THE COMBINED EFFECT OF ALCOHOL AND TEMAZEPAM ON INFORMATION PROCESSING

by

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SOURCES STATEMENT

I certify that this thesis contains no material which has been accepted for the award of any degree or diploma in any university, nor any material previously published or written by another person, except when due reference to such material is made in the text.

Signed .....

ABSTRACT

The present research investigated the separate and interactive effects of high doses of a minor tranquilliser (temazepam) (20 mg) and alcohol (BAC = 0.10%) on human information processing using a dual-task paradigm.

For this purpose dual task methodology was combined with P300 amplitude and latency as an index of resource allocation. A dual task paradigm in which subjects were instructed to attend to two tasks concurrently (which had the effect of increasing overall cognitive load) was used to indicate if the affects of alcohol and/or temazepam impaired the contextual updating of neuronal models in the brain and/or reduced specific 'pools of available resources'.

Twelve subjects completed four drug treatments in a repeated measures design. The four drug treatments organised in a two by two design, included a placebo condition (alcohol no/temazepam no), an alcohol only condition (alcohol yes/temazepam no), a temazepam only condition (alcohol no/temazepam yes), and a combined condition (alcohol yes/temazepam yes). Event-related potentials were recorded from midline sites Fz, Cz and Pz within a dual task paradigm.

The results indicated that at higher doses, widespread neural depression by alcohol overlapped the specific depressant effects of temazepam. The effect of ingesting high doses of alcohol and temazepam was synergistic, that is the combined effects of alcohol and temazepam were greater than their summated individual effects. In terms of information processing, from the perspective of contextual updating the process of updating the pre-existing neuronal model may be restricted, or from the view of resource allocation the actual pool of available resources may have been reduced.

The RT data suggested that alcohol and temazepam may have had an additive effect on psychomotor processing. Both alcohol and temazepam significantly increased RT when ingested separately, but there was no interaction between the two drugs. Therefore alcohol and temazepam appeared to affect different aspects of RT processing.

CONTENTS

Chapter 1

Introduction

Introduction

The effect that drugs such as alcohol and benzodiazepines have on the physical and behavioural functions of the human body when ingested separately are well documented (Wallgren & Barry III, 1970; Greenblatt & Shader, 1974). Alcohol causes dose dependent impairment, disorganisation and depression of CNS functioning. Temazepam is a short acting anxiolytic from the benzodiazepine group, which inhibits neural firing in a dose dependent fashion creating CNS depression, sedation and anxiety reduction (Davies, 1990).

The few available studies on the simultaneous ingestion of alcohol and benzodiazepines have shown widely differing results on the physiological and behavioural functioning of the human body. Including antagonistic, in which the effects of one of the drugs are lessened in the presence of the other and synergistic in which the combined effects are greater than the sum of the two separate effects (Mhatre, Mehta, & Ticku, 1988). If the drugs do not interact, then they are said to work additively, that is, the effect of each is the same whether or not the other is present. In this situation the drug effects are summed, that is, the behavioural and physiological effects of alcohol and benzodiazepines are equal to the sum of the separate effects of the two drugs (Smith, Corbascio, & Ty-Smith, 1986).

Psychophysiological measures of brain activity in the form of the event-related potential (ERP) have been utilised to assess the effects of alcohol and benzodiazepines on CNS functioning. The P300 component of the ERP can be used in combination with reaction time (RT) to investigate the neural events that underlie information processing and the mechanisms that affect the psychophysiological processes of attention. At a functional level, P300 amplitude indexes stimulus significance and

performs an important role in memory (Donchin, 1984). P300 latency is suggested to be determined by the time required for stimulus evaluation and to be independent of response selection and execution times (Johnson, 1986; Donchin, Kramer, & Wickens, 1986; Magliero, Bashore, Coles, & Donchin, 1984; Kutas, McCarthy, & Donchin, 1977). RT is thought to be an indicator of psychomotor processes underlying components of motor response. In addition, the P300 component has been employed as an index of resource allocation theories of attention and it has been shown that P300 amplitude is a valid measure of limited capacity perceptual-cognitive resources (Donchin et al., 1986). Resource allocation theories (Israel, Chesney, Wickens, & Donchin, 1980a) assume that there are distinct kinds of resources, rather than a single pool of resources, and that different types of processing utilise specific pools of resources, which can be shared by different cognitive operations (Wickens, 1980).

