011.7	2.79	.014
Within Groups	129	2175413.0	16863.7		
Total	135	2457483.0			

Mean Tone 0 = -193.6
Mean Tone 1 = -190.2
Mean Tone 2 = -223.1
Mean Tone 3 = -385.1
Mean Tone 4 = -241.4
Mean Tone 5 = -221.5
Mean Tone 6 = -232.3
Mean Overall = -218.0

Significant ($p<.05$) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: Tone 3
Subset 2: Tone 4; Tone 6; Tone 2; Tone 5; Tone 0; Tone 1

N1 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	1709.8	285.0	1.68	.131
Within Groups	129	21942.1	170.1		
Total	135	23651.8			

Mean Tone 0 = -20.1
Mean Tone 1 = -23.2
Mean Tone 2 = -17.3
Mean Tone 3 = -27.3
Mean Tone 4 = -24.6
Mean Tone 5 = -29.5
Mean Tone 6 = -23.8
Mean Overall = -22.2

P2 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	1511.0	251.9	1.55	.165
Within Groups	129	20920.8	162.2		
Total	135	22432.0			

Mean Tone 0 = 25.4
Mean Tone 1 = 18.9
Mean Tone 2 = 25.3
Mean Tone 3 = 15.4
Mean Tone 4 = 20.6
Mean Tone 5 = 20.7
Mean Tone 6 = 16.8
Mean Overall = 22.7

P3 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	522.8	87.1	.64	.698
Within Groups	128	17354.9	135.6		
Total	134	17877.8			

Mean Tone 0 = 10.4
Mean Tone 1 = 7.5
Mean Tone 2 = 12.1
Mean Tone 3 = 3.1
Mean Tone 4 = 9.9
Mean Tone 5 = 11.4
Mean Tone 6 = 9.0
Mean Overall = 9.9

Table D.20

Oneway Analysis of Variance of DC3 Data For Tones

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	289152.0	48192.0	.61	.728
Within Groups	88	7010256.0	79662.0		
Total	94	7299408.0			

Mean Tone 0 = 579.3
Mean Tone 1 = 688.0
Mean Tone 2 = 660.9
Mean Tone 3 = 583.2
Mean Tone 4 = 722.0
Mean Tone 5 = 677.7
Mean Tone 6 = 571.5
Mean Overall = 629.7

CNV Amp(Cz) - M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	308.0	51.3	1.30	.265
Within Groups	88	3474.8	39.5		
Total	94	3782.8			

Mean Tone 0 = -11.3
Mean Tone 1 = -10.8
Mean Tone 2 = -12.0
Mean Tone 3 = -4.8
Mean Tone 4 = -7.8
Mean Tone 5 = -10.3
Mean Tone 6 = -11.0
Mean Overall = -10.4

CNV INT(Cz) - M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	54390.9	9065.1	1.85	.099
Within Groups	88	432350.8	4913.1		
Total	94	486741.7			

Mean Tone 0 = -93.9
Mean Tone 1 = -66.3
Mean Tone 2 = -80.7
Mean Tone 3 = -10.3
Mean Tone 4 = -36.9
Mean Tone 5 = -73.7
Mean Tone 6 = -89.0
Mean Overall = -75.1

N1 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	395.3	65.9	2.07	.065
Within Groups	85	2709.4	31.9		
Total	91	3104.7			

Mean Tone 0 = -7.4
Mean Tone 1 = -9.1
Mean Tone 2 = -12.6
Mean Tone 3 = -12.5
Mean Tone 4 = -9.1
Mean Tone 5 = -7.9
Mean Tone 6 = -13.8
Mean Overall = -8.9

P2 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	327.5	54.6	1.44	.210
Within Groups	85	3231.5	38.0		
Total	91	3558.9			

Mean Tone 0 = 9.9
Mean Tone 1 = 13.8
Mean Tone 2 = 8.0
Mean Tone 3 = 9.8
Mean Tone 4 = 9.4
Mean Tone 5 = 10.7
Mean Tone 6 = 4.5
Mean Overall = 10.0

P3 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	190.6	31.8	.82	.563
Within Groups	78	3040.4	39.0		
Total	84	3231.0			

Mean Tone 0 = 9.4
Mean Tone 1 = 9.1
Mean Tone 2 = 13.0
Mean Tone 3 = 8.8
Mean Tone 4 = 7.6
Mean Tone 5 = 8.5
Mean Tone 6 = 5.8
Mean Overall = 9.2

Table D.21

Oneway Analysis of Variance of DC4 Data For Tones

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	295456.0	49242.7	1.15	.339
Within Groups	95	4060832.0	42745.6		
Total	101	4356288.0			

Mean Tone 0 = 728.4
Mean Tone 1 = 680.9
Mean Tone 2 = 778.0
Mean Tone 3 = 717.5
Mean Tone 4 = 844.8
Mean Tone 5 = 628.5
Mean Tone 6 = 729.3
Mean Overall = 731.2

CNV Amp(Cz) - M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	1100.5	183.4	1.06	.394
Within Groups	95	16470.8	173.4		
Total	101	17571.3			

Mean Tone 0 = -16.6
Mean Tone 1 = -16.0
Mean Tone 2 = -12.8
Mean Tone 3 = -17.0
Mean Tone 4 = -23.4
Mean Tone 5 = -18.1
Mean Tone 6 = -8.2
Mean Overall = -16.5

CNV INT(Cz) - M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	98582.0	16430.3	.69	.660
Within Groups	95	2260637.0	23796.2		
Total	101	2359219.0			

Mean Tone 0 = -204.9
Mean Tone 1 = -204.2
Mean Tone 2 = -129.6
Mean Tone 3 = -257.0
Mean Tone 4 = -247.5
Mean Tone 5 = -193.2
Mean Tone 6 = -148.3
Mean Overall = -198.2

N1 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	447.9	74.6	.61	.724
Within Groups	95	11630.0	122.4		
Total	101	12077.8			

Mean Tone 0 = -25.4
Mean Tone 1 = -21.2
Mean Tone 2 = -28.4
Mean Tone 3 = -23.5
Mean Tone 4 = -25.3
Mean Tone 5 = -21.8
Mean Tone 6 = -28.5
Mean Overall = -25.0

P2 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	725.6	120.9	.91	.496
Within Groups	95	12698.2	133.7		
Total	101	13423.9			

Mean Tone 0 = 20.8
Mean Tone 1 = 24.6
Mean Tone 2 = 20.4
Mean Tone 3 = 16.0
Mean Tone 4 = 13.9
Mean Tone 5 = 18.9
Mean Tone 6 = 19.5
Mean Overall = 20.0

P3 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	337.6	56.3	.45	.854
Within Groups	88	11345.4	128.9		
Total	94	11682.9			

Mean Tone 0 = 13.3
Mean Tone 1 = 16.7
Mean Tone 2 = 12.1
Mean Tone 3 = 14.0
Mean Tone 4 = 11.6
Mean Tone 5 = 18.0
Mean Tone 6 = 14.2
Mean Overall = 13.9

Table D.22

Oneway Analysis of Variance of DC5 Data For Tones

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	331664.0	55277.3	1.02	.417
Within Groups	89	4812320.0	54071.0		
Total	95	5143984.0			

Mean Tone 0 = 653.0
Mean Tone 1 = 743.2
Mean Tone 2 = 783.4
Mean Tone 3 = 583.7
Mean Tone 4 = 757.2
Mean Tone 5 = 785.0
Mean Tone 6 = 695.0
Mean Overall = 696.5

CNV Amp(Cz) - M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	1169.1	194.9	.89	.506
Within Groups	89	19453.5	218.6		
Total	95	20622.6			

Mean Tone 0 = -24.0
Mean Tone 1 = -20.0
Mean Tone 2 = -19.3
Mean Tone 3 = -28.7
Mean Tone 4 = -29.0
Mean Tone 5 = -16.8
Mean Tone 6 = -27.8
Mean Overall = -23.3

CNV INT(Cz) - M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	68494.0	11415.7	.38	.888
Within Groups	89	2646597.0	29737.0		
Total	95	2715091.0			

Mean Tone 0 = -265.0
Mean Tone 1 = -276.3
Mean Tone 2 = -286.8
Mean Tone 3 = -297.0
Mean Tone 4 = -348.6
Mean Tone 5 = -249.8
Mean Tone 6 = -266.5

Mean Overall = -276.1

N1 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	516.6	86.1	.70	.656
Within Groups	89	11019.9	123.8		
Total	95	11536.5			

Mean Tone 0 = -26.6
Mean Tone 1 = -26.8
Mean Tone 2 = -29.0
Mean Tone 3 = -35.3
Mean Tone 4 = -25.5
Mean Tone 5 = -32.3
Mean Tone 6 = -27.8
Mean Overall = -27.6

P2 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	928.0	154.7	1.26	.285
Within Groups	89	10851.3	123.0		
Total	95	11879.3			

Mean Tone 0 = 14.7
Mean Tone 1 = 19.8
Mean Tone 2 = 11.5
Mean Tone 3 = 2.0
Mean Tone 4 = 16.7
Mean Tone 5 = 16.1
Mean Tone 6 = 10.5
Mean Overall = 14.7

P3 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	496.2	82.7	.98	.450
Within Groups	61	5165.6	84.7		
Total	67	5661.8			

Mean Tone 0 = 1.9
Mean Tone 1 = -3.0
Mean Tone 2 = -1.5
Mean Tone 3 = 3.5
Mean Tone 4 = 5.6
Mean Tone 5 = 0.3
Mean Tone 6 = -9.0
Mean Overall = 0.9

Table D.23

Oneway Analysis of Variance of DC6 Data For Tones

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	758608.0	126434.6	1.94	.079
Within Groups	120	7811504.0	65095.9		
Total	126	8570112.0			

Mean Tone 0 = 619.2
Mean Tone 1 = 414.9
Mean Tone 2 = 580.7
Mean Tone 3 = 593.1
Mean Tone 4 = 451.4
Mean Tone 5 = 556.5
Mean Tone 6 = 426.4
Mean Overall = 561.2

CNV Amp(Cz) - M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	538.0	89.7	.99	.434
Within Groups	120	10840.2	90.3		
Total	126	11378.2			

Mean Tone 0 = -10.9
Mean Tone 1 = -7.4
Mean Tone 2 = -10.0
Mean Tone 3 = -5.9
Mean Tone 4 = -5.8
Mean Tone 5 = -6.8
Mean Tone 6 = -9.6
Mean Overall = -9.2

CNV INT(Cz) - M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	119534.0	19922.3	2.07	.061
Within Groups	120	1155506.0	9629.2		
Total	126	1275040.0			

Mean Tone 0 = -146.7
Mean Tone 1 = -99.5
Mean Tone 2 = -126.7
Mean Tone 3 = -88.0
Mean Tone 4 = -84.7
Mean Tone 5 = -65.2
Mean Tone 6 = -149.3
Mean Overall = -122.6

N1 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	811.3	135.2	1.76	.111
Within Groups	120	9196.9	76.6		
Total	126	10008.1			

Mean Tone 0 = -26.1
Mean Tone 1 = -21.6
Mean Tone 2 = -22.4
Mean Tone 3 = -17.1
Mean Tone 4 = -24.9
Mean Tone 5 = -22.0
Mean Tone 6 = -27.3
Mean Overall = -24.4

P2 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	1258.0	209.7	4.50	.000
Within Groups	120	5591.0	46.6		
Total	126	6849.0			

Mean Tone 0 = -0.5
Mean Tone 1 = 5.6
Mean Tone 2 = 4.5
Mean Tone 3 = 3.4
Mean Tone 4 = 3.5
Mean Tone 5 = 8.4
Mean Tone 6 = -1.3
Mean Overall = 2.0

Significant ($p<.05$) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: Tone 6; Tone 0; Tone 3; Tone 4; Tone 2; Tone 1
Subset 2: Tone 3; Tone 4; Tone 2; Tone 1; Tone 5

P3 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	161.5	26.9	.73	.631
Within Groups	96	3557.9	37.1		
Total	102	3719.4			

Mean Tone 0 = 6.7
Mean Tone 1 = 5.9
Mean Tone 2 = 7.3
Mean Tone 3 = 6.5
Mean Tone 4 = 8.3
Mean Tone 5 = 10.1
Mean Tone 6 = 9.8
Mean Overall = 7.3

Table D.24

Oneway Analysis of Variance of DC7 Data For Tones

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	141008.0	23501.3	.29	.939
Within Groups	125	10048304.0	80383.4		
Total	131	10189312.0			

Mean Tone 0 = 576.3
Mean Tone 1 = 513.7
Mean Tone 2 = 632.8
Mean Tone 3 = 662.2
Mean Tone 4 = 594.4
Mean Tone 5 = 568.7
Mean Tone 6 = 595.4
Mean Overall = 582.2

CNV Amp(Cz) - M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	195.2	32.5	.37	.900
Within Groups	125	11149.8	89.2		
Total	131	11345.0			

Mean Tone 0 = -12.8
Mean Tone 1 = -13.2
Mean Tone 2 = -15.0
Mean Tone 3 = -16.0
Mean Tone 4 = -14.3
Mean Tone 5 = -11.6
Mean Tone 6 = -10.9
Mean Overall = -13.2

CNV INT(Cz) - M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	29906.0	4984.3	.60	.730
Within Groups	125	1034137.0	8273.1		
Total	131	1064043.0			

Mean Tone 0 = -136.2
Mean Tone 1 = -151.9
Mean Tone 2 = -158.2
Mean Tone 3 = -172.8
Mean Tone 4 = -168.1
Mean Tone 5 = -130.5
Mean Tone 6 = -116.3
Mean Overall = -144.0

N1 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	994.0	165.7	2.16	.052
Within Groups	121	9299.5	76.9		
Total	127	10293.5			

Mean Tone 0 = -20.2
Mean Tone 1 = -15.7
Mean Tone 2 = -19.2
Mean Tone 3 = -14.3
Mean Tone 4 = -17.8
Mean Tone 5 = -14.2
Mean Tone 6 = -10.3
Mean Overall = -17.9

P2 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	283.6	47.3	.77	.598
Within Groups	116	7136.3	61.5		
Total	122	7419.9			

Mean Tone 0 = 15.5
Mean Tone 1 = 11.4
Mean Tone 2 = 13.9
Mean Tone 3 = 13.8
Mean Tone 4 = 12.1
Mean Tone 5 = 13.1
Mean Tone 6 = 12.8
Mean Overall = 14.0

P3 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	301.2	50.2	.76	.605
Within Groups	114	7540.3	66.1		
Total	120	7841.4			

Mean Tone 0 = 15.1
Mean Tone 1 = 13.3
Mean Tone 2 = 12.3
Mean Tone 3 = 11.6
Mean Tone 4 = 11.3
Mean Tone 5 = 14.1
Mean Tone 6 = 10.7
Mean Overall = 13.7

Table D.25

Oneway Analysis of Variance of DC8 Data For Tones

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	353488.0	58914.7	1.14	.346
Within Groups	104	5391616.0	51842.5		
Total	110	5745104.0			

Mean Tone 0 = 647.6
Mean Tone 1 = 513.0
Mean Tone 2 = 698.3
Mean Tone 3 = 660.4
Mean Tone 4 = 539.0
Mean Tone 5 = 604.3
Mean Tone 6 = 471.7
Mean Overall = 625.4

CNV Amp(Cz) - M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	1079.4	179.9	1.73	.120
Within Groups	104	10803.7	103.9		
Total	110	11883.1			

Mean Tone 0 = -14.8
Mean Tone 1 = -15.9
Mean Tone 2 = -9.8
Mean Tone 3 = -4.7
Mean Tone 4 = -10.8
Mean Tone 5 = -17.3
Mean Tone 6 = -15.3
Mean Overall = -13.6

CNV INT(Cz) - M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	94507.0	15751.2	1.35	.242
Within Groups	104	1215457.0	11687.1		
Total	110	1309964.0			

Mean Tone 0 = -179.0
Mean Tone 1 = -180.4
Mean Tone 2 = -130.1
Mean Tone 3 = -93.4
Mean Tone 4 = -124.5
Mean Tone 5 = -199.3
Mean Tone 6 = -184.0
Mean Overall = -165.7

N1 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	2028.5	338.1	2.31	.039
Within Groups	104	15252.9	146.7		
Total	110	17281.4			

Mean Tone 0 = -30.4
Mean Tone 1 = -25.6
Mean Tone 2 = -28.6
Mean Tone 3 = -19.1
Mean Tone 4 = -23.6
Mean Tone 5 = -24.3
Mean Tone 6 = -12.0
Mean Overall = -27.4

Significant ($p<.05$) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: Tone 0; Tone 2; Tone 1; Tone 5; Tone 4;
Subset 2: Tone 2; Tone 1;; Tone 5; Tone 4; Tone 3; Tone 6

P2 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	776.9	129.5	1.17	.329
Within Groups	104	11521.5	110.8		
Total	110	12298.4			

Mean Tone 0 = 10.7
Mean Tone 1 = 2.0
Mean Tone 2 = 9.1
Mean Tone 3 = 12.4
Mean Tone 4 = 13.2
Mean Tone 5 = 8.0
Mean Tone 6 = 6.3
Mean Overall = 9.8

P3 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	554.2	92.4	1.15	.339
Within Groups	91	7300.3	80.2		
Total	97	7854.5			

Mean Tone 0 = 11.0
Mean Tone 1 = 13.4
Mean Tone 2 = 10.0
Mean Tone 3 = 4.8
Mean Tone 4 = 12.1
Mean Tone 5 = 5.9
Mean Tone 6 = 1.0
Mean Overall = 10.2

Table D.26

Oneway Analysis of Variance of DC9 Data For Tones

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	180992.0	30165.3	.64	.702
Within Groups	105	4969760.0	47331.0		
Total	111	5150752.0			

Mean Tone 0 = 691.6
Mean Tone 1 = 760.4
Mean Tone 2 = 689.8
Mean Tone 3 = 628.7
Mean Tone 4 = 662.0
Mean Tone 5 = 685.8
Mean Tone 6 = 550.4
Mean Overall = 684.6

CNV Amp(Cz) - M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	192.4	32.1	.27	.951
Within Groups	105	12691.6	120.9		
Total	111	12884.0			

Mean Tone 0 = -13.0
Mean Tone 1 = -13.5
Mean Tone 2 = -14.8
Mean Tone 3 = -16.8
Mean Tone 4 = -12.9
Mean Tone 5 = -10.8
Mean Tone 6 = -14.6
Mean Overall = -13.3

CNV INT(Cz) - N4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	65625.0	10937.5	.66	.684
Within Groups	105	1741440.0	16585.1		
Total	111	1807065.0			

Mean Tone 0 = -152.1
Mean Tone 1 = -178.0
Mean Tone 2 = -157.8
Mean Tone 3 = -188.0
Mean Tone 4 = -154.8
Mean Tone 5 = -102.6
Mean Tone 6 = -90.0
Mean Overall = -148.9

N1 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	806.6	134.4	2.58	.023
Within Groups	94	4902.1	52.2		
Total	100	5708.7			

Mean Tone 0 = -14.5
Mean Tone 1 = -15.3
Mean Tone 2 = -20.4
Mean Tone 3 = -12.8
Mean Tone 4 = -15.3
Mean Tone 5 = -12.7
Mean Tone 6 = -5.0
Mean Overall = -14.6

Significant ($p<.05$) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.

Subset 1: Tone 2; Tone 4; Tone 1; Tone 0; Tone 3
Subset 2: Tone 4; Tone 1; Tone 0; Tone 3; Tone 5
Subset 3: Tone 3; Tone 5; Tone 6

P2 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	468.8	78.1	1.19	.318
Within Groups	92	6034.1	65.6		
Total	98	6502.9			

Mean Tone 0 = 11.4
Mean Tone 1 = 9.5
Mean Tone 2 = 6.6
Mean Tone 3 = 11.0
Mean Tone 4 = 14.7
Mean Tone 5 = 12.1
Mean Tone 6 = 15.8
Mean Overall = 11.3

P3 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	944.2	157.4	2.99	.011
Within Groups	76	4005.6	52.7		
Total	82	4949.8			

Mean Tone 0 = 13.3
Mean Tone 1 = 4.6
Mean Tone 2 = 16.6
Mean Tone 3 = 5.5
Mean Tone 4 = 9.3
Mean Tone 5 = 12.4
Mean Tone 6 = 16.5
Mean Overall = 12.0

Significant ($p<.05$) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.