A dual task paradigm can be utilised as a tool to assess the demand for specific pools of available resources. A task in which subjects are instructed to attend to two tasks concurrently may be a useful strategy to indicate if the effects of alcohol and/or temazepam reduce distinct pools of available resources. It is suggested that the amount of processing capacity available to either of the two tasks would be less than the amount available if only one task was being performed.

This study aims to investigate the separate and interactive effects of high doses of alcohol and temazepam on human information processing using a dual-task paradigm and P300 amplitude, latency, and RT as an index of resource allocation. Chapter 2 will review the literature on the effects of alcohol on the CNS and the cognitive and behavioural effects of alcohol. Chapter 3 will examine the effects of benzodiazepines on the CNS and the cognitive and behavioural effects of benzodiazepines. An analysis of what

is known about the combined effects of alcohol and benzodiazepines will be conducted in Chapter 4. Chapter 5 will describe the late component of the ERP known as P300 which has evolved as a useful tool in cognitive psychophysiology. Chapter 6 will discuss the efficacy of using the P300 as an index of the neural events that underlie the psychophysiological processes of attention and theoretical models of this process will be reviewed. Chapter 7 will consider the effects of alcohol and benzodiazepines on information processing as indexed by P300. Chapter 8 will summarise the presented information and propose some likely outcomes of the study. Chapters 9 and 10 will describe the methodology and results of this research project, which will then be critically discussed in relation to prior research and expected outcomes in Chapter 11.

Chapter 2

Effects of Alcohol

Effects of Alcohol

2.0 Introduction

The ingestion of alcohol results in progressive and simultaneous impairment of function (Barry III, 1979). The effects of alcohol vary depending on many factors including: amount, type, method consumed, and such individual factors as: percentage of body fat, tolerance, age, sex, nutritional state, personality, and physical state. Impairment occurs progressively with increasing levels of blood alcohol concentration (BAC), (Wallgren & Barry III, 1970). Although the most visible effects of alcohol are on the physical and behavioural functions of the body, its most serious effect is on the brain and CNS.

2.1 Effects of alcohol on the Central Nervous System

Alcohol causes universal and progressive impairment, disorganisation, retardation, and depression of CNS functioning. The sedative effect of alcohol is generally thought to result from inhibition of brain functions (Donelson, 1988). Low doses of alcohol suppress inhibitory mechanisms in the brain, leading to what is outwardly observed as behavioural excitation. At higher doses, excitatory suppression takes over, and CNS depression is observed as simultaneous behavioural inhibition (Arif & Westermeyer, 1988). Physiologically, at low alcohol levels, increased neuronal excitation reflects synaptic transmission enhancement, while at higher doses, the progressive reduction of excitation is due to the delay of synaptic impulses which at increasing levels of intoxication can lead to a complete block of synaptic transmission (Berry & Pentreath, 1980; Block, 1973; Julien, 1978).

The exact nature of the neuronal response to alcohol ingestion is

unclear. Calcium is a transmitter which is vital in regulating the excitatory impulses of the brain. Alcohol depletes calcium levels within the CNS which causes deregulation of neuronal excitation. Another of the neural effects of alcohol which has received attention is its action on the inhibitory neurotransmitter gamma-aminobutyric acid (GABA). Alcohol is a CNS depressant which depresses GABA inhibition, therefore alcohol may depress the brain's activity through GABA (Nestoros, 1980). Alcohol administration may increase the binding capacity of GABA binding sites. Nestoros (1980) suggests that alcohol enhances the effects of GABA. Using much lower concentrations of alcohol than many earlier studies he found that alcohol did not produce inhibition alone, but only in the presence of GABA, suggesting that it does not directly mimic the actions of GABA. Therefore at lower doses, alcohol may facilitate GABAergic inhibition producing behavioural disinhibition. Whereas at higher doses alcohol may cause CNS inhibition through a general depressing effect and also through potentiating GABA.

2.2 Behavioural and Cognitive effects of alcohol

The most visible effects of alcohol are on the physical and behavioural functions of the body. The immediate effects of alcohol ingestion include loss of inhibition, dizziness, loss of co-ordination and motor skills, slow reactions, staggering, slurred speech, and impairment of senses (Wallgren & Barry III, 1970; Berry & Pentreath, 1980). Impairment of function is progressive with increasing levels of BAC, (Barry III, 1979), that is, the effects of alcohol are dose dependent.

A distinction can be drawn between the motor effects of alcohol and the cognitive effects. Both of these kinds of action are centrally regulated by the CNS (Wallgren & Barry III, 1970). The consumption of alcohol produces

obvious signs of motor impairment primarily due to the depression of the cortical centres that control muscular activity. Peripheral action of alcohol on muscle tissue and other structures have slight influence.

Psychomotor impairment is greatest at high levels of alcohol consumption (BAC: 0.05% and above) (Young, 1970; Franks, Hensley, & Starmer, 1976; Ellinwood & Heatherley, 1985). However, even at low doses hand eye co-ordination, muscular co-ordination and smooth motor operating processes are impaired (Franks, Hensley, Hensley, Starmer, & Teo, 1976b). Due to the inherent difficulties in measuring the effects of alcohol consumption on psychomotor performance, the RT measure has been used. RT refers to the time it takes for a subject to respond to a stimulus with a motor response. A direct relationship exists between alcohol dosage and performance on tasks involving simple and choice reaction time (CRT) in that a dose dependent slowing of response occurs: as BAC increases, RT increases (Ross & Pihl, 1987). Some controversy exists with inconsistent results being found at BACs under 0.07% (Wallgren & Barry III, 1970). Alcohol has little effect on RT at low doses and has even been found to decrease RT (Wallgren & Barry III, 1970). At moderate alcohol doses (BAC of 0.02% - 0.05%), Declerck (1990) found no impairment on RT in a task requiring rapid response to unexpected stimuli. At higher BACs (0.05% and above), RT is consistently slowed (Declerck, 1990; Rohrbaugh, Stapleton, Parasuraman, Zubovic, Frowein, Varner, Adinoff, Lane, Eckardt, & Linnoila, 1987; Ross & Pihl, 1987; Linnoila, Erwin, Ramm, & Clevland, 1980; Young, 1970; Franks et al., 1976; McKim, 1986; Taylor 1988). Declerck (1990) found significantly increased RT's with 0.08% BAC compared to placebo doses. The slowing of RT has been hypothesised to reflect a slowing of the cognitive processes involved in responding to stimuli (Wallgren & Barry III, 1970).

It is generally considered that alcohol consumption disrupts cognitive functions. Franks et al. (1976) suggest that cognitive performance is more resilient to alcohol effects than psychomotor performance. Impairment is substantial after high doses, whereas at lower levels results are ambiguous. Such tasks as intellectual reasoning, judgement, psychometric performance, memory for words and numbers, attention, and concentration are all severely diminished after moderate to high doses of alcohol (Franks, et al., 1976; Minocha, Barth, Roberson, Herold, & Spyler, 1985; Oscar-Berman, 1987). Also information processing indexed by the distribution of attention over a complex situation seems to be sensitive to alcohol consumption (Buikhuisen & Jongman, 1972). Buikhuisen and Jongman (1972) found that intoxicated individuals (BAC 0.08%) showed reduced range of attention and less flexible searching strategies than sober individuals. Alcohol consumption results in a decreased ability to deal with the unexpected because of the additive demands on attention and judgement. Alcohol therefore impairs arousal and attention which has the effect of decreasing the amount of cognitive resources available to tasks (Oscar-Berman, 1987).