Subset 1: Tone 1; Tone 3; Tone 4
Subset 2: Tone 3; Tone 4; Tone 5; Tone 0; Tone 6
Subset 3: Tone 4; Tone 5; Tone 0; Tone 6; Tone 2

Table D.27

Oneway Analysis of Variance of DC11 Data For Tones

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	1181888.0	196981.3	3.24	.005
Within Groups	131	7970336.0	60842.3		
Total	137	9152224.0			

Mean Tone 0 = 612.1
Mean Tone 1 = 542.9
Mean Tone 2 = 773.3
Mean Tone 3 = 475.6
Mean Tone 4 = 755.9
Mean Tone 5 = 788.6
Mean Tone 6 = 691.7
Mean Overall = 652.5

Significant ($p<.05$) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: Tone 3; Tone 1; Tone 0; Tone 6
Subset 2: Tone 0; Tone 6; Tone 4
Subset 3: Tone 6: Tone 4; Tone 2; Tone 5

CNV Amp(Cz) - M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	1676.5	279.4	1.80	.103
Within Groups	131	20313.4	155.1		
Total	137	21989.9			

Mean Tone 0 = -17.0
Mean Tone 1 = -9.4
Mean Tone 2 = -16.3
Mean Tone 3 = -13.3
Mean Tone 4 = -9.4
Mean Tone 5 = -19.5
Mean Tone 6 = -21.0
Mean Overall = -15.6

CNV INT(Cz) - M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	109934.0	18322.3	1.14	.345
Within Groups	131	2114239.0	16139.2		
Total	137	2224173.0			

Mean Tone 0 = -194.1
Mean Tone 1 = -163.3
Mean Tone 2 = -197.1
Mean Tone 3 = -141.5
Mean Tone 4 = -121.9
Mean Tone 5 = -224.7
Mean Tone 6 = -197.9
Mean Overall = -184.4

N1 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	4882.3	813.7	6.70	.000
Within Groups	130	15799.4	121.5		
Total	136	20681.8			

Mean Tone 0 = -33.3
Mean Tone 1 = -23.0
Mean Tone 2 = -22.5
Mean Tone 3 = -22.9
Mean Tone 4 = -22.1
Mean Tone 5 = -22.5
Mean Tone 6 = -15.0
Mean Overall = -27.2

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: Tone 0
Subset 2: Tone 1; Tone 3; Tone 2; Tone 5; Tone 4; Tone 6

P2 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	595.2	99.2	.89	.503
Within Groups	121	13420.8	110.9		
Total	127	14016.0			

Mean Tone 0 = 16.2
Mean Tone 1 = 11.2
Mean Tone 2 = 15.6
Mean Tone 3 = 15.3
Mean Tone 4 = 18.1
Mean Tone 5 = 13.5
Mean Tone 6 = 10.1
Mean Overall = 15.1

P3 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	405.9	67.7	.51	.796
Within Groups	108	14206.7	131.5		
Total	114	14612.7			

Mean Tone 0 = 19.2
Mean Tone 1 = 17.7
Mean Tone 2 = 15.1
Mean Tone 3 = 16.5
Mean Tone 4 = 15.6
Mean Tone 5 = 14.4
Mean Tone 6 = 17.3
Mean Overall = 17.5

Table D.28

Oneway Analysis of Variance of DC12 Data For Tones

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	692256.0	115376.0	1.97	.082
Within Groups	63	3686968.0	58475.7		
Total	69	4376224.0			

Mean Tone 0 = 788.0
Mean Tone 1 = 551.2
Mean Tone 2 = 577.0
Mean Tone 3 = 450.8
Mean Tone 4 = 620.7
Mean Tone 5 = 764.8
Mean Tone 6 = 492.1
Mean Overall = 608.0

CNV Amp(Cz) - M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	179.2	29.9	.39	.886
Within Groups	63	4883.7	77.5		
Total	69	5062.9			

Mean Tone 0 = -7.0
Mean Tone 1 = -6.3
Mean Tone 2 = -10.4
Mean Tone 3 = -6.8
Mean Tone 4 = -7.0
Mean Tone 5 = -9.5
Mean Tone 6 = -7.3
Mean Overall = -8.0

CNV INT(Cz) - M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	14938.2	2489.7	.26	.951
Within Groups	63	598666.4	9502.6		
Total	69	613604.6			

Mean Tone 0 = -92.7
Mean Tone 1 = -73.5
Mean Tone 2 = -88.9
Mean Tone 3 = -55.2
Mean Tone 4 = -55.1
Mean Tone 5 = -71.8
Mean Tone 6 = -46.7
Mean Overall = -69.1

N1 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	386.0	64.3	.57	.757
Within Groups	61	6925.0	113.5		
Total	67	7311.0			

Mean Tone 0 = -19.0
Mean Tone 1 = -21.7
Mean Tone 2 = -22.9
Mean Tone 3 = -26.8
Mean Tone 4 = -20.9
Mean Tone 5 = -17.5
Mean Tone 6 = -23.0
Mean Overall = -21.5

P2 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	2518.1	419.7	2.59	.027
Within Groups	61	9902.7	162.3		
Total	67	12420.8			

Mean Tone 0 = 37.3
Mean Tone 1 = 19.5
Mean Tone 2 = 16.1
Mean Tone 3 = 13.8
Mean Tone 4 = 15.5
Mean Tone 5 = 11.2
Mean Tone 6 = 5.9
Mean Overall = 15.6

Significant ($p<.05$) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: Tone 6; Tone 5; Tone 3; Tone 4; Tone 2
Subset 2: Tone 5; Tone 3; Tone 4; Tone 2; Tone 1
Subset 3: Tone 0

P3 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	462.9	77.1	.66	.688
Within Groups	60	7065.4	117.8		
Total	66	7528.3			

Mean Tone 0 = 29.7
Mean Tone 1 = 18.1
Mean Tone 2 = 21.0
Mean Tone 3 = 23.2
Mean Tone 4 = 23.5
Mean Tone 5 = 22.2
Mean Tone 6 = 19.6
Mean Overall = 21.6

Table D.29

Oneway Analysis of Variance of DC13 Data For Tones

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	337136.0	56189.3	.84	.545
Within Groups	135	9062064.0	67126.4		
Total	141	9399200.0			

Mean Tone 0 = 713.6
Mean Tone 1 = 735.0
Mean Tone 2 = 700.9
Mean Tone 3 = 811.7
Mean Tone 4 = 675.1
Mean Tone 5 = 755.8
Mean Tone 6 = 536.7
Mean Overall = 710.0

CNV Amp(Cz) - M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	1878.6	313.1	1.68	.129
Within Groups	135	25115.1	186.0		
Total	141	26993.7			

Mean Tone 0 = -10.1
Mean Tone 1 = -16.6
Mean Tone 2 = -12.1
Mean Tone 3 = -14.0
Mean Tone 4 = -8.9
Mean Tone 5 = -20.4
Mean Tone 6 = -10.4
Mean Overall = -12.1

CNV INT(Cz) - M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	134929.0	22488.2	1.02	.417
Within Groups	135	2985336.0	22113.6		
Total	141	3120265.0			

Mean Tone 0 = -190.1
Mean Tone 1 = -178.7
Mean Tone 2 = -205.8
Mean Tone 3 = -98.2
Mean Tone 4 = -137.9
Mean Tone 5 = -224.0
Mean Tone 6 = -129.7
Mean Overall = -181.2

N1 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	3056.9	509.5	2.90	.011
Within Groups	129	22644.9	175.5		
Total	135	25701.8			

Mean Tone 0 = -27.2
Mean Tone 1 = -24.9
Mean Tone 2 = -16.9
Mean Tone 3 = -30.3
Mean Tone 4 = -21.3
Mean Tone 5 = -18.9
Mean Tone 6 = -11.7
Mean Overall = -23.8

Significant ($p<.05$) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: Tone 3; Tone 0; Tone 1; Tone 4; Tone 5; Tone 2
Subset 2: Tone 1; Tone 4; Tone 5; Tone 2; Tone 6

P2 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	933.0	155.5	.86	.525
Within Groups	125	22513.2	180.1		
Total	131	23446.2			

Mean Tone 0 = 17.3
Mean Tone 1 = 16.0
Mean Tone 2 = 10.6
Mean Tone 3 = 18.5
Mean Tone 4 = 13.1
Mean Tone 5 = 15.7
Mean Tone 6 = 8.5
Mean Overall = 15.6

P3 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	552.6	92.1	.61	.727
Within Groups	105	15957.1	152.0		
Total	111	16509.7			

Mean Tone 0 = 12.4
Mean Tone 1 = 10.4
Mean Tone 2 = 11.8
Mean Tone 3 = 18.0
Mean Tone 4 = 18.2
Mean Tone 5 = 12.5
Mean Tone 6 = 8.0
Mean Overall = 12.9

Table D.30

Oneway Analysis of Variance of DC14 Data For Tones

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	247328.0	41221.3	.48	.821
Within Groups	110	9387280.0	85338.9		
Total	116	9634608.0			

Mean Tone 0 = 600.3
Mean Tone 1 = 596.7
Mean Tone 2 = 631.4
Mean Tone 3 = 697.0
Mean Tone 4 = 686.8
Mean Tone 5 = 682.0
Mean Tone 6 = 504.5
Mean Overall = 622.0

CNV Amp(Cz) - M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	894.3	149.1	.70	.655
Within Groups	110	23550.7	214.1		
Total	116	24445.0			

Mean Tone 0 = -30.1
Mean Tone 1 = -27.1
Mean Tone 2 = -33.2
Mean Tone 3 = -32.0
Mean Tone 4 = -29.3
Mean Tone 5 = -35.6
Mean Tone 6 = -38.3
Mean Overall = -31.3

CNV INT(Cz) - M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	65652.0	10942.0	.46	.837
Within Groups	110	2614229.0	23765.7		
Total	116	2679881.0			

Mean Tone 0 = -310.7
Mean Tone 1 = -286.3
Mean Tone 2 = -332.9
Mean Tone 3 = -268.8
Mean Tone 4 = -254.9
Mean Tone 5 = -319.8
Mean Tone 6 = -341.7
Mean Overall = -306.2

N1 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	446.6	74.4	.99	.438
Within Groups	110	8291.5	75.4		
Total	116	8738.1			

Mean Tone 0 = -15.1
Mean Tone 1 = -9.9
Mean Tone 2 = -12.5
Mean Tone 3 = -11.3
Mean Tone 4 = -10.3
Mean Tone 5 = -12.8
Mean Tone 6 = -13.2
Mean Overall = -13.3

P2 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	396.5	66.1	.86	.531
Within Groups	107	8253.1	77.1		
Total	113	8649.6			

Mean Tone 0 = 7.8
Mean Tone 1 = 10.7
Mean Tone 2 = 6.5
Mean Tone 3 = 12.3
Mean Tone 4 = 7.4
Mean Tone 5 = 7.1
Mean Tone 6 = 2.2
Mean Overall = 7.7

P3 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	367.9	61.3	.97	.453
Within Groups	84	5320.8	63.3		
Total	90	5688.7			

Mean Tone 0 = 5.7
Mean Tone 1 = 9.9
Mean Tone 2 = 4.9
Mean Tone 3 = 5.7
Mean Tone 4 = 5.1
Mean Tone 5 = 6.8
Mean Tone 6 = -1.0
Mean Overall = 5.6

Table D.31

Oneway Analysis of Variance of DC15 Data For Tones

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	213216.0	35536.0	.46	.841
Within Groups	131	10213488.0	77965.5		
Total	137	10426704.0			

Mean Tone 0 = 612.1
Mean Tone 1 = 550.4
Mean Tone 2 = 628.7
Mean Tone 3 = 716.0
Mean Tone 4 = 673.7
Mean Tone 5 = 597.1
Mean Tone 6 = 560.7
Mean Overall = 615.9

CNV Amp(Cz) - M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	1579.8	263.3	.92	.486
Within Groups	131	37615.6	287.1		
Total	137	39195.4			

Mean Tone 0 = -14.6
Mean Tone 1 = -12.7
Mean Tone 2 = -22.2
Mean Tone 3 = -9.7
Mean Tone 4 = -15.8
Mean Tone 5 = -17.8
Mean Tone 6 = -23.6
Mean Overall = -15.9

CNV INT(Cz) - M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	164661.0	27443.5	.96	.456
Within Groups	131	3748166.0	28612.0		
Total	137	3912827.0			

Mean Tone 0 = -145.7
Mean Tone 1 = -135.0
Mean Tone 2 = -249.4
Mean Tone 3 = -105.6
Mean Tone 4 = -149.4
Mean Tone 5 = -169.1
Mean Tone 6 = -155.4
Mean Overall = -157.2

N1 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	6602.8	1100.5	7.75	.000
Within Groups	129	18312.3	142.0		
Total	135	24915.1			

Mean Tone 0 = -33.5
Mean Tone 1 = -28.4
Mean Tone 2 = -45.0
Mean Tone 3 = -24.6
Mean Tone 4 = -22.5
Mean Tone 5 = -22.2
Mean Tone 6 = -20.2
Mean Overall = -30.8

Significant ($p<.05$) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
- Subset 1: Tone 2
- Subset 2: Tone 0; Tone 1; Tone 3
- Subset 3: Tone 1; Tone 4; Tone 3; Tone 5; Tone 6

P2 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	1121.8	187.0	1.22	.298
Within Groups	128	19569.5	152.9		
Total	134	20691.3			

Mean Tone 0 = 8.2
Mean Tone 1 = 9.4
Mean Tone 2 = 4.3
Mean Tone 3 = 13.3
Mean Tone 4 = 13.9
Mean Tone 5 = 13.3
Mean Tone 6 = 7.7
Mean Overall = 9.3

P3 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	610.7	101.8	.78	.593
Within Groups	104	13655.6	131.3		
Total	110	14266.3			

Mean Tone 0 = 14.4
Mean Tone 1 = 14.2
Mean Tone 2 = 14.0
Mean Tone 3 = 2.8
Mean Tone 4 = 13.0
Mean Tone 5 = 16.8
Mean Tone 6 = 13.0
Mean Overall = 13.9

Table D.32

Oneway Analysis of Variance of DC16 Data For Tones

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	473440.0	78906.6	1.04	.402
Within Groups	113	8545760.0	75626.2		
Total	119	9019200.0			

Mean Tone 0 = 597.7
Mean Tone 1 = 614.8
Mean Tone 2 = 791.8
Mean Tone 3 = 573.0
Mean Tone 4 = 664.3
Mean Tone 5 = 639.3
Mean Tone 6 = 662.5
Mean Overall = 633.4

CNV Amp(Cz) - M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	868.7	144.8	.67	.680
Within Groups	113	24581.1	517.5		
Total	119	25449.8			

Mean Tone 0 = -26.5
Mean Tone 1 = -24.8
Mean Tone 2 = -22.3
Mean Tone 3 = -19.6
Mean Tone 4 = -27.6
Mean Tone 5 = -23.7
Mean Tone 6 = -34.0
Mean Overall = -25.5

CNV INT(Cz) - M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	79853.0	13308.8	.81	.565
Within Groups	113	1855559.0	16420.9		
Total	119	1935412.0			

Mean Tone 0 = -238.1
Mean Tone 1 = -251.8
Mean Tone 2 = -198.6
Mean Tone 3 = -169.4
Mean Tone 4 = -271.2
Mean Tone 5 = -209.1
Mean Tone 6 = -250.5
Mean Overall = -231.1

N1 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	1158.9	193.2	1.23	.296
Within Groups	109	17126.2	157.1		
Total	115	18285.1			

Mean Tone 0 = -25.9
Mean Tone 1 = -24.1
Mean Tone 2 = -26.1
Mean Tone 3 = -15.8
Mean Tone 4 = -27.9
Mean Tone 5 = -20.6
Mean Tone 6 = -31.0
Mean Overall = -24.8

P2 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	1079.9	180.0	1.47	.193
Within Groups	107	13065.6	122.1		
Total	113	14145.4			

Mean Tone 0 = 15.8
Mean Tone 1 = 16.6
Mean Tone 2 = 19.6
Mean Tone 3 = 18.8
Mean Tone 4 = 8.3
Mean Tone 5 = 16.9
Mean Tone 6 = 8.0
Mean Overall = 15.7

P3 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	380.0	63.3	.66	.682
Within Groups	93	8887.4	95.6		
Total	99	9567.4			

Mean Tone 0 = 15.3
Mean Tone 1 = 18.0
Mean Tone 2 = 15.9
Mean Tone 3 = 20.6
Mean Tone 4 = 12.4
Mean Tone 5 = 16.6
Mean Tone 6 = 20.0
Mean Overall = 15.8

Table D.33

Oneway Analysis of Variance of DC18 Data For Tones

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	351888.0	58648.0	.92	.484
Within Groups	125	7968864.0	63750.9		
Total	131	8320752.0			

Mean Tone 0 = 792.6
Mean Tone 1 = 805.8
Mean Tone 2 = 789.2
Mean Tone 3 = 620.0
Mean Tone 4 = 835.9
Mean Tone 5 = 858.4
Mean Tone 6 = 702.7
Mean Overall = 792.9

CNV Amp(Cz) - M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	1189.6	198.3	.82	.559
Within Groups	125	30266.2	242.1		
Total	131	31455.8			

Mean Tone 0 = -19.1
Mean Tone 1 = -16.0
Mean Tone 2 = -15.4
Mean Tone 3 = -19.1
Mean Tone 4 = -18.0
Mean Tone 5 = -26.9
Mean Tone 6 = -17.2
Mean Overall = -19.0

CNV INT(Cz) - M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	216672.0	36112.0	1.19	.317
Within Groups	125	3802308.0	30418.5		
Total	131	4018980.0			

Mean Tone 0 = -202.0
Mean Tone 1 = -153.1
Mean Tone 2 = -153.6
Mean Tone 3 = -149.4
Mean Tone 4 = -162.2
Mean Tone 5 = -293.1
Mean Tone 6 = -179.5
Mean Overall = -193.2

N1 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	436.4	72.7	.41	.869
Within Groups	113	19857.9	175.7		
Total	119	20294.4			

Mean Tone 0 = -22.9
Mean Tone 1 = -21.5
Mean Tone 2 = -18.2
Mean Tone 3 = -16.8
Mean Tone 4 = -23.3
Mean Tone 5 = -21.3
Mean Tone 6 = -21.0
Mean Overall = -21.8

P2 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	1130.3	188.4	1.46	.198
Within Groups	112	14464.8	129.2		
Total	118	15595.1			

Mean Tone 0 = 15.6
Mean Tone 1 = 18.0
Mean Tone 2 = 12.0
Mean Tone 3 = 26.5
Mean Tone 4 = 18.6
Mean Tone 5 = 18.5
Mean Tone 6 = 20.7
Mean Overall = 16.9

P3 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	354.6	59.1	.37	.896
Within Groups	99	15771.4	159.3		
Total	105	16126.0			

Mean Tone 0 = 20.8
Mean Tone 1 = 16.8
Mean Tone 2 = 25.2
Mean Tone 3 = 21.3
Mean Tone 4 = 23.7
Mean Tone 5 = 21.0
Mean Tone 6 = 21.2
Mean Overall = 9.9

Table D.34

Oneway Analysis of Variance of DC19 Data For Tones

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	645008.0	107501.3	1.55	.168
Within Groups	123	8553712.0	69542.3		
Total	129	9198720.0			

Mean Tone 0 = 657.1
Mean Tone 1 = 631.1
Mean Tone 2 = 483.9
Mean Tone 3 = 728.6
Mean Tone 4 = 560.5
Mean Tone 5 = 636.9
Mean Tone 6 = 413.4
Mean Overall = 621.7

CNV Amp(Cz) - M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	1692.4	282.1	1.65	.139
Within Groups	123	21062.4	171.2		
Total	129	22754.8			

Mean Tone 0 = -12.3
Mean Tone 1 = -10.4
Mean Tone 2 = -7.6
Mean Tone 3 = -14.4
Mean Tone 4 = -11.9
Mean Tone 5 = -22.2
Mean Tone 6 = -7.8
Mean Overall = -12.6

CNV INT(Cz) - M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	150524.0	25087.3	1.30	.261
Within Groups	123	2373068.0	19293.2		
Total	129	2523592.0			

Mean Tone 0 = -111.1
Mean Tone 1 = -109.4
Mean Tone 2 = -48.4
Mean Tone 3 = -194.3
Mean Tone 4 = -90.6
Mean Tone 5 = -175.5
Mean Tone 6 = -122.6
Mean Overall = -114.8

N1 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	935.0	155.8	1.31	.257
Within Groups	116	13797.0	118.9		
Total	122	14732.0			

Mean Tone 0 = -18.3
Mean Tone 1 = -22.8
Mean Tone 2 = -18.5
Mean Tone 3 = -18.7
Mean Tone 4 = -16.2
Mean Tone 5 = -16.8
Mean Tone 6 = -4.3
Mean Overall = -18.1

P2 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	1297.3	216.2	1.46	.197
Within Groups	115	17007.8	147.9		
Total	121	18305.0			

Mean Tone 0 = 24.7
Mean Tone 1 = 15.8
Mean Tone 2 = 25.8
Mean Tone 3 = 17.3
Mean Tone 4 = 22.1
Mean Tone 5 = 25.0
Mean Tone 6 = 18.3
Mean Overall = 23.0

P3 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	1052.5	175.4	1.75	.117
Within Groups	105	10547.7	100.5		
Total	111	11600.3			

Mean Tone 0 = 21.9
Mean Tone 1 = 12.4
Mean Tone 2 = 22.9
Mean Tone 3 = 22.1
Mean Tone 4 = 22.6
Mean Tone 5 = 21.9
Mean Tone 6 = 25.5
Mean Overall = 21.1

Table D.35

Oneway Analysis of Variance of DC20 Data For Tones

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	458128.0	76354.6	1.09	.373
Within Groups	108	7559520.0	69992.5		
Total	114	8017648.0			

Mean Tone 0 = 712.3
Mean Tone 1 = 724.7
Mean Tone 2 = 776.8
Mean Tone 3 = 545.0
Mean Tone 4 = 773.2
Mean Tone 5 = 800.8
Mean Tone 6 = 881.3
Mean Overall = 734.1

CNV Amp(Cz) - M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	810.1	135.0	.73	.627
Within Groups	108	19919.1	184.4		
Total	114	20729.2			

Mean Tone 0 = -17.9
Mean Tone 1 = -17.0
Mean Tone 2 = -16.2
Mean Tone 3 = -18.5
Mean Tone 4 = -23.4
Mean Tone 5 = -23.8
Mean Tone 6 = -23.3
Mean Overall = -19.2

CNV INT(Cz) - M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	60031.0	10005.2	.48	.821
Within Groups	108	2236766.0	20710.8		
Total	114	2296797.0			

Mean Tone 0 = -161.5
Mean Tone 1 = -133.2
Mean Tone 2 = -129.2
Mean Tone 3 = -188.8
Mean Tone 4 = -193.9
Mean Tone 5 = -210.5
Mean Tone 6 = -184.3
Mean Overall = -167.3

N1 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	185.8	31.0	.23	.965
Within Groups	108	14544.0	134.7		
Total	114	14729.8			

Mean Tone 0 = -23.9
Mean Tone 1 = -24.2
Mean Tone 2 = -23.0
Mean Tone 3 = -25.3
Mean Tone 4 = -20.9
Mean Tone 5 = -23.5
Mean Tone 6 = -20.5
Mean Overall = -23.3

P2 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	496.7	82.8	.56	.761
Within Groups	108	15903.1	147.3		
Total	114	16399.8			

Mean Tone 0 = 25.4
Mean Tone 1 = 27.7
Mean Tone 2 = 29.4
Mean Tone 3 = 19.2
Mean Tone 4 = 23.5
Mean Tone 5 = 25.6
Mean Tone 6 = 24.3
Mean Overall = 25.3

P3 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	1173.3	195.5	1.41	.220
Within Groups	96	13360.4	139.2		
Total	102	14533.7			

Mean Tone 0 = 20.1
Mean Tone 1 = 12.7
Mean Tone 2 = 20.6
Mean Tone 3 = 8.4
Mean Tone 4 = 19.5
Mean Tone 5 = 15.3
Mean Tone 6 = 23.0
Mean Overall = 18.5

Table D.36

Oneway Analysis of Variance of DC21 Data For Tones

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	127296.0	21216.0	.76	.609
Within Groups	94	2642928.0	28116.3		
Total	100	2770224.0			

Mean Tone 0 = 880.7
Mean Tone 1 = 942.7
Mean Tone 2 = 895.3
Mean Tone 3 = 921.4
Mean Tone 4 = 917.6
Mean Tone 5 = 915.0
Mean Tone 6 = 763.8
Mean Overall = 892.0

CNV Amp(Cz) - M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	1270.2	211.7	1.28	.273
Within Groups	94	15545.4	165.4		
Total	100	16815.6			

Mean Tone 0 = -17.1
Mean Tone 1 = -16.1
Mean Tone 2 = -22.5
Mean Tone 3 = -8.9
Mean Tone 4 = -9.8
Mean Tone 5 = -17.5
Mean Tone 6 = -13.8
Mean Overall = -15.9

CNV INT(Cz) - M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	147779.0	24629.8	1.21	.310
Within Groups	94	1921560.0	20442.1		
Total	100	2069339.0			

Mean Tone 0 = -218.9
Mean Tone 1 = -224.3
Mean Tone 2 = -266.8
Mean Tone 3 = -145.3
Mean Tone 4 = -124.8
Mean Tone 5 = -192.8
Mean Tone 6 = -184.6
Mean Overall = -21.60

N1 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	1649.0	274.8	2.18	.053
Within Groups	83	10472.0	126.2		
Total	89	12121.0			

Mean Tone 0 = -24.6
Mean Tone 1 = -21.2
Mean Tone 2 = -30.1
Mean Tone 3 = -27.0
Mean Tone 4 = -22.2
Mean Tone 5 = -16.1
Mean Tone 6 = -12.3
Mean Overall = -23.2

P2 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	718.4	119.7	1.09	.378
Within Groups	82	9048.1	110.3		
Total	88	9766.5			

Mean Tone 0 = 8.2
Mean Tone 1 = 10.7
Mean Tone 2 = 10.1
Mean Tone 3 = -1.0
Mean Tone 4 = 9.0
Mean Tone 5 = 9.5
Mean Tone 6 = 5.0
Mean Overall = 7.9

P3 Amp(Cz)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	212.4	35.4	.40	.875
Within Groups	53	4674.6	88.2		
Total	59	4887.0			

Mean Tone 0 = 7.5
Mean Tone 1 = 6.7
Mean Tone 2 = 4.0
Mean Tone 3 = 3.8
Mean Tone 4 = 7.4
Mean Tone 5 = 8.0
Mean Tone 6 = 1.3
Mean Overall = 6.5

Appendix E

Analysis of Variance and Duncan Multiple Range Test Summary Tables for Averaged Data Pooled Over:

1) All Ss
2) Males
3) Females

Table E.1

Oneway Analysis of Variance For Conditions For Averaged Data Over All Ss and Electrodes

CNV M1

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	287.0	143.5	1.53	.215
Within Groups	645	60348.1	93.6		
Total	647	60635.1			

Mean A1 = -5.7
Mean B = -7.3
Mean A2 = -6.1
Mean Overall = -6.4

CNV M2

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	745.4	372.7	7.23	.001
Within Groups	645	33526.3	51.6		
Total	647	34001.7			

Mean A1 = -11.5
Mean B = -13.4
Mean A2 = -10.8
Mean Overall = -11.9

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: B
Subset 2: A1;A2

CNV M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	1555.9	777.9	12.61	.000
Within Groups	645	39810.3	61.7		
Total	647	41366.3			

Mean A1 = -11.6
Mean B = -15.3
Mean A2 = -12.9
Mean Overall = -13.3

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: B
Subset 2: A1;A2

CNV M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	11358464.0	5679232.0	6.63	.002
Within Groups	645	552694016.0	856889.9		
Total	647	564052480.0			

Mean A1 = -143.9
Mean B = -172.2
Mean A2 = -144.3
Mean Overall = -153.4

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: B
Subset 2: A1;A2

N1 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	505.6	252.8	4.65	.010
Within Groups	645	35059.3	54.4		
Total	647	35564.9			

Mean A1 = -16.7
Mean B = -16.5
Mean A2 = -14.7
Mean Overall = -15.9

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: A1;B
Subset 2: A2

N1 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	640.0	320.0	1.56	.210
Within Groups	645	132884.0	206.0		
Total	647	133524.0			

Mean A1 = 141.0
Mean B = 143.4
Mean A2 = 142.3
Mean Overall = 142.2

P2 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	688.0	344.0	6.24	.002
Within Groups	645	35421.4	55.1		
Total	647	36109.4			

Mean A1 =12.4
Mean B =10.1
Mean A2 =10.4
Mean Overall =10.9

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: B; A2
Subset 2: A1

P2 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	1136.0	568.0	1.24	.291
Within Groups	643	295712.0	459.9		
Total	645	296848.0			

Mean A1 = 221.7
Mean B = 223.2
Mean A2 = 220.0
Mean Overall = 221.6

P3 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	820.6	410.3	5.89	.003
Within Groups	622	43271.4	69.6		
Total	624	44091.9			

Mean A1 = 9.5
Mean B = 6.9
Mean A2 = 7.2
Mean Overall = 7.9

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: B;A2
Subset 2: A1

P3 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	1824.0	912.0	.21	.815
Within Groups	622	2751920.0	4424.3		
Total	624	2753744.0			

Mean A1 = 397.2
Mean B = 393.0
Mean A2 = 394.7
Mean Overall = 394.9

Table E.2

Oneway Analysis of Variance For Electrodes For Averaged Data Over All $\underline{S}$s and Conditions

CNV M1

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	33073.1	16536.6	386.98	.000
Within Groups	645	27561.9	42.7		
Total	647	60635.1			

Mean Cz = -9.1
Mean Pz = 3.4
Mean Fz = -13.4
Mean Overall = -6.4

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: Cz
Subset 2: Pz
Subset 3: Fz

CNV M2

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	5240.2	2620.1	58.75	.000
Within Groups	645	28761.5	44.6		
Total	647	34001.7			

Mean Cz = -15.0
Mean Pz = -8.1
Mean Fz = -12.6
Mean Overall = -11.9

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: Cz
Subset 2: Pz
Subset 3: Fz

CNV M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	3617.4	1808.7	30.91	.000
Within Groups	645	37748.9	58.5		
Total	647	41366.3			

Mean Cz = -16.6
Mean Pz = -11.4
Mean Fz = -11.8
Mean Overall = -13.3

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: Cz
Subset 2: Pz;Fz

CNV M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	139031040.	69515520.0	105.49	.000
Within Groups	645	425022976.0	658950.3		
Total	647	564052480.0			

Mean Cz = -195.3
Mean Pz = -88.9
Mean Fz = -176.2
Mean Overall = -153.4

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: Cz
Subset 2: Pz
Subset 3: Fz

N1 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	4527.6	2263.8	47.04	.000
Within Groups	645	31037.3	48.1		
Total	647	35564.9			

Mean Cz = -19.7
Mean Pz = -13.7
Mean Fz = -14.6
Mean Overall = -16.0

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: Cz
Subset 2: Pz;Fz

N1 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	18189.0	9094.5	50.86	.000
Within Groups	645	115335.0	178.8		
Total	647	133524.0			

Mean Cz = 142.4
Mean Pz = 135.7
Mean Fz = 148.6
Mean Overall = 142.2

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: Cz
Subset 2: Pz
Subset 3: Fz

P2 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	2802.7	1401.3	27.05	.000
Within Groups	643	33306.7	51.8		
Total	645	36109.4			

Mean Cz = 12.0
Mean Pz = 12.8
Mean Fz = 8.0
Mean Overall = 10.94

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: Cz;Pz
Subset 2: Fz

P2 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	1040.0	520.0	1.13	.324
Within Groups	643	295824.0	460.0		
Total	645	296848.0			

Mean Cz = 219.9
Mean Pz = 222.6
Mean Fz = 222.5
Mean Overall = 221.6

P3 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	12386.7	6193.3	121.59	.000
Within Groups	622	31705.3	50.9		
Total	624	44091.9			

Mean Cz = 4.4
Mean Pz = 14.0
Mean Fz = 5.0
Mean Overall = 7.9

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: Cz;Fz
Subset 2: Pz

P3 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	100352.0	50176.0	11.76	.000
Within Groups	622	2653488.0	4266.1		
Total	624	2753744.0			

Mean Cz = 403.6
Mean Pz = 404.0
Mean Fz = 376.8
Mean Overall = 394.9

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.

Subset 1: Cz;Pz
Subset 2: Fz

Table E.3

Oneway Analysis of Variance For Sex Diff. For Averaged Data Over All Conds. and Electrodes

CNV M1

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	1	589.6	589.6	6.34	.012
Within Groups	646	60045.5	92.9		
Total	647	60635.1			

Mean Male = -5.7
Mean Female = -5.6
Mean Overall = -6.4

CNV M2

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	1	624.3	624.3	12.18	.001
Within Groups	646	33377.4	51.6		
Total	647	34001.7			

Mean Male = -10.7
Mean Female = -12.7
Mean Overall = -11.9

CNV M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	1	1967.4	1967.4	32.25	.000
Within Groups	646	39398.8	60.9		
Total	647	41366.3			

Mean Male = -11.1
Mean Female = -14.6
Mean Overall = -13.3

CNV N4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	1	8655616.0	8655616.0	10.07	.002
Within Groups	646	555389924.0	859736.8		
Total	647	564052480.0			

Mean Male = -139.0
Mean Female = -162.7
Mean Overall = -153.4

N1 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	1	213.3	213.3	3.89	.046
Within Groups	646	35351.7	54.8		
Total	647	35564.9			

Mean Male = -15.3
Mean Female = -16.4
Mean Overall = -15.9

N1 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	1	1605.0	1605.0	7.86	.005
Within Groups	646	131920.0	204.2		
Total	647	133524.0			

Mean Male = 144.2
Mean Female = 140.9
Mean Overall = 142.2

P2 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	1	49.12	49.12	0.87	.352
Within Groups	646	36060.3	55.9		
Total	647	36109.4			

Mean Male = 11.3
Mean Female = 10.7
Mean Overall = 10.9

P2 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	1	1888.04	1888.0	4.15	.041
Within Groups	644	295648.0	459.9		
Total	645	297536.0			

Mean Male = 219.5
Mean Female = 223.0
Mean Overall = 221.6

P3 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	1	277.9	277.9	3.96	.045
Within Groups	623	43814.1	70.3		
Total	624	44091.9			

Mean Male = 7.0
Mean Female = 8.4
Mean Overall = 7.9

P3 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	1	605520.0	605520.0	175.42	.000
Within Groups	623	2150528.0	3451.9		
Total	624	2756048.0			

Mean Male = 356.2
Mean Female = 419.9
Mean Overall = 394.9

Table E.4

Oneway Analysis of Variance For Conditions For Averaged Data Over All Male Ss and Electrodes

CNV M1

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	61.8	30.9	.36	.700
Within Groups	249	21103.8	84.7		
Total	251	21165.6			

Mean A1 = -6.9
Mean B = -8.1
Mean A2 = -7.8
Mean Overall = -7.6

CNV M2

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	62.2	31.1	.77	.466
Within Groups	249	9996.8	40.1		
Total	251	10058.1			

Mean A1 = -10.3
Mean B = -11.4
Mean A2 = -10.7
Mean Overall = -10.7

CNV M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	328.7	164.4	3.82	.023
Within Groups	249	10687.4	42.9		
Total	251	11016.1			

Mean A1 = -9.6
Mean B = -12.4
Mean A2 = -11.3
Mean Overall = -11.1

CNV M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	1952000.0	967000.0	1.53	.209
Within Groups	249	155226624.0	623400.0		
Total	251	157178624.0			

Mean A1 = -127.6
Mean B = -149.1
Mean A2 = -140.1
Mean Overall = -139.0

N1 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	167.7	83.9	1.19	.308
Within Groups	249	17621.9	70.8		
Total	251	17789.7			

Mean A1 = -16.0
Mean B = -15.6
Mean A2 = -14.1
Mean Overall = -15.3

N1 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	1091.0	545.5	2.99	.050
Within Groups	249	45327.0	182.0		
Total	251	46418.0			

Mean A1 = 141.3
Mean B = 145.1
Mean A2 = 146.2
Mean Overall = 144.2

P2 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	603.6	301.8	65.68	.004
Within Groups	249	13232.8	53.2		
Total	251	13836.3			

Mean A1 =13.3
Mean B =9.5
Mean A2 =11.0
Mean Overall =11.3

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: B; A2
Subset 2: A1

P2 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	129.0	64.5	.34	.711
Within Groups	249	46094.0	185.1		
Total	251	46223.0			

Mean A1 = 220.3
Mean B = 218.6
Mean A2 = 219.6
Mean Overall = 219.5

P3 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	339.3	169.6	3.66	.027
Within Groups	242	11213.4	46.3		
Total	244	11552.7			

Mean A1 = 8.7
Mean B = 6.2
Mean A2 = 6.2
Mean Overall = 7.0

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: B;A2
Subset 2: A1

P3 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	1232.0	616.0	.73	.486
Within Groups	242	203648.0	841.5		
Total	244	204880.0			

Mean A1 = 359.3
Mean B = 354.5
Mean A2 = 354.7
Mean Overall = 356.2

Table E.5

Oneway Analysis of Variance For Electrodes For Averaged Data Over All Male Ss and Conditions

CNV M1

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	11212.9	5606.5	140.38	.000
Within Groups	249	9952.6	39.9		
Total	251	21165.6			

Mean Cz = -10.1
Mean Pz = 1.5
Mean Fz = -14.2
Mean Overall = -7.6

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: Cz
Subset 2: Pz
Subset 3: Fz

CNV M2

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	1803.6	901.8	27.26	.000
Within Groups	249	8255.4	33.2		
Total	251	10058.9			

Mean Cz = -14.1
Mean Pz = -7.6
Mean Fz = -10.3
Mean Overall = -10.7

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: Cz
Subset 2: Pz
Subset 3: Fz

CNV M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	1897.7	948.9	325.91	.000
Within Groups	249	9118.4	36.6		
Total	251	11016.1			

Mean Cz = -14.8
Mean Pz = -10.0
Mean Fz = -8.4
Mean Overall = -11.1

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: Cz
Subset 2: Pz;Fz

CNV M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	41625600.0	20812800.0	44.85	.000
Within Groups	249	115550720.0	464059.1		
Total	251	157176320.0			

Mean Cz = -183.0
Mean Pz = -84.9
Mean Fz = -148.9
Mean Overall = -138.9

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: Cz
Subset 2: Pz
Subset 3: Fz

N1 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	2394.3	1197.1	19.44	.000
Within Groups	249	15395.4	61.8		
Total	251	17789.6			

Mean Cz = -19.5
Mean Pz = -13.9
Mean Fz = -12.4
Mean Overall = -15.3

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: Cz
Subset 2: Pz;Fz

N1 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	13735.0	6867.5	52.32	.000
Within Groups	249	32683.0	131.3		
Total	251	46418.0			

Mean Cz = 144.8
Mean Pz = 134.9
Mean Fz = 152.9
Mean Overall = 144.2

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: Cz
Subset 2: Pz
Subset 3: Fz

P2 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	967.9	483.9	9.36	.000
Within Groups	249	12868.3	51.7		
Total	251	13836.3			

Mean Cz = 11.4
Mean Pz = 13.6
Mean Fz = 8.8
Mean Overall = 11.3

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: Cz
Subset 2: Pz
Subset 3: Fz

P2 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	283.0	141.5	.77	.469
Within Groups	249	45942.0	184.5		
Total	251	46225.0			

Mean Cz = 218.2
Mean Pz = 219.4
Mean Fz = 220.8
Mean Overall = 219.5

P3 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	3765.6	1882.6	58.59	.000
Within Groups	242	7787.4	32.2		
Total	244	11552.7			

Mean Cz = 3.7
Mean Pz = 12.4
Mean Fz = 4.8
Mean Overall = 7.0

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: Cz;Fz
Subset 2: Pz

P3 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	480.0	240.0	.28	.756
Within Groups	242	204416.0	844.7		
Total	244	204896.0			

Mean Cz = 356.8
Mean Pz = 354.3
Mean Fz = 357.5
Mean Overall = 356.2

Table E.6

Oneway Analysis of Variance For Conditions For Averaged Data Over All Female Ss and Electrodes

CNV M1

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	272.1	136.0	1.38	.250
Within Groups	393	38607.8	98.3		
Total	395	38879.9			