Chapter 3

Effects of Benzodiazepines

Effects of Benzodiazepines

3.0 Introduction

Unlike alcohol, the minor tranquillisers known as benzodiazepines are not generally considered neuronal depressants, however, like alcohol they inhibit neural firing in a dose dependent fashion creating CNS depression (Davies, 1990). As dose increases the signs of CNS depression become more apparent. These signs include ataxia, somnolence, and slurred speech at very high doses and overdose can cause death through respiratory depression (Benzer, 1987). Benzodiazepines loci of effect lies in the spinal cord, the ascending reticular activating system, hypothalamus, cerebellum, limbic system and the cerebral cortex (Balderssarini, 1980; Colesanti, 1982; Greenblatt & Shader, 1981; Shalleck, Scholsser, & Randell, 1972; Davies, 1990).

3.1 Effects of benzodiazepines on the Central Nervous System

As with alcohol, benzodiazepines enhance inhibitory interneuronal action resulting in the brain being unable to respond to rapid impulses generated by the CNS (Greenblatt & Shader, 1976). Neurochemically, benzodiazepine specific receptors are found predominantly in the cerebral cortex and cerebellum. When benzodiazepines are ingested they bind to these receptors which are in close association with GABA receptors. As with alcohol, benzodiazepines act predominantly by potentiating inhibitory neurotransmission mediated by GABA. Thus benzodiazepines stimulate the transfer of GABA-mediated inhibitory signals which cause an opening of chloride ion channels and result in increased feelings of calmness, ease and relaxation (Davies, 1990; Costa, Guidotti, Mao, & Suria, 1975; ; Martin, Siddle, Gourley, Taylor, & Dick, 1992b; Gray, 1988; Mant, et al., 1987;

Mashford, 1984; Ray & Ksir, 1987; Hayward, Wardle, & Higgitt, 1989).

The CNS depressant actions of benzodiazepines are far more localised than those of alcohol, concentrating mainly in the limbic system and the RAS (Iversen, 1983; Young & Kuhar, 1980). The limbic system is thought to be involved in the regulation of emotional behaviour and is closely associated with the presence of anxiety. Benzodiazepines relieve anxiety and tension by reducing autonomic functioning and selectively inhibiting limbic system activity, that is, exerting their hypnosedative effect throughout the system (Greenblatt & Shader, 1976).

3.2 Behavioural and Cognitive effects of Benzodiazepines

The predominant effects of the benzodiazepines include the reduction of hostility and aggressive behaviour, and the lessening of the behavioural consequences of frustration, fear, and punishment, producing a reduction of tension, stress, and anxiety and a calm sense of relaxation (Greenblatt & Shader, 1974; Burrows, Norman, & Vajda, 1990).

The cognitive and motor effects of benzodiazepines can be differentiated. As with alcohol both of these kinds of action are centrally controlled by the CNS. Peripheral action of benzodiazepines on muscle tissue and other structures exercise little if any influence.

Due to the diverse effects of benzodiazepines across a range of dosage levels, a discussion of psychomotor impairment is tentative. Benzodiazepines appear to produce a decrement in psychomotor performance but the degree of impairment is in dispute. Co-ordination and standing steadiness were found to be impaired at 5 mg and 10 mg doses of diazepam (Seppala, Korttila, Hakkinen, & Linnoila, 1976), but at a dose of 6 mg no decrement was reported (Wittenborn, 1979). Studies involving the psychomotor performance measurement of RT have yielded similar

findings. In a review of the literature Kleinknecht and Donaldson (1975) found that benzodiazepine RT decrements are dose dependent, dependent on the mode of administration and on the sub-type of benzodiazepine used. Palva, Linnoila, Routledge, and Seppälä (1982) found that a 10 mg dose of diazepam did not impair performance on CRT. Kleinknecht and Donaldson (1975) cite a study where CRT was not impaired at an oral dose of 15 mg of diazepam but was after a 0.2 mg/kg dose intravenously administered. In a recent study Martin et al. (1992b) found that temazepam had no significant effect on RT at the 10 mg dose used. Temazepam has been discovered not to slow CRT at a 15 mg oral dose but does after a 30 mg dose (Bond & Lader, 1980; Hindmarch, 1988). It would appear that moderate doses of benzodiazepines produce little decrement in psychomotor performance, this may suggest that there is little detriment to the cognitive processes which underlie RT.

It is generally understood that benzodiazepine consumption influences cognitive functions. Cognitive impairment after benzodiazepine ingestion is dose dependent (Wittenborn, 1979). Decision making, card sorting, cancelling designated letters, perceptual speed tests, and digit symbol substitution tests are all effected by benzodiazepine administration (McKim, 1986; Smith, Kroboth, & Phillips, 1986; Wittenborn, 1979). Learning and memory consolidation deficits also appear after benzodiazepine ingestion (Lister, 1985), but the more established higher mental functions are less sensitive to benzodiazepine interference (Lader, 1983). It has also been postulated that the cognitive correlate of benzodiazepine GABAergic inhibition may be a reduction in attentional resources available for efficient allocation of resources (Martin, Nichols, Mills, & Siddle, 1992a).

Chapter 4

Interaction of Alcohol and Benzodiazepines

Interaction of alcohol and benzodiazepines

The simultaneous ingestion of alcohol and benzodiazepines, if taken in high enough concentrations, may lead to excessive CNS depression and even death. At lower doses simultaneous benzodiazepine and alcohol ingestion results in motor co-ordination impairment and in the impairment of judgement and psychomotor tasks (Martin et al., 1992a; Tong & Bernstein, 1988; Funderburk, Bigelow, Liebson, & MacKenzie, 1989). The interactive effects of these two classes of drugs have shown widely differing effects, including antagonistic, in which the effects of one of the drugs are lessened in the presence of the other and synergistic in which the combined effects are greater than the summated individual effects (Mhatre et al., 1988). If the drugs do not interact, then they are said to work additively, that is, the effect of each is the same whether or not the other is present. In this situation the drug effects are summed, that is, the behavioural and physiological effects of alcohol and benzodiazepines are equal to the sum of the separate effects of the two drugs (Smith et al., 1986).

Clinical literature (Davies, 1990; MIMS, 1989) cautions of an interaction between the two types of drugs however, the origin of this information is unclear, since the few studies of the combined effect of alcohol and benzodiazepines have shown inconsistent results. Greenblatt and Shader (1974) believe that any benzodiazepine-alcohol interactions are minimal or non-existent. In a review of five studies that combined benzodiazepines with alcohol Greenblatt and Shader (1974) found no evidence of an interaction, as measured by psychomotor tasks. Palva et al. (1982) found that a combination of 0.03-0.04% BAC and 10 mg of diazepam had no significant effect on CRT, tracking or attention. Martin et al. (1992a) found no interaction between the two drugs, using a BAC of 0.04% and 10

mg of temazepam, that is, there was no indication of an antagonistic or synergistic effect of the combined drugs. The majority of researchers believe that the benzodiazepine-alcohol combination is of an additive nature (American Medical Association, 1986; Balderssarini, 1980; Stock, 1981; Hansten, 1979; Julien, 1978; Milner, 1972; Wincor, 1988).

On a neurophysiological level, alcohol is a CNS depressant which depresses GABA inhibition (Nestoros, 1980). Drugs with a similar pharmacological profile such as the benzodiazepines may potentiate the effects of alcohol. Thus, benzodiazepine and alcohol administration depress the brain's activity through GABA. It is possible that benzodiazepines cause the brain to become more receptive to the effects of alcohol (Linnoila, Saano, Seppala, Olkeheimi, & Liljeqvist, 1974). Laisi, Linnoila, Seppälä, Himberg, and Mattila (1979) suggest that any interaction between alcohol and benzodiazepines may be pharmacodynamic in nature, with alcohol enhancing the absorption of benzodiazepines, thus accelerating the availability of the drug. It is possible that GABA benzodiazepine receptor action is potentiated after alcohol administration, resulting in a facilitation of GABA benzodiazepine inhibition and an increase in the depressive effects of both above and beyond what would normally occur separately, such a physiological reaction would be synergistic in nature (Mhatre et al., 1988; Chan, 1984). On the other hand high doses of temazepam may have an antagonistic effect on alcohol. That is the effect of alcohol ingestion may be reduced by temazepam. Physiologically this may not cause alcohol's potentiation of GABA in the presence of temazepam. This may be due in part to the CNS depressant actions of temazepam being far more localised than those of alcohol.