Mean A1 = -5.0
Mean B = -6.8
Mean A2 = -5.1
Mean Overall = -5.6

CNV M2

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	838.6	419.3	7.33	.001
Within Groups	393	22479.9	57.2		
Total	395	23318.4			

Mean A1 = -12.3
Mean B = -14.6
Mean A2 = -11.1
Mean Overall = -12.7

Significant ($p<.05$) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: B
Subset 2: A1;A2

CNV M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	1367.4	683.7	9.95	.000
Within Groups	393	27015.3	68.7		
Total	395	28382.7			

Mean A1 = -12.9
Mean B = -17.2
Mean A2 = -13.9
Mean Overall = -14.7

Significant ($p<.05$) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: B
Subset 2: A1;A2

CNV M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	11922432.0	5961216.0	6.06	.003
Within Groups	393	386307584.0	982970.9		
Total	395	398230016.0			

Mean A1 = -154.2
Mean B = -186.8
Mean A2 = -146.9
Mean Overall = -162.7

Significant ($p<.05$) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: B
Subset 2: A1;A2

N1 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	344.3	172.2	3.93	.020
Within Groups	393	17217.7	43.8		
Total	395	17562.0			

Mean A1 = -17.1
Mean B = -17.1
Mean A2 = -15.1
Mean Overall = -16.4

Significant ($p<.05$) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: A1;B
Subset 2: A2

N1 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	449.0	224.5	1.04	.357
Within Groups	393	85049.0	216.4		
Total	395	85498.0			

Mean A1 = 140.8
Mean B = 142.4
Mean A2 = 139.8
Mean Overall = 141.0

P2 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	244.4	122.2	2.17	.113
Within Groups	391	21979.5	56.2		
Total	393	22223.9			

Mean A1 =11.8
Mean B =10.4
Mean A2 =10.0
Mean Overall =10.9

P2 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	2336.0	1168.0	1.85	.156
Within Groups	391	246400.0	630.2		
Total	393	248736.0			

Mean A1 = 222.5
Mean B = 226.2
Mean A2 = 220.3
Mean Overall = 223.0

P3 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	482.5	241.2	2.86	.057
Within Groups	377	31778.9	84.3		
Total	379	32261.4			

Mean A1 = 9.9
Mean B = 7.4
Mean A2 = 7.8
Mean Overall = 8.4

P3 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	1392.0	696.0	.13	.870
Within Groups	377	1940656.0	5147.6		
Total	379	1942048.0			

Mean A1 = 421.0
Mean B = 417.3
Mean A2 = 421.7
Mean Overall = 420.0

Table E.7

Oneway Analysis of Variance For Electrodes For Averaged Data Over All Female Ss and Conditions

CNV M1

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	21952.8	10976.4	254.88	.000
Within Groups	393	16927.1	43.0		
Total	395	38879.9			

Mean Cz = -8.5
Mean Pz = 4.6
Mean Fz = -13.0
Mean Overall = -5.6

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: Cz
Subset 2: Pz
Subset 3: Fz

CNV M2

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	3652.7	1826.4	36.48	.000
Within Groups	393	19665.7	50.0		
Total	395	23318.4			

Mean Cz = -15.6
Mean Pz = -8.5
Mean Fz = -14.0
Mean Overall = -12.7

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: Cz;Fz
Subset 2: Pz

CNV M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	2075.3	1037.7	15.50	.000
Within Groups	393	26307.4	66.9		
Total	395	28382.7			

Mean Cz = -17.7
Mean Pz = -12.2
Mean Fz = -14.1
Mean Overall = -14.7

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: Cz
Subset 2: Pz;Fz

CNV M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	101256960.	50628480.0	66.99	.000
Within Groups	393	296974848.0	755661.2		
Total	395	398231808.0			

Mean Cz = -203.1
Mean Pz = -91.4
Mean Fz = -193.6
Mean Overall = -162.7

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: Cz;Fz
Subset 2: Pz

N1 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	2587.9	1293.9	33.96	.000
Within Groups	393	14974.1	38.1		
Total	395	17562.0			

Mean Cz = -19.8
Mean Pz = -13.6
Mean Fz = -16.0
Mean Overall = -16.4

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: Cz
Subset 2: Pz
Subset 3: Fz

N1 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	6272.0	3136.0	15.56	.000
Within Groups	393	79228.0	201.6		
Total	395	85500.0			

Mean Cz = 140.8
Mean Pz = 136.2
Mean Fz = 145.9
Mean Overall = 141.0

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: Cz
Subset 2: Pz
Subset 3: Fz

P2 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	2022.7	1011.4	19.58	.000
Within Groups	391	20201.2	51.7		
Total	393	22223.9			

Mean Cz = 12.4
Mean Pz = 12.3
Mean Fz = 7.5
Mean Overall = 10.7

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: Cz;Pz
Subset 2: Fz

P2 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	944.0	472.0	.75	.480
Within Groups	391	247792.0	633.7		
Total	393	248736.0			

Mean Cz = 220.9
Mean Pz = 224.6
Mean Fz = 223.5
Mean Overall = 223.0

P3 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	8766.6	4383.3	70.33	.000
Within Groups	377	23494.8	62.3		
Total	379	32261.4			

Mean Cz = 4.8
Mean Pz = 15.1
Mean Fz = 5.1
Mean Overall = 8.4

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: Cz;Fz
Subset 2: Pz

P3 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	162512.0	81256.0	17.21	.000
Within Groups	377	1779520.0	4720.2		
Total	379	1942032.0			

Mean Cz = 432.1
Mean Pz = 436.1
Mean Fz = 390.0
Mean Overall = 420.0

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: Cz;Pz
Subset 2: Fz

Table E.8

Oneway Analysis of Variance For Conditions For Averaged Fz Data Over All Ss

CNV M1

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	154.0	77.0	1.75	.174
Within Groups	213	9370.3	43.9		
Total	215	9524.4			

Mean A1 = -12.9
Mean B = -14.6
Mean A2 = -12.8
Mean Overall = -13.4

CNV M2

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	151.7	75.8	1.52	.218
Within Groups	213	10587.6	49.7		
Total	215	10739.3			

Mean A1 = -11.8
Mean B = -13.7
Mean A2 = -12.2
Mean Overall = -12.6

CNV M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	237.5	118.7	1.75	.175
Within Groups	213	14481.2	67.9		
Total	215	14718.7			

Mean A1 = -10.6
Mean B = -13.2
Mean A2 = -11.7
Mean Overall = -11.8

CNV M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	2655232.0	1327616.0	1.87	.154
Within Groups	213	151310848.0	710379.6		
Total	215	153966080.0			

Mean A1 = -165.1
Mean B = -191.3
Mean A2 = -172.1
Mean Overall = -176.2

N1 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	161.3	80.7	1.84	.159
Within Groups	213	9346.6	43.9		
Total	215	9507.9			

Mean A1 = -15.2
Mean B = -15.2
Mean A2 = -13.4
Mean Overall = -14.6

N1 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	576.0	288.0	1.13	.327
Within Groups	213	54519.0	255.9		
Total	215	55095.0			

Mean A1 = 146.4
Mean B = 149.5
Mean A2 = 150.0
Mean Overall = 148.6

P2 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	268.0	134.0	2.38	.093
Within Groups	211	11883.8	56.3		
Total	213	12151.8			

Mean A1 =9.6
Mean B =7.2
Mean A2 =7.3
Mean Overall =8.0

P2 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	58.0	29.0	.07	.924
Within Groups	211	88494.0	419.4		
Total	213	88552.0			

Mean A1 = 222.2
Mean B = 223.2
Mean A2 = 222.0
Mean Overall = 222.5

P3 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	263.0	131.5	2.31	.100
Within Groups	202	11510.5	56.9		
Total	204	11773.5			

Mean A1 = 6.5
Mean B = 4.3
Mean A2 = 4.0
Mean Overall = 4.9

P3 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	5200.0	2600.0	.89	.415
Within Groups	202	590768.0	2924.6		
Total	204	595968.0			

Mean A1 = 382.5
Mean B = 370.3
Mean A2 = 377.8
Mean Overall = 376.8

Table E.9

Oneway Analysis of Variance For Conditions For Averaged Cz Data Over All Ss

CNV M1

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	214.8	107.4	2.52	.081
Within Groups	213	9093.1	42.7		
Total	215	9307.8			

Mean A1 = -8.1
Mean B = -10.5
Mean A2 = -8.8
Mean Overall = -9.1

CNV M2

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	451.4	225.7	4.91	.008
Within Groups	213	9783.5	45.9		
Total	215	10234.9			

Mean A1 = -14.4
Mean B = -17.0
Mean A2 = -13.6
Mean Overall = -15.0

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: B
Subset 2: A1;A2

CNV M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	925.6	462.8	7.53	.001
Within Groups	213	13092.2	61.7		
Total	215	14017.8			

Mean A1 = -14.3
Mean B = -19.3
Mean A2 = -16.2
Mean Overall = -16.6

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: B
Subset 2: A1;A2

CNV M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	7241472.0	3620736.0	5.15	.007
Within Groups	213	149499392.0	701875.1		
Total	215	156740864.0			

Mean A1 = -181.1
Mean B = -221.1
Mean A2 = -183.5
Mean Overall = -195.2

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: B
Subset 2: A1;A2

N1 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	318.7	159.3	2.97	.052
Within Groups	213	11419.6	53.6		
Total	215	11738.3			

Mean A1 = -20.6
Mean B = -20.5
Mean A2 = -17.9
Mean Overall = -19.7

N1 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	135.0	67.5	.67	.517
Within Groups	213	21411.0	100.5		
Total	215	21546.0			

Mean A1 = 141.8
Mean B = 143.4
Mean A2 = 141.8
Mean Overall = 142.4

P2 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	314.6	157.3	2.84	.059
Within Groups	213	11784.4	55.3		
Total	215	12098.9			

Mean A1 =13.6
Mean B =10.7
Mean A2 =11.6
Mean Overall =11.9

P2 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	194.0	97.0	.28	.757
Within Groups	213	72882.0	342.2		
Total	215	73076.0			

Mean A1 = 220.3
Mean B = 220.8
Mean A2 = 218.5
Mean Overall = 219.9

P3 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	410.7	205.4	4.87	.009
Within Groups	203	8561.2	42.2		
Total	205	8971.9			

Mean A1 = 6.2
Mean B = 2.9
Mean A2 = 3.9
Mean Overall = 4.4

Significant ($p<.05$) A Posteriori Cpntrasts: Homogenous Subsets using Duncan Range Test.

Subset 1: B;A2
Subset 2: A1

P3 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	176.0	88.0	.02	.970
Within Groups	203	1007248.0	44961.8		
Total	205	1007424.0			

Mean A1 = 403.5
Mean B = 402.4
Mean A2 = 404.7
Mean Overall = 403.6

Table E.10

Oneway Analysis of Variance For Conditions For Averaged Pz Data Over All <u>S</u>s

CNV M1

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	22.1	11.1	.27	.766
Within Groups	213	8707.6	40.9		
Total	215	8729.8			

Mean A1 = 3.8
Mean B = 3.2
Mean A2 = 3.1
Mean Overall = 3.4

CNV M2

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	260.9	130.4	3.69	.026
Within Groups	213	7526.4	35.3		
Total	215	7787.3			

Mean A1 = -8.4
Mean B = -9.4
Mean A2 = -6.7
Mean Overall = -8.19

Significant ($p<.05$) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: B;A1
Subset 2: A1;A2

CNV M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	518.8	259.4	6.51	.002
Within Groups	213	8493.6	39.9		
Total	215	9012.4			

Mean A1 = -9.9
Mean B = -13.5
Mean A2 = -10.7
Mean Overall = -11.4

Significant ($p<.05$) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: B
Subset 2: A1;A2

CNV M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	2722976.0	1361488.0	2.59	.075
Within Groups	213	111614096.0	524009.8		
Total	215	114337072.0			

Mean A1 = -85.3
Mean B = -104.0
Mean A2 = -77.1
Mean Overall = -88.8

N1 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	79.4	39.6	.87	.423
Within Groups	213	9711.6	45.6		
Total	215	9790.9			

Mean A1 = -14.4
Mean B = -13.8
Mean A2 = -12.9
Mean Overall = -13.7

N1 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	270.0	135.0	.75	.479
Within Groups	213	38431.0	180.4		
Total	215	38701.0			

Mean A1 = 134.9
Mean B = 137.3
Mean A2 = 134.9
Mean Overall = 135.8

P2 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	147.4	73.7	1.76	.172
Within Groups	213	8908.4	41.8		
Total	215	9055.8			

Mean A1 =13.9
Mean B =12.3
Mean A2 =12.2
Mean Overall =12.8

P2 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	1396.0	698.0	1.12	.329
Within Groups	213	132792.0	623.4		
Total	215	134188.0			

Mean A1 = 222.5
Mean B = 225.7
Mean A2 = 219.4
Mean Overall = 222.6

P3 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	228.5	114.2	2.24	.106
Within Groups	211	10731.4	50.9		
Total	213	10959.8			

Mean A1 = 15.5
Mean B = 13.5
Mean A2 = 13.1
Mean Overall = 14.0

P3 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	816.0	408.0	.08	.914
Within Groups	211	1048640.0	4969.9		
Total	213	1049456.0			

Mean A1 = 404.9
Mean B = 405.8
Mean A2 = 401.3
Mean Overall = 404.0

Table E.11

Oneway Analysis of Variance For Conditions For Averaged Fz Data Over All Males Ss

CNV M1

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	18.0	9.0	.18	.838
Within Groups	81	4142.3	51.1		
Total	83	4160.3			

Mean A1 = -13.5
Mean B = -14.5
Mean A2 = -14.5
Mean Overall = -14.2

CNV M2

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	27.7	13.9	.40	.677
Within Groups	81	2802.6	34.6		
Total	83	2830.3			

Mean A1 = -9.6
Mean B = -10.1
Mean A2 = -11.1
Mean Overall = -10.3

CNV M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	37.9	18.9	.43	.655
Within Groups	81	3539.8	43.7		
Total	83	3577.5			

Mean A1 = -7.5
Mean B = -9.1
Mean A2 = -8.6
Mean Overall = -8.4

CNV M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	770864.0	385432.0	.77	.470
Within Groups	81	40496896.0	385432.0		
Total	83	41267760.0			

Mean A1 = -136.3
Mean B = -150.8
Mean A2 = -159.5
Mean Overall = -148.9

N1 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	25.5	12.8	.20	.816
Within Groups	81	5062.7	62.5		
Total	837	5088.2			

Mean A1 = -12.6
Mean B = -12.9
Mean A2 = -11.6
Mean Overall = -12.4

N1 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	1154.0	577.0	2.40	.094
Within Groups	81	19400.0	239.5		
Total	83	20554.0			

Mean A1 = 148.5
Mean B = 152.6
Mean A2 = 157.6
Mean Overall = 152.9

P2 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	391.9	195.9	3.68	.029
Within Groups	81	4313.1	53.2		
Total	83	4704.9			

Mean A1 =11.9
Mean B =7.1
Mean A2 =7.5
Mean Overall =8.8

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: B; A2
Subset 2: A1

P2 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	77.0	38.5	.16	.853
Within Groups	81	19937.0	246.1		
Total	83	20014.0			

Mean A1 = 222.1
Mean B = 220.6
Mean A2 = 219.8
Mean Overall = 220.8

P3 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	63.8	31.9	.93	.401
Within Groups	80	2741.4	34.3		
Total	82	2805.2			

Mean A1 = 6.0
Mean B = 4.4
Mean A2 = 3.9
Mean Overall = 4.8

P3 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	1201.0	600.5	.92	.406
Within Groups	80	52362.0	654.5		
Total	82	53563.0			

Mean A1 = 362.1
Mean B = 357.8
Mean A2 = 352.7
Mean Overall = 357.5

Table E.12

Oneway Analysis of Variance For Conditions For Averaged Cz Data Over All Male Ss

CNV M1

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	45.0	22.5	.44	.649
Within Groups	81	4114.5	50.7		
Total	83	4159.6			

Mean A1 = -9.1
Mean B = -10.8
Mean A2 = -10.4
Mean Overall = -10.1

CNV M2

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	48.6	24.3	.59	.558
Within Groups	81	3294.2	40.6		
Total	83	3342.8			

Mean A1 = -13.8
Mean B = -15.2
Mean A2 = -13.4
Mean Overall = -14.1

CNV M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	184.1	92.0	2.18	.117
Within Groups	81	3420.9	42.2		
Total	83	3604.9			

Mean A1 = -12.8
Mean B = -16.3
Mean A2 = -15.4
Mean Overall = -14.8

CNV M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	1061888.0	530944.0	.85	.433
Within Groups	81	50483200.0	623249.4		
Total	83	51545088.0			

Mean A1 = -169.3
Mean B = -196.9
Mean A2 = -182.6
Mean Overall = -183.0

N1 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	82.9	41.5	.64	.535
Within Groups	81	5253.9	64.9		
Total	83	5336.8			

Mean A1 = -20.3
Mean B = -20.2
Mean A2 = -18.1
Mean Overall = -19.5

N1 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	186.0	93.0	1.53	.221
Within Groups	81	4925.0	60.8		
Total	83	5111.0			

Mean A1 = 142.8
Mean B = 146.4
Mean A2 = 145.2
Mean Overall = 144.8

P2 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	213.6	106.8	1.74	.179
Within Groups	81	4958.4	61.2		
Total	83	5172.0			

Mean A1 =13.1
Mean B =9.3
Mean A2 =11.8
Mean Overall =11.4

P2 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	89.0	44.5	.26	.771
Within Groups	81	13619.0	168.0		
Total	83	13699.0			

Mean A1 = 219.6
Mean B = 217.0
Mean A2 = 218.1
Mean Overall = 218.2

P3 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	200.9	100.5	2.80	.065
Within Groups	75	2688.7	35.8		
Total	77	2688.7			

Mean A1 = 5.9
Mean B = 2.7
Mean A2 = 2.3
Mean Overall = 3.7

P3 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	432.0	216.0	.23	.797
Within Groups	75	70452.0	939.4		
Total	77	70884.0			

Mean A1 = 359.5
Mean B = 353.8
Mean A2 = 357.1
Mean Overall = 356.7

Table E.13

Oneway Analysis of Variance For Conditions For Averaged Pz Data Over All Male Ss

CNV M1

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	7.9	3.9	.19	.822
Within Groups	81	1624.9	20.1		
Total	83	1632.8			

Mean A1 = 1.9
Mean B = 1.2
Mean A2 = 1.5
Mean Overall = 1.5

CNV M2

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	80.9	40.4	1.63	.199
Within Groups	81	2001.4	24.7		
Total	83	2082.2			

Mean A1 = -7.5
Mean B = -8.6
Mean A2 = -6.5
Mean Overall = -7.6

CNV M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	145.2	72.6	3.28	.041
Within Groups	81	1790.6	22.1		
Total	83	1935.8			

Mean A1 = -8.5
Mean B = -11.7
Mean A2 = -9.9
Mean Overall = -10.4

Significant ($p<.05$) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: B;A2
Subset 2: A1;A2

CNV M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	890048.0	445024.0	1.65	.197
Within Groups	81	21850064.0	269753.9		
Total	837	22740112.0			

Mean A1 = -77.2
Mean B = -99.5
Mean A2 = -78.1
Mean Overall = -84.9

N1 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	93.4	46.7	.77	.467
Within Groups	81	4876.8	60.2		
Total	83	4970.3			

Mean A1 = -15.2
Mean B = -13.7
Mean A2 = -12.6
Mean Overall = -13.9

N1 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	232.0	116.0	1.39	.253
Within Groups	81	6741.0	83.2		
Total	83	6973.0			

Mean A1 = 132.5
Mean B = 136.3
Mean A2 = 135.7
Mean Overall = 134.9

P2 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	101.8	50.9	1.42	.245
Within Groups	81	2889.5	35.7		
Total	83	2991.3			

Mean A1 =14.9
Mean B =12.2
Mean A2 =13.8
Mean Overall =13.6

P2 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	104.0	52.0	.35	.712
Within Groups	81	12125.0	149.7		
Total	83	12229.0			

Mean A1 = 219.4
Mean B = 218.1
Mean A2 = 220.8
Mean Overall = 219.4

P3 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	109.9	54.9	2.25	.110
Within Groups	81	1982.6	24.5		
Total	83	2092.6			

Mean A1 = 14.0
Mean B = 11.5
Mean A2 = 11.8
Mean Overall = 12.4

P3 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	302.0	151.0	.15	.856
Within Groups	81	79606.0	982.8		
Total	83	79908.0			