Chapter 5

The P300 ERP Component

The P300 ERP component

The interaction between information processing and behavioural output may be reflected via cognitive psychophysiological measures of brain activity in the form of event-related potentials (ERPs). The late ERP components are assumed to be neuronal manifestations of information processing or stimulus evaluation and response execution (Brandeis & Lehmann, 1986). The P300 is a late component of the ERP which has evolved as a useful tool in cognitive psychophysiology, it can be used in combination with reaction time (RT) to deduce the neural events that underlie the psychophysiological processes of attention (Donchin, 1984).

Event Related Potential (ERP)

The ERP consists of a series of positive and negative waveforms. The ERP can be defined in terms of polarity (positive, negative), latency (time of occurrence after stimulus presentation), amplitude (the electrical magnitude in microvolts), and scalp distribution. Sutton, Braren, Zubin, and John (1965) suggest that components of the waveform occurring within the first 250 ms after stimulus presentation are a reflection of activity associated with the physical characteristics of the stimulus (which are known as exogenous influences). Subsequent components, that occur after 250 ms are independent of these parameters and therefore are generated endogenously, that is, they are defined by internal processes of the brain.

Exogenous waveform

Exogenous components represent the response of brain tissue to the activation of a peripheral sense organ by an external event. They are obligatory responses to stimuli. For example, if a stimulus is presented to a

living person with an intact auditory system, these potentials will invariably appear. In fact, if these potentials do not appear, we can assume the person to have some hearing loss (Davis, 1976b). The exogenous components are very sensitive to the sensory characteristics of the eliciting stimulus (Donchin & Isreal, 1980). As exogenous components are influenced by physical characteristics of the stimulus, they vary in their distribution over the scalp relative to the primary cortical area subserving the stimulus modality (Spong, Haider, & Lindsley, 1965), thus such components are often called 'sensory evoked potentials' (Ritter, Simson, & Vaughan, 1972). These components are affected by variations in stimulus frequency, intensity, and duration (Squires, Squires, & Hillyard, 1975).

Of note are the N200 and P200 components which are thought to index physical characteristics of stimuli. The N200 and P200 components are considered to be primarily exogenous in origin and as such to be related to the quality of sensory input and are relatively insensitive to changes in information processing demands (Rohrbaugh et al., 1987; Hillyard & Kutas, 1983).

Endogenous waveform

The endogenous components are unaffected by external stimulus characteristics. Of particular interest is the P300 (or late positive component), exhibited at approximately 300 ms latency, which has been postulated to reflect cognitive processing invoked by preceding stimuli.

The P300 is found in both auditory and visual evoked potentials. It's latency and amplitude can be affected by discriminability, duration and the complexity of the assigned task. P300 will not occur until the stimulus is categorised, thus the longer it takes to discriminate a stimulus, the longer P300 latency will be (Ritter et al., 1972; Squires, Donchin, Squires, &

Grossberg, 1977). In addition P300 amplitude will not reach maximum amplitude until all information has been evaluated. The two main parameters of interest are the amplitude of the P300, and it's latency, that is, the time which elapses between stimulus onset and the peak of the P300.

Amplitude of P300

P300 amplitude is a measurement taken from a baseline to the peak of the response. Maximum amplitude of P300 is recorded at parietal and central recording sites (Duncan-Johnson & Donchin, 1977). The amplitude of P300 can be influenced by a number of factors; including, manipulation of probability, meaning, and stimulus information transmission (Johnson, 1986; Squires, Donchin, Herning, & McCarthy, 1977).