Mean A1 = 356.5
Mean B = 351.9
Mean A2 = 354.6
Mean Overall = 354.4

Table E.14

Oneway Analysis of Variance For Conditions For Averaged Fz Data Over All Female Ss

CNV M1

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	206.6	103.3	2.62	.075
Within Groups	129	5081.3	39.4		
Total	131	5287.9			

Mean A1 = -12.5
Mean B = -14.7
Mean A2 = -11.7
Mean Overall = -12.9

CNV M2

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	277.7	138.9	2.58	.078
Within Groups	129	6945.2	53.8		
Total	131	7222.9			

Mean A1 = -13.1
Mean B = -16.0
Mean A2 = -12.8
Mean Overall = -13.9

CNV M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	228.6	114.3	1.59	.205
Within Groups	129	9263.9	71.7		
Total	131	9482.6			

Mean A1 = -12.6
Mean B = -15.8
Mean A2 = -13.7
Mean Overall = -14.1

CNV M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	3681024.0	1840512.0	2.40	.092
Within Groups	129	98790400.0	765817.0		
Total	131	102471424.0			

Mean A1 = -183.4
Mean B = -217.0
Mean A2 = -180.1
Mean Overall = -193.5

N1 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	152.2	76.1	2.72	.068
Within Groups	129	3606.8	27.9		
Total	131	3758.9			

Mean A1 = -16.8
Mean B = -16.6
Mean A2 = -14.4
Mean Overall = -15.9

N1 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	191.0	95.5	.39	.685
Within Groups	129	31841.0	246.0		
Total	131	32032.0			

Mean A1 = 144.9
Mean B = 147.6
Mean A2 = 145.2
Mean Overall = 145.9

P2 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	26.9	13.5	.23	.794
Within Groups	127	7327.6	57.7		
Total	129	7354.5			

Mean A1 =8.1
Mean B =7.2
Mean A2 =7.2
Mean Overall =7.5

P2 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	158.0	79.0	.15	.860
Within Groups	127	68003.0	535.5		
Total	129	68161.0			

Mean A1 = 222.2
Mean B = 224.8
Mean A2 = 223.5
Mean Overall = 223.5

P3 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	207.5	103.8	1.41	.247
Within Groups	119	8765.6	73.6		
Total	121	8963.2			

Mean A1 = 6.9
Mean B = 4.2
Mean A2 = 4.1
Mean Overall = 5.1

P3 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	8112.0	4056.0	1.00	.372
Within Groups	119	482080.0	4051.1		
Total	121	490192.0			

Mean A1 = 395.6
Mean B = 378.7
Mean A2 = 396.2
Mean Overall = 389.9

Table E.15

Oneway Analysis of Variance For Conditions For Averaged Cz Data Over All Female Ss

CNV M1

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	202.0	101.0	2.71	.069
Within Groups	129	4810.9	37.3		
Total	131	5012.9			

Mean A1 = -7.5
Mean B = -10.3
Mean A2 = -7.7
Mean Overall = -8.5

CNV M2

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	468.4	234.2	4.78	.010
Within Groups	129	6311.3	48.9		
Total	131	6779.7			

Mean A1 = -14.9
Mean B = -18.2
Mean A2 = -13.7
Mean Overall = -15.6

Significant ($p<.05$) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: B
Subset 2: A1;A2

CNV M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	854.1	427.0	6.03	.003
Within Groups	129	9134.6	70.8		
Total	131	9988.6			

Mean A1 = -15.2
Mean B = -21.2
Mean A2 = -16.7
Mean Overall = -17.7

Significant ($p<.05$) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: B
Subset 2: A1;A2

CNV M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	7427072.0	3713536.0	5.06	.008
Within Groups	129	95702528.0	741880.0		
Total	131	103129600.0			

Mean A1 = -188.5
Mean B = -236.5
Mean A2 = -184.3
Mean Overall = -203.1

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: B
Subset 2: A1;A2

N1 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	242.5	121.2	2.54	.081
Within Groups	129	6156.2	47.7		
Total	131	6398.7			

Mean A1 = -20.7
Mean B = -20.7
Mean A2 = -17.9
Mean Overall = -19.8

N1 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	82.0	41.0	.34	.716
Within Groups	129	15505.0	120.0		
Total	131	15587.0			

Mean A1 = 141.0
Mean B = 141.5
Mean A2 = 139.7
Mean Overall = 140.8

P2 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	157.8	78.9	1.51	.222
Within Groups	129	6720.7	52.1		
Total	131	6878.5			

Mean A1 =13.9
Mean B =11.6
Mean A2 =11.5
Mean Overall =12.4

P2 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	406.0	203.0	.45	.646
Within Groups	129	58595.0	454.2		
Total	131	59001.0			

Mean A1 = 220.7
Mean B = 223.2
Mean A2 = 218.8
Mean Overall = 220.9

P3 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	260.3	130.2	2.83	.061
Within Groups	125	5757.8	46.1		
Total	127	6018.1			

Mean A1 = 6.5
Mean B = 3.0
Mean A2 = 4.9
Mean Overall = 4.8

P3 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	368.0	184.0	.03	.954
Within Groups	125	661440.0	5291.5		
Total	127	661808.0			

Mean A1 = 430.6
Mean B = 431.4
Mean A2 = 434.5
Mean Overall = 432.1

Table E.16

Oneway Analysis of Variance For Conditions For Averaged Pz Data Over All Female Ss

CNV M1

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	19.3	9.6	.19	.828
Within Groups	129	6606.9	51.2		
Total	131	6626.2			

Mean A1 = 5.1
Mean B = 4.5
Mean A2 = 4.1
Mean Overall = 4.6

CNV M2

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	189.9	94.9	2.24	.109
Within Groups	129	5663.1	42.4		
Total	131	5663.0			

Mean A1 = -8.9
Mean B = -9.7
Mean A2 = -6.8
Mean Overall = -8.5

CNV M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	398.5	199.2	3.99	.020
Within Groups	129	6437.1	49.9		
Total	131	6836.0			

Mean A1 = -10.8
Mean B = -14.6
Mean A2 = -11.2
Mean Overall = -12.2

Significant ($p<.05$) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: B
Subset 2: A1;A2

CNV M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	2026144.0	1013072.0	1.46	.234
Within Groups	129	89359936.0	692712.6		
Total	131	91386080.0			

Mean A1 = -90.5
Mean B = -106.9
Mean A2 = -76.5
Mean Overall = -91.3

N1 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	18.0	9.0	.24	.787
Within Groups	129	4798.3	37.2		
Total	131	4816.4			

Mean A1 = -13.8
Mean B = -13.8
Mean A2 = -13.0
Mean Overall = -13.5

N1 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	270.0	135.0	.56	.581
Within Groups	129	31351 0	243.0		
Total	131	31621.0			

Mean A1 = 136.3
Mean B = 137.8
Mean A2 = 134.4
Mean Overall = 136.2

P2 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	113.8	56.9	1.25	.289
Within Groups	129	5864.4	45.4		
Total	131	5968.2			

Mean A1 =13.4
Mean B =12.3
Mean A2 =11.1
Mean Overall =12.3

P2 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	3133.0	1566.5	1.72	.181
Within Groups	129	117458.0	910.5		
Total	131	120591.0			

Mean A1 = 224.6
Mean B = 230.5
Mean A2 = 218.6
Mean Overall = 224.6

P3 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	128.8	64.4	.97	.381
Within Groups	127	8384.8	66.0		
Total	129	8513.5			

Mean A1 = 16.4
Mean B = 14.8
Mean A2 = 13.9
Mean Overall = 15.1

P3 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	1280.0	640.0	.13	.875
Within Groups	127	626816.0	4935.6		
Total	129	628096.0			

Mean A1 = 435.8
Mean B = 440.1
Mean A2 = 432.4
Mean Overall = 436.1

Table E.17

Oneway Analysis of Variance of Avg. Data For Tones

CNV M1

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	262.0	43.7	.53	.790
Within Groups	371	30802.1	83.0		
Total	377	31064.1			

Mean Tone 0 = -7.0
Mean Tone 1 = -5.9
Mean Tone 2 = -6.0
Mean Tone 3 = -7.0
Mean Tone 4 = -5.4
Mean Tone 5 = -5.4
Mean Tone 6 = -4.5
Mean Overall = -5.9

CNV M2

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	280.1	46.7	1.02	.411
Within Groups	371	16942.5	45.7		
Total	377	17222.6			

Mean Tone 0 = -12.1
Mean Tone 1 = -11.8
Mean Tone 2 = -12.5
Mean Tone 3 = - 9.8
Mean Tone 4 = -12.3
Mean Tone 5 = -12.5
Mean Tone 6 = -11.4
Mean Overall = -11.8

CNV M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	522.9	87.2	1.44	.198
Within Groups	371	22480.3	60.6		
Total	377	23003.3			

Mean Tone 0 = -12.9
Mean Tone 1 = -12.0
Mean Tone 2 = -12.8
Mean Tone 3 = -11.7
Mean Tone 4 = -12.9
Mean Tone 5 = -14.7
Mean Tone 6 = -15.1
Mean Overall = -13.2

CNV M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	274304.0	45717.3	.60	.732
Within Groups	371	28249702.4	76144.8		
Total	377	28524006.4			

Mean Tone 0 = -157.7
Mean Tone 1 = -147.2
Mean Tone 2 = -153.1
Mean Tone 3 = -132.7
Mean Tone 4 = -147.0
Mean Tone 5 = -160.7
Mean Tone 6 = -153.2
Mean Overall = -150.2

N1 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	714.2	119.0	2.59	.018
Within Groups	369	16950.1	45.9		
Total	375	17664.3			

Mean Tone 0 = -15.9
Mean Tone 1 = -15.4
Mean Tone 2 = -17.9
Mean Tone 3 = -16.4
Mean Tone 4 = -15.1
Mean Tone 5 = -13.95
Mean Tone 6 = -13.5
Mean Overall = -15.4

Significant (p<.05) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: Tone 3 ;Tone 2;Tone 0 Tone 1; Tone 4
Subset 2: Tone 3; Tone 0; Tone 1; Tone 4; Tone 5; Tone 6

N1 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	803.0	133.8	.54	.781
Within Groups	369	91762.0	248.7		
Total	375	92565.0			

Mean Tone 0 = 144.0
Mean Tone 1 = 144.2
Mean Tone 2 = 140.2
Mean Tone 3 = 142.7
Mean Tone 4 = 140.6
Mean Tone 5 = 142.7
Mean Tone 6 = 143.3
Mean Overall = 142.5

P2 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	504.9	84.2	1.76	.105
Within Groups	376	17690.1	47.8		
Total	376	18195.1			

Mean Tone 0 = 11.2
Mean Tone 1 = 10.2
Mean Tone 2 = 10.9
Mean Tone 3 = 11.1
Mean Tone 4 = 9.1
Mean Tone 5 = 10.6
Mean Tone 6 = 7.8
Mean Overall = 10.2

P2 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	5920.0	986.6	1.55	.161
Within Groups	370	235968.0	637.8		
Total	376	241888.0			

Mean Tone 0 = 222.2
Mean Tone 1 = 224.3
Mean Tone 2 = 221.1
Mean Tone 3 = 218.8
Mean Tone 4 = 218.5
Mean Tone 5 = 228.0
Mean Tone 6 = 214.8
Mean Overall = 221.2

P3 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	86.9	14.5	.249	.958
Within Groups	353	20505.0	58.0		
Total	359	20591.9			

Mean Tone 0 = 7.8
Mean Tone 1 = 7.3
Mean Tone 2 = 7.7
Mean Tone 3 = 8.1
Mean Tone 4 = 6.6
Mean Tone 5 = 7.1
Mean Tone 6 = 7.8
Mean Overall = 7.5

P3 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	6544.0	1090.7	.23	.967
Within Groups	353	1709248.0	4842.1		
Total	359	1715792.0			

Mean Tone 0 = 394.1
Mean Tone 1 = 396.4
Mean Tone 2 = 395.5
Mean Tone 3 = 387.9
Mean Tone 4 = 393.3
Mean Tone 5 = 399.5
Mean Tone 6 = 402.5
Mean Overall = 395.6

Table E.18

Oneway Analysis of Variance of Male Data For Tones

CNV M1

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	237.7	39.6	.49	.814
Within Groups	140	11237.5	80.3		
Total	146	11475.2			

Mean Tone 0 = -8.1
Mean Tone 1 = -7.4
Mean Tone 2 = -6.1
Mean Tone 3 = -9.8
Mean Tone 4 = -6.6
Mean Tone 5 = -6.9
Mean Tone 6 = -5.7
Mean Overall = -7.2

CNV M2

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	56.2	9.4	.25	.957
Within Groups	140	5203.9	37.2		
Total	146	5359.9			

Mean Tone 0 = -10.5
Mean Tone 1 = -11.2
Mean Tone 2 = - 9.6
Mean Tone 3 = -11.0
Mean Tone 4 = -11.5
Mean Tone 5 = -10.8
Mean Tone 6 = -10.1
Mean Overall = -10.7

CNV M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	97.0	16.2	.36	.905
Within Groups	140	6335.7	45.3		
Total	146	6432.8			

Mean Tone 0 = -11.1
Mean Tone 1 = - 9.3
Mean Tone 2 = - 9.4
Mean Tone 3 = -10.2
Mean Tone 4 = -11.34
Mean Tone 5 = -10.65
Mean Tone 6 = -11.53
Mean Overall = -10.5

CNV M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	732160.0	122026.6	.19	.976
Within Groups	140	86842112.0	620300.8		
Total	146	87574272.0			

Mean Tone 0 = -1440.9
Mean Tone 1 = -1395.7
Mean Tone 2 = -1210.9
Mean Tone 3 = -1383.8
Mean Tone 4 = -1378.6
Mean Tone 5 = -1370.5
Mean Tone 6 = -1296.2
Mean Overall = -1353.8

N1 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	143.5	23.9	.44	.854
Within Groups	140	7665.3	54.7		
Total	146	7808.8			

Mean Tone 0 = -14.5
Mean Tone 1 = -15.9
Mean Tone 2 = -16.9
Mean Tone 3 = -15.9
Mean Tone 4 = -16.3
Mean Tone 5 = -14.6
Mean Tone 6 = -14.1
Mean Overall = -15.5

N1 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	486.0	81.0	.52	.794
Within Groups	140	21793.0	155.7		
Total	146	22279.0			

Mean Tone 0 = 146.7
Mean Tone 1 = 145.5
Mean Tone 2 = 141.0
Mean Tone 3 = 142.4
Mean Tone 4 = 143.6
Mean Tone 5 = 144.1
Mean Tone 6 = 145.5
Mean Overall = 144.1

P2 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	291.8	48.6	1.16	.330
Within Groups	140	5858.2	41.8		
Total	146	6150.0			

Mean Tone 0 = 11.9
Mean Tone 1 = 10.4
Mean Tone 2 = 11.7
Mean Tone 3 = 11.5
Mean Tone 4 = 8.9
Mean Tone 5 = 10.7
Mean Tone 6 = 7.9
Mean Overall = 10.47

P2 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	1601.0	266.8	1.38	.226
Within Groups	140	27057.0	193.3		
Total	146	28658.0			

Mean Tone 0 = 218.9
Mean Tone 1 = 226.2
Mean Tone 2 = 217.5
Mean Tone 3 = 223.1
Mean Tone 4 = 221.1
Mean Tone 5 = 225.0
Mean Tone 6 = 217.5
Mean Overall = 221.3

P3 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	284.7	47.5	1.27	.275
Within Groups	136	5086.8	37.4		
Total	142	5371.6			

Mean Tone 0 = 7.5
Mean Tone 1 = 6.6
Mean Tone 2 = 6.6
Mean Tone 3 = 3.2
Mean Tone 4 = 5.0
Mean Tone 5 = 7.5
Mean Tone 6 = 6.0
Mean Overall = 6.1

P3 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	3760.0	626.7	.65	.694
Within Groups	136	131600.0	967.6		
Total	142	135360.0			

Mean Tone 0 = 353.7
Mean Tone 1 = 357.7
Mean Tone 2 = 357.7
Mean Tone 3 = 356.7
Mean Tone 4 = 367.5
Mean Tone 5 = 361.9
Mean Tone 6 = 370.8
Mean Overall = 359.4

Table E.19

Oneway Analysis of Variance of Female Data For Tones

CNV M1

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	153.6	25.6	.30	.935
Within Groups	224	19008.4	84.9		
Total	230	19162.0			

Mean Tone 0 = -6.3
Mean Tone 1 = -9.3
Mean Tone 2 = -6.0
Mean Tone 3 = -5.2
Mean Tone 4 = -4.6
Mean Tone 5 = -4.5
Mean Tone 6 = -3.8
Mean Overall = -5.19

CNV M2

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	546.7	91.1	1.83	.093
Within Groups	224	11134.5	49.7		
Total	230	11681.2			

Mean Tone 0 = -13.1
Mean Tone 1 = -12,2
Mean Tone 2 = -14.3
Mean Tone 3 = - 9.1
Mean Tone 4 = -12.7
Mean Tone 5 = -13.6
Mean Tone 6 = -12.2
Mean Overall = -12.5

CNV M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	653.1	108.9	1.72	.117
Within Groups	224	14203.5	63.4		
Total	230	14856.6			

Mean Tone 0 = -14.2
Mean Tone 1 = -13.7
Mean Tone 2 = -15.0
Mean Tone 3 = -12.7
Mean Tone 4 = -13.8
Mean Tone 5 = -17.3
Mean Tone 6 = -17.4
Mean Overall = -14.9

CNV M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	5291264.0	881877.3	1.06	.390
Within Groups	224	187063040.0	835102.8		
Total	230	192354304.0			

Mean Tone 0 = -166.4
Mean Tone 1 = -152.1
Mean Tone 2 = -173.5
Mean Tone 3 = -129.1
Mean Tone 4 = -152.1
Mean Tone 5 = -175.7
Mean Tone 6 = -168.2
Mean Overall = -159.7

N1 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	763.7	127.3	3.15	.006
Within Groups	222	9090.7	40.9		
Total	228	9854.4			

Mean Tone 0 = -16.8
Mean Tone 1 = -15.1
Mean Tone 2 = -18.4
Mean Tone 3 = -16.6
Mean Tone 4 = -14.4
Mean Tone 5 = -13.3
Mean Tone 6 = -13.1
Mean Overall = -15.4

N1 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	569.0	94.8	.31	.933
Within Groups	222	69055.0	311.1		
Total	228	69624.0			

Mean Tone 0 = 142.3
Mean Tone 1 = 143.4
Mean Tone 2 = 139.6
Mean Tone 3 = 142.9
Mean Tone 4 = 138.7
Mean Tone 5 = 141.8
Mean Tone 6 = 141.8
Mean Overall = 141.5

P2 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	241.8	40.3	.76	.602
Within Groups	223	11786.1	52.8		
Total	229	12026.9			

Mean Tone 0 = 10.8
Mean Tone 1 = 10.1
Mean Tone 2 = 10.5
Mean Tone 3 = 10.8
Mean Tone 4 = 9.3
Mean Tone 5 = 10.6
Mean Tone 6 = 7.7
Mean Overall = 9.9

P2 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	6671.0	1111.8	1.20	.306
Within Groups	223	206506.0	926.0		
Total	229	213177.0			

Mean Tone 0 = 224.4
Mean Tone 1 = 223.1
Mean Tone 2 = 223.5
Mean Tone 3 = 216.2
Mean Tone 4 = 216.9
Mean Tone 5 = 229.9
Mean Tone 6 = 213.1
Mean Overall = 221.0

P3 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	420.2	70.0	1.03	.409
Within Groups	210	14316.8	68.2		
Total	216	14737.0			

Mean Tone 0 = 8.1
Mean Tone 1 = 7.9
Mean Tone 2 = 8.4
Mean Tone 3 = 11.6
Mean Tone 4 = 7.6
Mean Tone 5 = 6.8
Mean Tone 6 = 9.0
Mean Overall = 8.4

P3 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	4800.0	800.0	0.13	.991
Within Groups	210	1263584.0	6017.1		
Total	216	1268384.0			

Mean Tone 0 = 420.6
Mean Tone 1 = 422.7
Mean Tone 2 = 421.2
Mean Tone 3 = 409.5
Mean Tone 4 = 415.6
Mean Tone 5 = 422.3
Mean Tone 6 = 424.4
Mean Overall = 419.5

Table E.20

Oneway Analysis of Variance of Avg. Fz Data For Tones

CNV M1

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	156.8	26.1	.68	.662
Within Groups	119	4523.8	38.0		
Total	125	4680.5			

Mean Tone 0 = -14.8
Mean Tone 1 = -12.6
Mean Tone 2 = -12.8
Mean Tone 3 = -13.6
Mean Tone 4 = -11.1
Mean Tone 5 = -12.1
Mean Tone 6 = -12.1
Mean Overall = -12.7

CNV M2

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	110.6	18.4	.41	.874
Within Groups	119	5392.3	45.3		
Total	125	5502.9			

Mean Tone 0 = -13.7
Mean Tone 1 = -12.6
Mean Tone 2 = -12.5
Mean Tone 3 = -10.9
Mean Tone 4 = -11.6
Mean Tone 5 = -12.1
Mean Tone 6 = -10.8
Mean Overall = -12.0

CNV M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	152.2	25.4	.38	.893
Within Groups	119	8008.3	67.3		
Total	125	8160.5			

Mean Tone 0 = -11.9
Mean Tone 1 = -10.2
Mean Tone 2 = -10.4
Mean Tone 3 = -11.2
Mean Tone 4 = -10.4
Mean Tone 5 = -12.1
Mean Tone 6 = -13.5
Mean Overall = -11.4

CNV M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	161843.2	26973.8	.42	.865
Within Groups	119	7623756.8	64065.2		
Total	125	7785600.0			

Mean Tone 0 = -192.1
Mean Tone 1 = -170.0
Mean Tone 2 = -167.5
Mean Tone 3 = -160.4
Mean Tone 4 = -152.2
Mean Tone 5 = -171.5
Mean Tone 6 = -169.8
Mean Overall = -169.1

N1 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	110.9	18.5	.45	.845
Within Groups	117	4810.0	41.1		
Total	123	4920.9			

Mean Tone 0 = -13.9
Mean Tone 1 = -14.2
Mean Tone 2 = -17.0
Mean Tone 3 = -15.1
Mean Tone 4 = -15.2
Mean Tone 5 = -14.4
Mean Tone 6 = -15.0
Mean Overall = -14.9

N1 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	532.0	88.7	.52	.793
Within Groups	117	19886.0	169.9		
Total	123	20418.0			

Mean Tone 0 = 150.3
Mean Tone 1 = 151.1
Mean Tone 2 = 146.5
Mean Tone 3 = 150.1
Mean Tone 4 = 146.5
Mean Tone 5 = 146.2
Mean Tone 6 = 150.6
Mean Overall = 148.7

P2 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	194.9	32.5	.61	.721
Within Groups	118	6248.2	52.9		
Total	124	6443.1			

Mean Tone 0 = 8.7
Mean Tone 1 = 7.3
Mean Tone 2 = 8.4
Mean Tone 3 = 8.0
Mean Tone 4 = 7.0
Mean Tone 5 = 7.3
Mean Tone 6 = 4.6
Mean Overall = 7.4

P2 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	1846.0	307.7	.63	.706
Within Groups	118	57371.0	486.2		
Total	124	59217.0			

Mean Tone 0 = 224.9
Mean Tone 1 = 230.8
Mean Tone 2 = 222.2
Mean Tone 3 = 220.6
Mean Tone 4 = 224.5
Mean Tone 5 = 227.8
Mean Tone 6 = 218.6
Mean Overall = 224.2

P3 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	45.8	7.6	.19	.978
Within Groups	113	4567.5	40.4		
Total	119	4613.3			

Mean Tone 0 = 4.2
Mean Tone 1 = 4.9
Mean Tone 2 = 4.8
Mean Tone 3 = 6.2
Mean Tone 4 = 4.8
Mean Tone 5 = 4.3
Mean Tone 6 = 4.6
Mean Overall = 4.8

P3 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	4832.0	805.3	.30	.934
Within Groups	113	300336.0	2657.8		
Total	119	305168.0			

Mean Tone 0 = 378.9
Mean Tone 1 = 369.6
Mean Tone 2 = 376.2
Mean Tone 3 = 371.4
Mean Tone 4 = 372.4
Mean Tone 5 = 378.3
Mean Tone 6 = 390.5
Mean Overall = 376.5

Table E.21

Oneway Analysis of Variance of Avg. Cz Data For Tones

CNV M1

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	102.4	17.7	.49	.815
Within Groups	119	4127.0	34.6		
Total	121	4220.4			

Mean Tone 0 = -9.9
Mean Tone 1 = -8.3
Mean Tone 2 = -8.4
Mean Tone 3 = -9.5
Mean Tone 4 = -8.1
Mean Tone 5 = -8.2
Mean Tone 6 = -7.0
Mean Overall = -8.5

CNV M2

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	101.0	16.8	.39	.885
Within Groups	119	5149.6	43.2		
Total	121	5250.7			

Mean Tone 0 = -15.1
Mean Tone 1 = -14.8
Mean Tone 2 = -15.4
Mean Tone 3 = -12.8
Mean Tone 4 = -15.3
Mean Tone 5 = -15.7
Mean Tone 6 = -14.6
Mean Overall = -14.8

CNV M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	186.1	31.0	.53	.786
Within Groups	119	6954.2	58.4		
Total	121	7140.3			

Mean Tone 0 = -16.6
Mean Tone 1 = -15.7
Mean Tone 2 = -16.3
Mean Tone 3 = -14.8
Mean Tone 4 = -16.2
Mean Tone 5 = -18.1
Mean Tone 6 = -18.6
Mean Overall = -16.7

CNV M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	112614.4	18769.0	.28	.941
Within Groups	119	7768678.4	65283.0		
Total	121	7881292.8			

Mean Tone 0 = -200.6
Mean Tone 1 = -188.6
Mean Tone 2 = -191.7
Mean Tone 3 = -172.7
Mean Tone 4 = -188.8
Mean Tone 5 = -203.8
Mean Tone 6 = -194.3
Mean Overall = -191.4

N1 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	636.3	106.0	2.18	.048
Within Groups	119	5764.6	48.4		
Total	125	6400.9			

Mean Tone 0 = -20.3
Mean Tone 1 = -19.0
Mean Tone 2 = -21.7
Mean Tone 3 = -19.2
Mean Tone 4 = -17.8
Mean Tone 5 = -16.3
Mean Tone 6 = -14.5
Mean Overall = -18.4

Significant ($p<.05$) A Posteriori Contrasts: Homogenous Subsets using Duncan Range Test.

Subset 1: Tone 3 ;Tone 2;Tone 0 Tone 1; Tone 4

Subset 2: Tone 3; Tone 0; Tone 1; Tone 4; Tone 5; Tone 6

N1 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	896.0	149.3	.48	.821
Within Groups	119	36751.0	308.8		
Total	125	37647.0			

Mean Tone 0 = 145.8
Mean Tone 1 = 143.5
Mean Tone 2 = 140.6
Mean Tone 3 = 142.3
Mean Tone 4 = 140.6
Mean Tone 5 = 143.7
Mean Tone 6 = 137.0
Mean Overall = 141.9

P2 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	283.7	47.3	1.08	.378
Within Groups	119	5205.8	47.3		
Total	125	5489.5			

Mean Tone 0 = 12.2
Mean Tone 1 = 11.8
Mean Tone 2 = 12.1
Mean Tone 3 = 12.0
Mean Tone 4 = 10.2
Mean Tone 5 = 11.4
Mean Tone 6 = 7.8
Mean Overall = 11.1

P2 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	5157.0	859.0	1.26	.278
Within Groups	119	80880.0	679.7		
Total	125	86037.0			

Mean Tone 0 = 220.6
Mean Tone 1 = 223.2
Mean Tone 2 = 217.9
Mean Tone 3 = 216.0
Mean Tone 4 = 215.0
Mean Tone 5 = 227.1
Mean Tone 6 = 205.5
Mean Overall = 217.9

P3 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	33.9	5.7	.13	.991
Within Groups	110	4708.3	42.8		
Total	116	4742.2			

Mean Tone 0 = 4.4
Mean Tone 1 = 4.0
Mean Tone 2 = 4.9
Mean Tone 3 = 4.6
Mean Tone 4 = 3.1
Mean Tone 5 = 4.2
Mean Tone 6 = 4.3
Mean Overall = 4.2

P3 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	10880.0	1813.3	.31	.929
Within Groups	110	641344.0	5830.4		
Total	116	652224.0			

Mean Tone 0 = 399.5
Mean Tone 1 = 409.5
Mean Tone 2 = 398.4
Mean Tone 3 = 391.5
Mean Tone 4 = 395.9
Mean Tone 5 = 399.1
Mean Tone 6 = 374.4
Mean Overall = 395.6

Table E.22

Oneway Analysis of Variance of Avg. Pz Data For Tones

CNV M1

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	120.7	20.0	.56	.763
Within Groups	119	4247.4	35.7		
Total	125	4367.5			

Mean Tone 0 = 3.7
Mean Tone 1 = 3.2
Mean Tone 2 = 3.1
Mean Tone 3 = 2.1
Mean Tone 4 = 3.0
Mean Tone 5 = 3.9
Mean Tone 6 = 5.4
Mean Overall = 3.5

CNV M2

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	230.5	38.4	1.27	.274
Within Groups	119	3580.7	30.2		
Total	125	3820.1			

Mean Tone 0 = -7.4
Mean Tone 1 = -7.8
Mean Tone 2 = - 9.4
Mean Tone 3 = - 5.8
Mean Tone 4 = - 9.8
Mean Tone 5 = - 9.6
Mean Tone 6 = - 8.7
Mean Overall = - 8.4

CNV M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	316.7	52.8	1.23	.292
Within Groups	119	5079.97	42.6		
Total	125	5396.6			

Mean Tone 0 = -10.4
Mean Tone 1 = -10.0
Mean Tone 2 = -11.7
Mean Tone 3 = - 9.0
Mean Tone 4 = -11.8
Mean Tone 5 = -13.8
Mean Tone 6 = -13.1
Mean Overall = -11.4

CNV M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	2263044.0	377173.0	.82	.560
Within Groups	119	54872576.0	461114.1		
Total	121	57135616.0			

Mean Tone 0 = -80.3
Mean Tone 1 = -83.0
Mean Tone 2 = -100.1
Mean Tone 3 = -65.3
Mean Tone 4 = -100.0
Mean Tone 5 = -106.7
Mean Tone 6 = -95.3
Mean Overall = -90.1

N1 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	277.3	46.2	1.34	.242
Within Groups	119	4087.9	46.2		
Total	125	4365.2			

Mean Tone 0 = -13.2
Mean Tone 1 = -13.0
Mean Tone 2 = -14.8
Mean Tone 3 = -14.7
Mean Tone 4 = -12.3
Mean Tone 5 = -10.8
Mean Tone 6 = -11.0
Mean Overall = -12.9

N1 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	963.0	160.5	.77	.596
Within Groups	119	24771.0	208.2		
Total	125	25734.0			

Mean Tone 0 = 136.4
Mean Tone 1 = 137.9
Mean Tone 2 = 133.4
Mean Tone 3 = 135.7
Mean Tone 4 = 134.7
Mean Tone 5 = 137.9
Mean Tone 6 = 142.6
Mean Overall = 136.9

P2 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	146.5	24.4	.63	.707
Within Groups	119	4608.4	38.7		
Total	125	4754.9			

Mean Tone 0 = 12.8
Mean Tone 1 = 11.5
Mean Tone 2 = 12.2
Mean Tone 3 = 13.2
Mean Tone 4 = 10.2
Mean Tone 5 = 13.1
Mean Tone 6 = 10.8
Mean Overall = 12.0

P2 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	1813.0	302.2	.39	.885
Within Groups	119	92230.0	775.0		
Total	125	94043.0			

Mean Tone 0 = 221.2
Mean Tone 1 = 218.9
Mean Tone 2 = 223.2
Mean Tone 3 = 219.9
Mean Tone 4 = 216.08
Mean Tone 5 = 229.1
Mean Tone 6 = 220.6
Mean Overall = 221.3

P3 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	117.1	19.5	1 .45	.845
Within Groups	116	5037.0	43.4		
Total	122	5154.1			

Mean Tone 0 = 14.6
Mean Tone 1 = 12.7
Mean Tone 2 = 13.1
Mean Tone 3 = 14.3
Mean Tone 4 = 11.6
Mean Tone 5 = 12.6
Mean Tone 6 = 13.5
Mean Overall = 13.2

P3 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	14512.0	2418.7	.43	.862
Within Groups	116	659424.0	5684.7		
Total	122	673936.0			

Mean Tone 0 = 404.1
Mean Tone 1 = 409.4
Mean Tone 2 = 411.0
Mean Tone 3 = 402.8
Mean Tone 4 = 410.4
Mean Tone 5 = 421.2
Mean Tone 6 = 436.6
Mean Overall = 413.9

Table E.23

Oneway Analysis of Variance of Male Fz Data For Tones

CNV M1

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	77.6	12.9	.29	.935
Within Groups	42	1834.8	43.7		
Total	48	1912.5			

Mean Tone 0 = -15.0
Mean Tone 1 = -14.5
Mean Tone 2 = -12.7
Mean Tone 3 = -15.2
Mean Tone 4 = -11.4
Mean Tone 5 = -13.8
Mean Tone 6 = -13.6
Mean Overall = -13.7

CNV M2

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	34.5	5.7	.19	.975
Within Groups	42	1244.3	29.6		
Total	48	1278.8			

Mean Tone 0 = -10.6
Mean Tone 1 = -10.8
Mean Tone 2 = -8.6
Mean Tone 3 = -11.0
Mean Tone 4 = -9.3
Mean Tone 5 = -9.4
Mean Tone 6 = -9.9
Mean Overall = -9.9

CNV M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	99.1	16.5	.35	.904
Within Groups	42	1961.7	46.7		
Total	485	2060.8			

Mean Tone 0 = -7.3
Mean Tone 1 = -4.8
Mean Tone 2 = -6.1
Mean Tone 3 = -8.6
Mean Tone 4 = -7.6
Mean Tone 5 = -7.3
Mean Tone 6 = -9.6
Mean Overall = -7.3

CNV M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	755968.0	125994.6	.25	.953
Within Groups	42	20624416.0	491057.5		
Total	48	21380384.0			

Mean Tone 0 = -158.0
Mean Tone 1 = -151.4
Mean Tone 2 = -123.7
Mean Tone 3 = -149.1
Mean Tone 4 = -123.4
Mean Tone 5 = -141.1
Mean Tone 6 = -144.2
Mean Overall = -141.5

N1 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	180.3	30.0	1 .49	.812
Within Groups	42	2566.8	61.1		
Total	48	2747.1			

Mean Tone 0 = -9.7
Mean Tone 1 = -14.6
Mean Tone 2 = -14.8
Mean Tone 3 = -12.1
Mean Tone 4 = -15.3
Mean Tone 5 = -15.6
Mean Tone 6 = -15.1
Mean Overall = -13.8

N1 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	522.8	87.1	.64	.698
Within Groups	42	17354.9	135.6		
Total	48	17877.8			

Mean Tone 0 = 155.9
Mean Tone 1 = 154.2
Mean Tone 2 = 151.7
Mean Tone 3 = 153.4
Mean Tone 4 = 150.9
Mean Tone 5 = 149.2
Mean Tone 6 = 152.6
Mean Overall = 152.6

P2 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	9152.0	192.0	.61	.728
Within Groups	42	10256.0	662.0		
Total	48	99408.0			

Mean Tone 0 = 9.7
Mean Tone 1 = 7.1
Mean Tone 2 = 9.1
Mean Tone 3 = 8.4
Mean Tone 4 = 7.0
Mean Tone 5 = 7.9
Mean Tone 6 = 4.0
Mean Overall = 7.6

P2 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	308.0	51.3	1.30	.265
Within Groups	42	3474.8	39.5		
Total	48	3782.8			

Mean Tone 0 = 218.3
Mean Tone 1 = 234.3
Mean Tone 2 = 220.8
Mean Tone 3 = 226.7
Mean Tone 4 = 224.2
Mean Tone 5 = 224.2
Mean Tone 6 = 218.3
Mean Overall = 223.8

P3 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	90.9	5.1	1.85	.099
Within Groups	42	2350.8	13.1		
Total	48	6741.7			

Mean Tone 0 = 5.0
Mean Tone 1 = 4.3
Mean Tone 2 = 4.1
Mean Tone 3 = 2.7
Mean Tone 4 = 2.7
Mean Tone 5 = 5.4
Mean Tone 6 = 3.7
Mean Overall = 4.0

P3 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	395.3	65.9	2.07	.065
Within Groups	42	2709.4	31.9		
Total	48	3104.7			

Mean Tone 0 = 362.4
Mean Tone 1 = 361.6
Mean Tone 2 = 356.5
Mean Tone 3 = 361.6
Mean Tone 4 = 356.5
Mean Tone 5 = 359.9
Mean Tone 6 = 364.9
Mean Overall = 360.5

Table E.24

Oneway Analysis of Variance of Male Cz Data For Tones

CNV M1

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	848.0	141.3	.57	.757
Within Groups	42	8256.0	87.3		
Total	48	9104.0			

Mean Tone 0 = -10.6
Mean Tone 1 = -9.4
Mean Tone 2 = -8.1
Mean Tone 3 = -12.1
Mean Tone 4 = -9.4
Mean Tone 5 = -9.3
Mean Tone 6 = -8.0
Mean Overall = -9.6

CNV M2

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	918.7	319.8	2.02	.068
Within Groups	42	466.3	58.6		
Total	48	884.0			

Mean Tone 0 = -16.1
Mean Tone 1 = -15.5
Mean Tone 2 = -17.6
Mean Tone 3 = -30.8
Mean Tone 4 = -15.8
Mean Tone 5 = -17.0
Mean Tone 6 = -24.5
Mean Overall = -17.5

CNV M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	70.0	11.7	2.79	.014
Within Groups	42	5413.0	63.7		
Total	48	7483.0			

Mean Tone 0 = -15.6
Mean Tone 1 = -14.3
Mean Tone 2 = -13.4
Mean Tone 3 = -13.7
Mean Tone 4 = -15.1
Mean Tone 5 = -14.3
Mean Tone 6 = -15.3
Mean Overall = -14.5

CNV M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	1709.8	285.0	1.68	.131
Within Groups	42	21942.1	170.1		
Total	48	23651.8			

Mean Tone 0 = -188.8
Mean Tone 1 = -183.5
Mean Tone 2 = -161.7
Mean Tone 3 = -181.4
Mean Tone 4 = -184.8
Mean Tone 5 = -180.8
Mean Tone 6 = -175.3
Mean Overall = -179.5

N1 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	1511.0	251.9	1.55	.165
Within Groups	42	20920.8	162.2		
Total	48	22432.0			

Mean Tone 0 = -20.1
Mean Tone 1 = -20.0
Mean Tone 2 = -21.1
Mean Tone 3 = -19.4
Mean Tone 4 = -19.7
Mean Tone 5 = -17.6
Mean Tone 6 = -16.7
Mean Overall = -19.2

N1 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	522.8	87.1	.64	.698
Within Groups	42	17354.9	135.6		
Total	48	17877.8			

Mean Tone 0 = 146.7
Mean Tone 1 = 145.8
Mean Tone 2 = 141.6
Mean Tone 3 = 139.9
Mean Tone 4 = 144.1
Mean Tone 5 = 144.9
Mean Tone 6 = 146.7
Mean Overall = 144.3

P2 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	9152.0	192.0	.61	.728
Within Groups	42	7010256.0	79662.0		
Total	48	7299408.0			

Mean Tone 0 = 11.4
Mean Tone 1 = 10.8
Mean Tone 2 = 11.8
Mean Tone 3 = 12.3
Mean Tone 4 = 9.1
Mean Tone 5 = 10.7
Mean Tone 6 = 8.0
Mean Overall = 10.6

P2 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	496.0	82.7	.59	.733
Within Groups	42	5820.0	138.6		
Total	48	6316.0			

Mean Tone 0 = 220.8
Mean Tone 1 = 223.4
Mean Tone 2 = 215.7
Mean Tone 3 = 219.9
Mean Tone 4 = 217.5
Mean Tone 5 = 223.4
Mean Tone 6 = 214.9
Mean Overall = 219.4

P3 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	121.3	20.2	.65	.689
Within Groups	39	1206.2	30.9		
Total	45	1327.4			