P300 amplitude is directly related to the amount of uncertainty produced by a stimulus, that is the greater the uncertainty, the greater the P300 amplitude. The variables that influence the magnitude of this dimension contributing to the overall P300 effect include *a priori* probability and formation of expectancies (Johnson, 1986; 1979). An inverse relationship exists between *a priori* stimulus probability and P300 amplitude, with P300 amplitude greater for low probability events (Duncan-Johnson & Donchin, 1977). Furthermore, this relationship has been found for virtually any kind of stimuli and across a wide range of tasks (Ruchkin, Sutton, Murison, Silver, & Macar, 1981). Variations in P300 amplitude occur as a function of the preceding sequence of events (Squires, Wickens, Squires, & Donchin, 1976) and repeated stimuli elicit smaller P300s than non-repeated stimuli, thus subjects expect events to repeat and are surprised when their expectations are violated. This sequential expectancy has been well documented (Duncan-Johnson & Donchin, 1977; Johnson & Donchin, 1978, 1980, 1982)

The magnitude of P300 elicited by a particular stimulus at a given level of probability varies as a function of the subject's task (Johnson, 1986). The portion of P300 amplitude sensitive to changes in meaning is influenced by task complexity, stimulus complexity, and stimulus value . Generally, the greater the complexity of the task demand, the more extensive processing of a stimulus is required in order to extract its full content. P300 amplitude increases directly with the degree of task complexity (Chesney & Donchin, 1979; Johnson & Donchin, 1978; 1982). Also the P300 amplitude is directly related to stimulus complexity. That is, some stimuli require more processing and categorisation than others (Johnson, 1986). Stimuli that have greater value, or significance (e.g. monetary rewards) elicit larger P300s than insignificant stimuli (Johnson, 1979; Obitz, Rhodes, & Creel, 1977).

P300 and Latency

The occurrence of a positive waveform component at a latency of approximately 300 ms (P300) was initially recognised by Sutton et al. (1965). However, P300 latency can vary from 200 ms (Roth & Kopell, 1973), to 750 ms (Donchin, 1979; Donchin et al., 1986).

The latency of P300 is a reflection of the time taken to evaluate and categorise a stimulus (Maglerio, Bashore, Coles, & Donchin, 1984). P300 latency is a sensitive index of the duration of stimulus evaluation processing (encoding, recognition and classification) and is affected by similar variables as for P300 amplitude (Hillyard, 1985). Generally the longer it takes to evaluate and categorise a stimulus, the longer P300 latency, thus the measure of P300 latency is indexing the time required for stimulus evaluation. Recent research has concentrated on the relationship between P300 and RT, as the two measure in combination yield useful data

concerning information processing.

P300 Latency and Reaction Time

In the P300 literature behavioural reaction time (RT) measures have been examined in attempts to identify categorisation and response factors (Craft & Simon, 1970). In this context RT refers to the time it takes a subject to respond with a motor response to a rare task relevant stimulus. There is considerable literature on the association or dissociation between P300 latency and RT. Tueting et al. (1971) noted that a majority of studies show a dissociation between P300 latency and RT. McCarthy and Donchin (1981) found RT was affected by discriminability and stimulus response compatibility, while P300 latency was affected only by stimulus discriminability. Donchin (1979) suggested that the dissociation between P300 latency and RT may depend on the strategy of the subject as many different processes determine RT but only a small subset of these processes determine P300 latency.

Kutas, McCarthy, and Donchin (1977) demonstrated that when subjects try to respond accurately to stimuli, that the correlation between P300 and RT is high. However, if subjects are trying to respond as quickly as possible, the stimuli may not be processed completely before responding, thus RT is faster and precedes P300 latency. Probable events are identified faster as reflected by the latency of both P300 and RT, but as probability increases the RT incrementally decreases at a faster rate than the P300 latency. Therefore in the case of low probability presentations, the P300 can precede the RT but at higher probability the RT markedly precedes the P300 (Duncan-Johnson, 1981). On trials where an incorrect response is made, RT typically precedes P300. Thus latency is determined largely by the duration of categorisation process and not by the response selection and execution

processes (Donchin et al., 1986; Kutas et al., 1977).