Mean Tone 0 = 3.8
Mean Tone 1 = 3.7
Mean Tone 2 = 3.0
Mean Tone 3 = -0.4
Mean Tone 4 = 1.3
Mean Tone 5 = 4.5
Mean Tone 6 = 1.7
Mean Overall = 2.5

P3 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	1199.0	199.8	2 .37	.890
Within Groups	39	20714.0	531.1		
Total	45	21913.0			

Mean Tone 0 = 348.1
Mean Tone 1 = 357.4
Mean Tone 2 = 350.6
Mean Tone 3 = 358.2
Mean Tone 4 = 353.9
Mean Tone 5 = 357.9
Mean Tone 6 = 364.8
Mean Overall = 355.7

Table E.25

Oneway Analysis of Variance of Male Pz Data For Tones

CNV M1

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	153.1	25.5	1.11	.373
Within Groups	42	964.6	22.9		
Total	48	1117.6			

Mean Tone 0 = 1.3
Mean Tone 1 = 1.7
Mean Tone 2 = 2.4
Mean Tone 3 = -2.0
Mean Tone 4 = 1.1
Mean Tone 5 = 2.4
Mean Tone 6 = 4.3
Mean Overall = 1.6

CNV M2

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	54.1	9.0	.35	.906
Within Groups	42	1080.9	25.7		
Total	48	1134.9			

Mean Tone 0 = -7.1
Mean Tone 1 = -8.3
Mean Tone 2 = -7.4
Mean Tone 3 = -7.9
Mean Tone 4 = -10.1
Mean Tone 5 = -8.6
Mean Tone 6 = -6.7
Mean Overall = -8.0

CNV M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	49.4	8.2	.28	.942
Within Groups	42	1230.0	29.3		
Total	48	1279.4			

Mean Tone 0 = -10.4
Mean Tone 1 = -8.8
Mean Tone 2 = -8.7
Mean Tone 3 = -8.3
Mean Tone 4 = -11.3
Mean Tone 5 = -10.3
Mean Tone 6 = -9.6
Mean Overall = -9.6

CNV M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	510032.0	85005.3	.26	.948
Within Groups	42	13383536.0	318655.0		
Total	48	13893568.0			

Mean Tone 0 = -85.4
Mean Tone 1 = -83.7
Mean Tone 2 = -77.8
Mean Tone 3 = -84.5
Mean Tone 4 = -105.2
Mean Tone 5 = -89.1
Mean Tone 6 = -69.2
Mean Overall = -85.0

N1 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	154.5	25.8	.72	.639
Within Groups	42	1505.7	35.8		
Total	48	1660.2			

Mean Tone 0 = -13.7
Mean Tone 1 = -13.3
Mean Tone 2 = -14.9
Mean Tone 3 = -16.3
Mean Tone 4 = -14.0
Mean Tone 5 = -11.9
Mean Tone 6 = -10.4
Mean Overall = -13.5

N1 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	354.1	59.0	.53	.779
Within Groups	42	4625.3	110.1		
Total	48	4979.4			

Mean Tone 0 = 137.4
Mean Tone 1 = 136.5
Mean Tone 2 = 129.8
Mean Tone 3 = 134.0
Mean Tone 4 = 135.7
Mean Tone 5 = 138.2
Mean Tone 6 = 137.4
Mean Overall = 135.6

P2 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	89.9	14.9	.41	.863
Within Groups	42	1504.9	35.8		
Total	48	1594.8			

Mean Tone 0 = 14.4
Mean Tone 1 = 13.3
Mean Tone 2 = 14.1
Mean Tone 3 = 14.0
Mean Tone 4 = 10.4
Mean Tone 5 = 13.4
Mean Tone 6 = 11.7
Mean Overall = 13.1

P2 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	624.0	104.0	.55	.765
Within Groups	42	7868.0	187.3		
Total	48	8492.0			

Mean Tone 0 = 217.4
Mean Tone 1 = 220.8
Mean Tone 2 = 215.8
Mean Tone 3 = 222.5
Mean Tone 4 = 221.7
Mean Tone 5 = 227.6
Mean Tone 6 = 219.1
Mean Overall = 220.7

P3 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	132.8	22.1	1.06	.400
Within Groups	41	853.1	20.8		
Total	47	985.9			

Mean Tone 0 = 13.6
Mean Tone 1 = 11.7
Mean Tone 2 = 12.7
Mean Tone 3 = 7.8
Mean Tone 4 = 10.4
Mean Tone 5 = 12.0
Mean Tone 6 = 12.0
Mean Overall = 11.5

P3 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	5414.0	902.3	.39	.879
Within Groups	41	93879.0	2289.7		
Total	47	99293.0			

Mean Tone 0 = 350.6
Mean Tone 1 = 353.9
Mean Tone 2 = 365.8
Mean Tone 3 = 349.1
Mean Tone 4 = 361.6
Mean Tone 5 = 367.5
Mean Tone 6 = 381.8
Mean Overall = 361.7

Table E.26

Oneway Analysis of Variance of Fem. Fz Data For Tones

CNV M1

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	130.4	21.7	.59	.733
Within Groups	70	2544.6	36.4		
Total	76	2674.9			

Mean Tone 0 = -14.6
Mean Tone 1 = -11.3
Mean Tone 2 = -12.8
Mean Tone 3 = -10.8
Mean Tone 4 = -10.9
Mean Tone 5 = -10.9
Mean Tone 6 = -11.1
Mean Overall = -12.0

CNV M2

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	201.3	33.6	.64	.700
Within Groups	70	3674.2	52.5		
Total	76	3875.5			

Mean Tone 0 = -15.6
Mean Tone 1 = -13.7
Mean Tone 2 = -15.0
Mean Tone 3 = -10.8
Mean Tone 4 = -13.1
Mean Tone 5 = -13.7
Mean Tone 6 = -11.4
Mean Overall = -13.5

CNV M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	123.1	20.5	.31	.929
Within Groups	70	4637.8	66.3		
Total	76	4760.9			

Mean Tone 0 = -14.9
Mean Tone 1 = -13.6
Mean Tone 2 = -13.2
Mean Tone 3 = -12.9
Mean Tone 4 = -12.3
Mean Tone 5 = -15.2
Mean Tone 6 = -16.0
Mean Overall = -14.0

CNV M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	1622368.0	270394.6	.39	.885
Within Groups	70	48784640.0	696923.4		
Total	76	50407008.0			

Mean Tone 0 = -213.8
Mean Tone 1 = -181.9
Mean Tone 2 = -195.3
Mean Tone 3 = -167.6
Mean Tone 4 = -170.5
Mean Tone 5 = -190.8
Mean Tone 6 = -186.1
Mean Overall = -186.6

N1 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	178.8	29.8	1.08	.383
Within Groups	68	1874.4	27.6		
Total	74	2053.1			

Mean Tone 0 = -16.9
Mean Tone 1 = -13.9
Mean Tone 2 = -18.4
Mean Tone 3 = -17.0
Mean Tone 4 = -15.1
Mean Tone 5 = -14.3
Mean Tone 6 = -14.9
Mean Overall = -15.8

N1 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	430.0	71.7	.36	.897
Within Groups	68	13236.0	194.6		
Total	74	13666.0			

Mean Tone 0 = 146.3
Mean Tone 1 = 149.1
Mean Tone 2 = 143.2
Mean Tone 3 = 148.0
Mean Tone 4 = 143.7
Mean Tone 5 = 144.3
Mean Tone 6 = 149.3
Mean Overall = 146.2

P2 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	68.8	11.5	.18	.980
Within Groups	69	4379.8	63.5		
Total	75	4448.6			

Mean Tone 0 = 8.1
Mean Tone 1 = 7.4
Mean Tone 2 = 8.0
Mean Tone 3 = 7.7
Mean Tone 4 = 7.0
Mean Tone 5 = 7.0
Mean Tone 6 = 5.0
Mean Overall = 7.2

P2 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	1752.0	292.0	.45	.839
Within Groups	69	44121.0	639.4		
Total	75	45873.0			

Mean Tone 0 = 229.0
Mean Tone 1 = 228.5
Mean Tone 2 = 223.1
Mean Tone 3 = 216.7
Mean Tone 4 = 224.7
Mean Tone 5 = 230.1
Mean Tone 6 = 218.9
Mean Overall = 224.5

P3 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	183.1	30.5	.55	.769
Within Groups	64	3541.8	55.3		
Total	70	3724.9			

Mean Tone 0 = 3.8
Mean Tone 1 = 5.3
Mean Tone 2 = 5.2
Mean Tone 3 = 8.7
Mean Tone 4 = 6.3
Mean Tone 5 = 3.5
Mean Tone 6 = 5.2
Mean Overall = 5.4

P3 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	7401.0	1233.5	.30	.934
Within Groups	64	262922.0	4108.2		
Total	70	270323.0			

Mean Tone 0 = 389.4
Mean Tone 1 = 375.2
Mean Tone 2 = 389.9
Mean Tone 3 = 378.2
Mean Tone 4 = 383.5
Mean Tone 5 = 389.9
Mean Tone 6 = 410.4
Mean Overall = 387.8

Table E.27

Oneway Analysis of Variance of Fem. Cz Data For Tones

CNV M1

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	67.6	11.3	.43	.856
Within Groups	70	1827.8	26.1		
Total	135	1895.4			

Mean Tone 0 = -9.5
Mean Tone 1 = -7.7
Mean Tone 2 = -8.6
Mean Tone 3 = -7.9
Mean Tone 4 = -7.3
Mean Tone 5 = -7.6
Mean Tone 6 = -6.4
Mean Overall = -7.9

CNV M2

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	185.7	30.9	.69	.655
Within Groups	70	3110.0	44.4		
Total	76	r 3295.8			

Mean Tone 0 = -15.9
Mean Tone 1 = -15.1
Mean Tone 2 = -17.2
Mean Tone 3 = -12.0
Mean Tone 4 = -15.5
Mean Tone 5 = -16.7
Mean Tone 6 = -15.2
Mean Overall = -15.4

CNV M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	254.8	42.5	.62	.712
Within Groups	70	4756.2	67.9		
Total	76	5010.9			

Mean Tone 0 = -17.2
Mean Tone 1 = -16.7
Mean Tone 2 = -18.1
Mean Tone 3 = -15.6
Mean Tone 4 = -17.0
Mean Tone 5 = -20.55
Mean Tone 6 = -20.8
Mean Overall = -18.0

CNV M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	2002432.0	333738.6	.51	.798
Within Groups	70	45508864.0	650126.6		
Total	76	47511296.0			

Mean Tone 0 = -208.1
Mean Tone 1 = -191.9
Mean Tone 2 = -210.9
Mean Tone 3 = -166.5
Mean Tone 4 = -191.3
Mean Tone 5 = -218.4
Mean Tone 6 = -206.4
Mean Overall = -199.1

N1 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	1511.0	251.9	1.55	.165
Within Groups	70	20920.8	162.2		
Total	76	22432.0			

Mean Tone 0 = -20.4
Mean Tone 1 = -18.4
Mean Tone 2 = -22.1
Mean Tone 3 = -19.1
Mean Tone 4 = -16.7
Mean Tone 5 = -15.5
Mean Tone 6 = -13.2
Mean Overall = -17.9

N1 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	522.8	87.1	.64	.698
Within Groups	70	17354.9	135.6		
Total	76	17877.8			

Mean Tone 0 = 145.3
Mean Tone 1 = 142.1
Mean Tone 2 = 139.9
Mean Tone 3 = 143.7
Mean Tone 4 = 138.4
Mean Tone 5 = 143.2
Mean Tone 6 = 130.9
Mean Overall = 140.5

P2 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	289152.0	48192.0	.61	.728
Within Groups	70	7010256.0	79662.0		
Total	76	7299408.0			

Mean Tone 0 = 12.6
Mean Tone 1 = 12.4
Mean Tone 2 = 12.3
Mean Tone 3 = 11.8
Mean Tone 4 = 10.9
Mean Tone 5 = 11.9
Mean Tone 6 = 7.5
Mean Overall = 11.4

P2 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	308.0	51.3	1.30	.265
Within Groups	70	3474.8	39.5		
Total	76	3782.8			

Mean Tone 0 = 220.4
Mean Tone 1 = 223.1
Mean Tone 2 = 219.4
Mean Tone 3 = 213.5
Mean Tone 4 = 213.5
Mean Tone 5 = 229.6
Mean Tone 6 = 199.5
Mean Overall = 216.9

P3 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	54390.9	9065.1	1.85	.099
Within Groups	64	432350.8	4913.1		
Total	70	486741.7			

Mean Tone 0 = 4.8
Mean Tone 1 = 4.3
Mean Tone 2 = 6.2
Mean Tone 3 = 8.1
Mean Tone 4 = 4.0
Mean Tone 5 = 4.1
Mean Tone 6 = 6.1
Mean Overall = 5.3

P3 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	395.3	65.9	2.07	.065
Within Groups	64	2709.4	31.9		
Total	70	3104.7			

Mean Tone 0 = 435.4
Mean Tone 1 = 446.0
Mean Tone 2 = 431.9
Mean Tone 3 = 414.8
Mean Tone 4 = 418.9
Mean Tone 5 = 421.6
Mean Tone 6 = 380.9
Mean Overall = 421.9

Table E.28

Oneway Analysis of Variance of Fem. Pz Data For Tones

CNV M1

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	52.3	8.7	.20	.971
Within Groups	70	2916.5	41.7		
Total	76	2968.9			

Mean Tone 0 = 5.27
Mean Tone 1 = 4.09
Mean Tone 2 = 3.4
Mean Tone 3 = 4.6
Mean Tone 4 = 4.2
Mean Tone 5 = 4.9
Mean Tone 6 = 6.2
Mean Overall = 4.7

CNV M2

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	326.2	54.4	1.62	.153
Within Groups	70	2348.6	33.5		
Total	76	2673.8			

Mean Tone 0 = - 7.6
Mean Tone 1 = - 7.6
Mean Tone 2 = -10.7
Mean Tone 3 = - 4.4
Mean Tone 4 = - 9.6
Mean Tone 5 = -10.2
Mean Tone 6 = -10.1
Mean Overall = -8.6

CNV M3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	282070.0	47011.7	2.79	.014
Within Groups	70	2175413.0	16863.7		
Total	76	2457483.0			

Mean Tone 0 = -10.4
Mean Tone 1 = -10.7
Mean Tone 2 = -13.7
Mean Tone 3 = - 9.5
Mean Tone 4 = -12.2
Mean Tone 5 = -16.1
Mean Tone 6 = -15.3
Mean Overall = -12.6

CNV M4

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	1709.8	285.0	1.68	.131
Within Groups	70	21942.1	170.1		
Total	76	23651.8			

Mean Tone 0 = -77.1
Mean Tone 1 = -82.5
Mean Tone 2 = -114.2
Mean Tone 3 = -53.1
Mean Tone 4 = -96.6
Mean Tone 5 = -117.9
Mean Tone 6 = -111.9
Mean Overall = -93.3

N1 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	1511.0	251.9	1.55	.165
Within Groups	70	20920.8	162.2		
Total	76	22432.0			

Mean Tone 0 = -13.0
Mean Tone 1 = -12.9
Mean Tone 2 = -14.8
Mean Tone 3 = -13.8
Mean Tone 4 = -11.2
Mean Tone 5 = -10.3
Mean Tone 6 = -11.4
Mean Overall = -12.5

N1 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	522.8	87.1	.64	.698
Within Groups	70	17354.9	135.6		
Total	76	17877.8			

Mean Tone 0 = 135.7
Mean Tone 1 = 138.9
Mean Tone 2 = 135.6
Mean Tone 3 = 136.7
Mean Tone 4 = 134.0
Mean Tone 5 = 137.8
Mean Tone 6 = 145.9
Mean Overall = 137.9

P2 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	89.6	14.9	.35	.907
Within Groups	70	2981.6	42.6		
Total	76	3071.2			

Mean Tone 0 = 11.8
Mean Tone 1 = 10.4
Mean Tone 2 = 11.1
Mean Tone 3 = 12.7
Mean Tone 4 = 10.1
Mean Tone 5 = 12.9
Mean Tone 6 = 10.4
Mean Overall = 11.3

P2 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	2501.0	416.8	.35	.907
Within Groups	70	83028.0	1186.1		
Total	76	85529.0			

Mean Tone 0 = 223.7
Mean Tone 1 = 217.8
Mean Tone 2 = 227.9
Mean Tone 3 = 218.3
Mean Tone 4 = 212.4
Mean Tone 5 = 230.1
Mean Tone 6 = 221.5
Mean Overall = 221.7

P3 AMPL.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	268.2	44.7	.82	.557
Within Groups	68	3688.9	54.2		
Total	74	3957.1			

Mean Tone 0 = 15.3
Mean Tone 1 = 13.4
Mean Tone 2 = 13.3
Mean Tone 3 = 18.7
Mean Tone 4 = 12.3
Mean Tone 5 = 12.9
Mean Tone 6 = 14.5
Mean Overall = 14.2

P3 LAT.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	9805.0	1634.2	.32	.926
Within Groups	68	350611.0	5156.0		
Total	74	360416.0			

Mean Tone 0 = 438.2
Mean Tone 1 = 444.6
Mean Tone 2 = 439.8
Mean Tone 3 = 438.6
Mean Tone 4 = 441.4
Mean Tone 5 = 455.4
Mean Tone 6 = 471.5
Mean Overall = 447.3

Appendix F

Analysis of Variance and Duncan Multiple Range Test Summary Tables for Pooled Single-Trial Data

Table F1

Oneway Analysis of Variance of All Single-Trial Data for Conditions

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	6192640.0	3096320.0	46.09	.000
Within Groups	2110	141763328.0	67186.4		
Total	2112	147955968.0			

Mean A1 = 739.5
Mean B = 635.6
Mean A2 = 614.5
Mean Overall = 661.2

Significant (p<.05) a posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: B; A2
Subset 2: A1

CNV Amp

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	5752.3	2876.2	14.94	.000
Within Groups	2110	406200.1	192.5		
Total	2112	411952.4			

Mean A1 = -14.8
Mean B = -18.6
Mean A2 = -15.6
Mean Overall = -16.3

Significant (p<.05) a posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: B
Subset 2: A1; A2

CNV Int

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	500192.0	250096.0	11.76	.000
Within Groups	2110	44862752.0	21262.0		
Total	2112	45362944.0			

Mean A1 = -166.7
Mean B = -198.8
Mean A2 = -165.7
Mean Overall = -177.0

Significant (p<.05) a posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: B
Subset 2: A1; A2

N1

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	1839.2	919.6	5.97	.003
Within Groups	2047	315405.4	154.1		
Total	2049	317244.6			

Mean A1 = -22.4
Mean B = -23.3
Mean A2 = -21.0
Mean Overall = -22.2

Significant (p<.05) a posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: A1; B
Subset 2: A2

P2

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	1918.3	959.2	6.26	.002
Within Groups	2018	309132.1	153.2		
Total	2020	311050.4			

Mean A1 = 16.8
Mean B = 13.6
Mean A2 = 13.8
Mean Overall = 14.4

Significant (p<.05) a posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: B; A2
Subset 2: A1

P3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	4494.6	2247.3	17.84	.000
Within Groups	1761	221863.5	126.0		
Total	1763	226358.1			

Mean A1 = 15.5
Mean B = 12.2
Mean A2 = 12.1
Mean Overall = 13.3

Significant (p<.05) a posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: B; A2
Subset 2: A1

Table F2

Oneway Analysis of Variance of Male Single-Trial Data for Conditions

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	870912.0	435456.0	6.85	.001
Within Groups	796	50570240.0	63530.4		
Total	798	51441152.0			

Mean A1 = 667.0
Mean B = 590.9
Mean A2 = 600.9
Mean Overall = 617.9

Significant (p<.05) a posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: B; A2
Subset 2: A1

CNV Amp

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	1025.6	512.8	3.63	.026
Within Groups	796	112578.6	141.4		
Total	798	113604.2			

Mean A1 = -13.0
Mean B = -15.6
Mean A2 = -15.0
Mean Overall = -14.6

Significant (p<.05) a posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: B; A2
Subset 2: A1; A2

CNV Int

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	51088.0	25544.0	1.42	.241
Within Groups	796	14325344.0	17996.7		
Total	798	14376432.0			

Mean A1 = -160.9
Mean B = -180.8
Mean A2 = -170.1
Mean Overall = -170.6

N1

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	497.9	249.0	1.74	.175
Within Groups	789	113235.8	143.5		
Total	791	113733.7			

Mean A1 = -22.3
Mean B = -22.9
Mean A2 = -21.1
Mean Overall = -22.1

P2

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	1847.4	923.7	6.50	.002
Within Groups	784	111450.6	142.2		
Total	786	113297.9			

Mean A1 = 15.6
Mean B = 11.9
Mean A2 = 12.8
Mean Overall = 13.4

Significant (p<.05) a posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: B; A2
Subset 2: A1

P3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	1620.6	810.3	8.67	.000
Within Groups	702	65642.4	93.5		
Total	704	67263.0			

Mean A1 = 12.0
Mean B = 9.0
Mean A2 = 8.6
Mean Overall = 9.8

Significant (p<.05) a posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: B; A2
Subset 2: A1

Table F3

Oneway Analysis of Variance of Female
Single-Trial Data for Conditions

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	5901312.0	2950656.0	43.84	.000
Within Groups	1311	88240640.0	67307.9		
Total	1313	94141952.0			

Mean A1 = 781.3
Mean B = 663.3
Mean A2 = 623.0
Mean Overall = 687.6

Significant (p<.05) a posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: A2
Subset 2: B
Subset 3: A1

CNV Amp

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	6008.8	3004.4	13.64	.000
Within Groups	1311	288747.2	220.2		
Total	1313	294755.9			

Mean A1 = -15.6
Mean B = -20.4
Mean A2 = -15.9
Mean Overall = -17.3

Significant (p<.05) a posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: B
Subset 2: A1; A2

CNV Int

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	563856.0	281928.0	12.17	.000
Within Groups	1311	30376400.0	23170.4		
Total	1313	30940256.0			

Mean A1 = -170.0
Mean B = -210.0
Mean A2 = -162.9
Mean Overall = -180.7

Significant (p<.05) a posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: B
Subset 2: A1; A2

N1

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	1378.5	689.3	4.28	.014
Within Groups	1255	202106.8	161.0		
Total	1257	203485.3			

Mean A1 = -22.5
Mean B = -23.5
Mean A2 = -21.0
Mean Overall = -22.3

Significant (p<.05) a posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: A1; B
Subset 2: A1; A2

P2

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	467.4	233.7	1.47	.229
Within Groups	1231	196001.3	159.2		
Total	1233	196468.7			

Mean A1 = 15.9
Mean B = 14.7
Mean A2 = 14.5
Mean Overall = 15.0

P3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	2418.6	1209.3	8.95	.000
Within Groups	1056	142646.1	135.1		
Total	1058	145064.8			

Mean A1 = 17.6
Mean B = 14.3
Mean A2 = 14.6
Mean Overall = 15.6

Significant (p<.05) a posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: B; A2
Subset 2: A1

Table F4

Oneway Analysis of Variance of All Single-Trial Data for Tones

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	1084160.0	180693.3	2.59	.017
Within Groups	2107	146923520.0	69731.1		
Total	2113	148007680.0			

Mean Tone 0 = 659.3
Mean Tone 1 = 628.0
Mean Tone 2 = 683.1
Mean Tone 3 = 636.2
Mean Tone 4 = 680.8
Mean Tone 5 = 694.3
Mean Tone 6 = 604.3
Mean Overall = 661.1

Significant (p<.05) a posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: Tone 6; Tone 1; Tone 3; Tone 0
Subset 2: Tone 1; Tone 3; Tone 0; Tone 4; Tone 2
Subset 3: Tone 3; Tone 0; Tone 4; Tone 2; Tone 5

CNV Amp

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	1837.6	306.3	1.57	.150
Within Groups	2107	410208.6	194.7		
Total	2113	412046.1			

Mean Tone 0 = -16.6
Mean Tone 1 = -14.5
Mean Tone 2 = -16.4
Mean Tone 3 = -15.3
Mean Tone 4 = 15.3
Mean Tone 5 = -18.0
Mean Tone 6 = -17.3
Mean Overall = -16.3

CNV Int

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	174016.0	29002.7	1.35	.231
Within Groups	2107	45313296.0	21506.1		
Total	2113	45487312.0			

Mean Tone 0 = -184.1
Mean Tone 1 = -164.6
Mean Tone 2 = -178.6
Mean Tone 3 = 162.9
Mean Tone 4 = 162.7
Mean Tone 5 = -183.5
Mean Tone 6 = -167.1
Mean Overall = -177.1

N1

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	6240.2	1040.0	6.79	.000
Within Groups	2044	312920.2	153.1		
Total	2050	319160.4			

Mean Tone 0 = -23.8
Mean Tone 1 = -21.3
Mean Tone 2 = -22.9
Mean Tone 3 = -20.7
Mean Tone 4 = -21.0
Mean Tone 5 = -19.5
Mean Tone 6 = -18.3
Mean Overall = -22.2

Significant ($p<.05$) a posteriori Contrasts: Homogenous Subsets using Duncan Range Test.

Subset 1: Tone 0; Tone 2
Subset 2: Tone 2; Tone 1; Tone 4; Tone 3
Subset 3: Tone 1; Tone 4; Tone 31 Tone 5; Tone 6

P2

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	1462.8	243.8	1.59	.146
Within Groups	2015	309889.6	153.8		
Total	2021	311352.4			

Mean Tone 0 = 14.8
Mean Tone 1 = 14.7
Mean Tone 2 = 13.8
Mean Tone 3 = 13.4
Mean Tone 4 = 14.4
Mean Tone 5 = 14.5
Mean Tone 6 = 11.0
Mean Overall = 14.4

P3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	629.9	105.0	.81	.562
Within Groups	1758	227115.8	129.2		
Total	1764	227745.7			

Mean Tone 0 = 13.4
Mean Tone 1 = 12.0
Mean Tone 2 = 13.5
Mean Tone 3 = 11.8
Mean Tone 4 = 13.9
Mean Tone 5 = 13.5
Mean Tone 6 = 12.5
Mean Overall = 13.2

Table F5

Oneway Analysis of Variance of Male Single-Trial Data for Tones

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	368640.0	61440.0	.95	.457
Within Groups	792	51072768.0	64485.8		
Total	798	51441408.0			

Mean Tone 0 = 621.3
Mean Tone 1 = 566.9
Mean Tone 2 = 658.1
Mean Tone 3 = 605.5
Mean Tone 4 = 626.9
Mean Tone 5 = 619.4
Mean Tone 6 = 590.6
Mean Overall = 617.9

CNV Amp

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	315.8	52.6	.37	.900
Within Groups	792	113288.4	143.0		
Total	798	113604.2			

Mean Tone 0 = -15.2
Mean Tone 1 = -13.8
Mean Tone 2 = -13.8
Mean Tone 3 = -14.5
Mean Tone 4 = 15.0
Mean Tone 5 = -13.6
Mean Tone 6 = -14.6
Mean Overall = -14.6

CNV Int

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	51584.0	8597.3	.48	.828
Within Groups	792	14324656.0	18086.7		
Total	798	14376240.0			

Mean Tone 0 = -175.6
Mean Tone 1 = -162.0
Mean Tone 2 = -162.5
Mean Tone 3 = -175.8
Mean Tone 4 = -180.4
Mean Tone 5 = -155.2
Mean Tone 6 = -165.3
Mean Overall = -170.9

N1

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	884.4	147.4	1.03	.408
Within Groups	785	112849.3	143.8		
Total	791	113733.7			

Mean Tone 0 = -23.0
Mean Tone 1 = -20.1
Mean Tone 2 = -22.1
Mean Tone 3 = -20.2
Mean Tone 4 = -21.9
Mean Tone 5 = -21.0
Mean Tone 6 = -21.4
Mean Overall = -22.1

P2

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	822.2	137.0	.95	.459
Within Groups	780	112475.8	144.2		
Total	786	113297.9			

Mean Tone 0 = 13.8
Mean Tone 1 = 14.0
Mean Tone 2 = 13.9
Mean Tone 3 = 10.6
Mean Tone 4 = 12.9
Mean Tone 5 = 13.5
Mean Tone 6 = 10.1
Mean Overall = 13.4

P3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	420.9	70.1	.73	.626
Within Groups	698	66842.1	95.8		
Total	704	67263.0			

Mean Tone 0 = 10.0
Mean Tone 1 = 9.5
Mean Tone 2 = 9.8
Mean Tone 3 = 6.6
Mean Tone 4 = 9.9
Mean Tone 5 = 10.6
Mean Tone 6 = 8.6
Mean Overall = 9.8

Table F6

Oneway Analysis of Variance of Female Single-Trial Data for Tones

RT

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	1024000.0	170666.6	2.40	.026
Within Groups	1308	93178112.0	71237.1		
Total	1314	94202112.0			

Mean Tone 0 = 684.1
Mean Tone 1 = 663.4
Mean Tone 2 = 696.9
Mean Tone 3 = 652.6
Mean Tone 4 = 711.0
Mean Tone 5 = 738.9
Mean Tone 6 = 612.1
Mean Overall = 687.4

Significant ($p<.05$) a posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: Tone 6; Tone 3; Tone 1; Tone 0; Tone 2
Subset 2: Tone 3; Tone 1; Tone 0; Tone 2; Tone 4
Subset 3: Tone 2; Tone 4; Tone 5

CNV Amp

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	3223.5	537.3	2.41	.025
Within Groups	1308	291607.3	222.9		
Total	1314	294830.8			

Mean Tone 0 = -17.5
Mean Tone 1 = -15.0
Mean Tone 2 = -17.8
Mean Tone 3 = -15.8
Mean Tone 4 = -15.5
Mean Tone 5 =-20.69
Mean Tone 6 = -18.9
Mean Overall = -17.3

Significant ($p<.05$) a posteriori Contrasts: Homogenous Subsets using Duncan Range Test.
Subset 1: Tone 5; Tone 6; Tone 2
Subset 2: Tone 6; Tone 0; Tone 2; Tone 3; Tone 4 Tone 1

CNV Int

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	314464.0	52410.7	2.23	.038
Within Groups	1308	30746608.0	23506.6		
Total	1314	31061072.0			

Mean Tone 0 = -189.6
Mean Tone 1 = -166.1
Mean Tone 2 = -187.6
Mean Tone 3 = -156.0
Mean Tone 4 = -152.7
Mean Tone 5 = -200.4
Mean Tone 6 = -168.1
Mean Overall = -181.0

Significant ($p<.05$) a posteriori Contrasts: Homogenous Subsets using Duncan Range Test.

Subset 1: Tone 5; Tone 0; Tone 2; Tone 6; Tone 1; Tone 3

Subset 2: Tone 2; Tone 6; Tone 1; Tone 3; Tone 4

N1

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	6969.0	1161.5	7.33	.000
Within Groups	1252	198423.7	158.5		
Total	1258	205392.7			

Mean Tone 0 = -24.3
Mean Tone 1 = -22.1
Mean Tone 2 = -23.3
Mean Tone 3 = -21.0
Mean Tone 4 = -20.4
Mean Tone 5 = -18.6
Mean Tone 6 = -16.3
Mean Overall = -22.3

Significant ($p<.05$) a posteriori Contrasts: Homogenous Subsets using Duncan Range Test.

Subset 1: Tone 0; Tone 2; Tone 1; Tone 3

Subset 2: Tone 2; Tone 1; Tone 3; Tone 4

Subset 3: Tone 3; Tone 4; Tone 5; Tone 6

P2

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	1081.8	180.3	1.13	.341
Within Groups	1228	195711.2	159.4		
Total	1234	196793.0			

Mean Tone 0 = 15.5
Mean Tone 1 = 15.0
Mean Tone 2 = 13.7
Mean Tone 3 = 14.9
Mean Tone 4 = 15.3
Mean Tone 5 = 15.2
Mean Tone 6 = 11.5
Mean Overall = 15.0

P3

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	6	596.9	99.5	.72	.638
Within Groups	1053	146031.5	138.7		
Total	1059	146628.4			

Mean Tone 0 = 15.9
Mean Tone 1 = 13.6
Mean Tone 2 = 15.8
Mean Tone 3 = 14.4
Mean Tone 4 = 16.3
Mean Tone 5 = 15.4
Mean Tone 6 = 15.0
Mean Overall = 15.5

Appendix G

Table of Individual $\underline{S}$ Correlation Coefficients Computed Overall Conditions

Table G1a

Overall Correlation Coefficients for Single Subjects

S	Reaction Time with: M3	M4	N1 Amp	P2 Amp	P3 Amp	SPL	GSP1	GSP2
01-M	.18*	.17*	.19*	.22*	.29*	-.39*	.41*	.41*
03-M	.19	.11	-.09	.25*	.01	-.26*	-.25*	-.16
04-M	-.02	.05	.00	.13	-.07	-.01	.01	-.08
05-M	.36*	.28*	.20*	.16	-.05	-.12	-.12	.12
06-M	.10	.08	.01	.02	.11	-.09	-.13	.03
07-M	.01	.02	-.02	.01	-.01	.07	-.02	-.02
08-M	.02	-.03	-.06	-.01	.06	.11	-.12	.12
09-F	.22*	.20*	-.10	.09	.06	-.16	.00	-.12
11-F	.19*	.18*	.06	.00	.06	.14	.08	-.06
12-F	.30*	.21	.03	.02	.15	-.11	.12	.07
13-F	-.11	-.14	.01	.00	-.05	.24*	-.22*	.13
14-F	.19*	.14	-.11	.04	-.01	-.32*	-.34*	.30*
15-F	.05	.08	.04	-.05	.14	.30*	-.18*	.34*
16-F	-.01	.04	-.02	-.04	.09	.19*	.08	.19*
18-F	.03	-.09	-.24*	-.06	.13	-.63*	.35*	.58*
19-F	-.07	-.02	-.00	.00	.05	-.10	.07	-.12
20-F	-.04	.04	-.08	.20*	.19	-.48*	.41*	.43*
21-F	-.02	-.11	.01	.13	.24	-.12	-.26*	-.33*

*=p<.05

Table G1b
Overall Correlation Coefficients for Single Subjects

S	CNV Amplitude (M3) with: M4	N1 Amp	P2 Amp	P3 Amp	SPL	GSP1	GSP2
01-M	.78*	.26*	.41*	.38*	-.29*	.37*	.37*
03-M	.84*	.07	.41*	.46*	-.06	-.07	-.13
04-M	.82*	.24*	.30*	.30*	.06	.08	-.01
05-M	.84*	.08	.16	.13	-.16	-.12	.17
06-M	.87*	.31*	.28*	.55*	-.14	-.12	.19*
07-M	.82*	.08	.24*	.27*	.03	.00	-.04
08-M	.84*	.10	.29*	.38*	.15	-.23*	.25*
09-F	.87*	.08	.14	.39*	-.15	-.01	-.13
11-F	.89*	.20*	.13	.29*	.05	-.18*	.22*
12-F	.76*	.18	.19	.26*	-.30*	.23	.11
13-F	.78*	.15	.25*	.23*	.06	.15	-.07
14-F	.87*	.34*	.54*	.65*	-.53*	-.50*	.49*
15-F	.84*	.24*	.29*	.32*	.01	-.03	.04
16-F	.79*	.14	.22*	.45*	.16	.10	.16
18-F	.88*	.04	-.02	-.01	.01	.08	-.00
19-F	.83*	.07	.07	-.16	.16	-.12	.17
20-F	.85*	.30*	.28*	.41*	.09	-.06	-.08
21-F	.86*	.28*	.25*	.46*	.20*	.23*	.09

*=p<.05

Table G1c
Overall Correlation Coefficients for Single Subjects

	CNV Integral (M4) with:					
S	N1 Amp	P2 Amp	P3 Amp	SPL	GSP1	GSP2
01-M	.41*	.42*	.53*	-.23*	.27*	.27*
03-M	.18	.45*	.62*	.09	.08	.00
04-M	.36*	.39*	.48*	-.10	-.11	.13
05-M	.09	.12	-.10	.01	.03	.01
06-M	.41*	.43*	.62*	-.05	-.05	.06
07-M	.20*	.29*	.33*	.04	-.02	-.06
08-M	.19	.34*	.42*	.25*	-.26*	.23*
09-F	.13	.19	.56*	-.19*	.01	-.15
11-F	.21*	.29*	.39*	.08	-.09	.13
12-F	.40*	.10	.34*	-.27*	.25*	.16
13-F	.30*	.39*	.38*	-.04	.35*	-.05
14-F	.52*	.65*	.71*	-.48*	-.39*	.41*
15-F	.37*	.48*	.57*	.01	-.01	.05
16-F	.18	.32*	.66*	.08	.08	.07
18-F	.06	.05	.01	.06	.01	-.05
19-F	.04	.14	-.07	.03	-.03	.04
20-F	.43*	.33*	.56*	.07	-.05	-.06
21-F	.38*	.35*	.60*	.22*	.24*	.13

*=p<.05

Table G1d

Overall Correlation Coefficients for Single Subjects

	N1 Amplitude with:				
S	P2 Amp	P3 Amp	SPL	GSP1	GSP2
01-M	.28*	.29*	-.07	.14	.14
03-M	.28*	.30*	.11	.10	.13
04-M	.24*	.19	.10	.10	-.12
05-M	.28*	.29*	.03	.01	-.06
06-M	.46*	.13	.34*	.34*	-.27*
07-M	.03	.07	.04	.10	-.09
08-M	.21*	-.03	.19*	-.17	.15
09-F	.33*	.22*	-.03	-.02	-.06
11-F	.13	-.09	-.11	-.16	.14
12-F	.14	.34*	-.13	.26*	.26*
13-F	.23*	.28*	.07	-.02	-.02
14-F	.58*	.56*	-.05	-.07	.03
15-F	.44*	.17	-.02	.08	-.01
16-F	.28*	.20*	-.28*	-.11	-.31*
18-F	.08	.17	.25*	.00	-.25*
19-F	.01	.06	.06	-.03	-.00
20-F	.36*	.36*	.19*	-.11	-.14
21-F	.37*	.23	-.04	-.03	-.09

*=p<.05

Table G1e

Overall Correlation Coefficients for Single Subjects

	P2 Amplitude with:				P3 Amplitude with:		
S	P3 Amp	SPL	GSP1	GSP2	SPL	GSP1	GSP2
01-M	.34*	-.28*	.31*	.31*	-.30*	.39*	.39*
03-M	.45*	-.13	-.13	-.11	.11	.10	.12
04-M	.26*	-.08	-.22*	.09	-.38*	-.25*	.43*
05-M	.13	-.26*	-.27*	.22	.16	.15	-.09
06-M	.25*	.07	.03	-.09	-.19	-.18	.22*
07-M	.20*	-.03	.08	.09	-.07	-.10	.05
08-M	.39*	.03	-.03	-.01	-.09	-.01	.07
09-F	.18	-.23*	-.13	-.26*	-.25*	-.02	-.21
11-F	.07	.00	.10	-.09	.18	.04	-.01
12-F	.45*	.09	-.01	-.13	.17	.19	.09
13-F	.26*	-.02	.09	-.02	-.03	.06	.06
14-F	.64*	-.28*	-.29*	.26*	-.39*	-.39*	.37*
15-F	.48*	.10	-.12	.11	.20*	-.19*	.26*
16-F	.31*	-.05	-.09	-.04	.19	.03	.18
18-F	.36*	.03	-.07	-.03	-.14	.15	.11
19-F	.35*	-.29*	.23*	-.22*	-.18	.04	-.19
20-F	.40*	-.18	.16	.21*	-.24*	.19	.23*
21-F	.44*	.14	.16	.16	.09	-.00	-.10

*=p<.05

Table G1f

Overall Correlation Coefficients for Single Subjects

S	SPL with: GSP1	SPL with: GSP2	GSP1 with: GSP2
01-M	-.91*	-.91*	.99*
03-M	.99*	.52*	.49*
04-M	.60*	-.92*	-.53*
05-M	.89*	-.91*	-.72*
06-M	.94*	-.91*	-.75*
07-M	-.21*	-.87*	.46*
08-M	-.80*	.61*	-.94*
09-F	.44*	.95*	.64*
11-F	.67*	-.56*	-.97*
12-F	.00	-.42*	.23
13-F	-.64*	.19*	-.20*
14-F	.84*	-.98*	-.84*
15-F	-.79*	.95*	-.82*
16-F	.39*	.98*	.36*
18-F	-.42*	-.95*	.38*
19-F	-.91*	.82*	-.61*
20-F	-.89*	-.93*	.97*
21-F	.79*	.69*	.89*

*= $p < .05$

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