Chapter 6

Context updating, resource allocation

and

dual task paradigms

Context updating, resource allocation and dual task paradigms

Cognitive psychophysiology is the relationship between cognitive processes and physiological measures. If psychophysiological measures are sensitive to particular information processing activities they can be used to understand how these processes interact to produce behavioural output.

It has long been suggested that brain waves might be used for the timing of mental events or processes (Kutas et al., 1977). Kutas et al. (1977) suggested that the timing of mental processes independent of response selection and execution time can be used to analyse stages of processing independently of motor responses. The P300 component of human ERP can serve as an index for measuring stimulus evaluation time. A number of theoretical views about the relationship between P300 and cognitive processes exist. These include Donchin's (1981) 'context updating theory' and the theory of resource allocation.

Context Updating

One of the most systematic and influential theoretical views to the functional significance of P300 is Donchin's (1981) 'context updating theory'. This assumes that the brain carries a neuronal model which is a representation of all the information which exists in the immediate environment. When the brain detects differences between its neuronal model and actual occurrences in the environment, a process of contextual updating occurs. This updating process brings the neuronal model into line with the new information that has become available. The P300 is a physiological marker of this updating process (Donchin, 1981). Stimuli

differing substantially from the current representation in the brain require more context updating resulting in larger P300s and this may suggest that P300 reflects the updating of working memory. Once a certain stimulus is identified and categorised it is hypothesised that 'context updating' commences. Surprising, low probability stimuli impinge on a subject's ongoing cognitive processes leading to a revision of those processes and an updating of the models of the environment held by the subject: the context revision is manifested by the P300 (Donchin, 1979., in Pritchard, 1981; Donchin & Coles, 1988).

Resource allocation

Another theoretical view has been to think of P300 as signifying the allocation of processing resources to a task. Several theories suggest that 'attention' should be viewed as a resource of limited supply, different quantities of which can be allocated to different information processing activities (Kahneman, 1973). The term 'resource' is used here to describe processing capabilities which must be used in a task performance. 'Resource' like attention is a hypothetical construct which is invoked to account for variance in performance (Isreal et al., 1980a). The processing capacity postulated by Kahneman (1973) is conceived as a pool of multi-purpose resources which can be drafted into any process.

Wickens (1980) suggested that resource allocation theories assume that there are distinct kinds of multi-purpose resources, rather than a single pool of resources, and that different types of processing utilise their own pool of resources which can be shared by several cognitive operations. P300 may signify the allocation of processing resources to a task and hence P300 amplitude may be employed as an index of resource allocation theories of attention. It has been shown that P300 amplitude is a valid measure of

limited-capacity perceptual or perceptual-cognitive resources (Donchin et al., 1986). This can be applied in situations such as divided attention and dual task performance.

Dual task paradigms

The use of dual task methodology has frequently been employed in research on human information processing (Fisk, Derrick, & Schneider, 1986). Dual task paradigms reflect a variety of different factors, depending on the particular dual task methodology used to address the identified research question. The dual task procedure may attempt to index any excess mental capacity of the individual while engaged in some task or some mental activity, that is assess the resource demands of some task or task components. It may be used to suggest the amount of cognitive effort/capacity demanded by a primary task. Or it may be used to assess the effects of increased cognitive load on an individual's performance, that is asking an individual to complete an additional task will increase the demand for cognitive processing and may reduce the ability to perform an initial task. The interpretation of dual task results in terms of overlapping demands is consistent with resource models of attention which assume that processing resources are limited in quantity and shareable between concurrently performed tasks (Kahneman, 1973).

Fisk et al. (1986) propose three criteria which should be met in dual task experiments that draw inferences from secondary task decrements, those being: (i) there should be resource trade-off with the secondary task sensitive to the resource demands of the primary task, (ii) there should be equivalence of single and dual primary task performance and (iii) the secondary task must remain resource sensitive throughout the experiment. It should be noted that these criteria are only important when the rationale

of the dual task paradigm is to postulate whether performance on a secondary task is predictive of primary task difficulty.

The implication is that only one hypothetical construct, which can assume different values, is necessary to account for performance variability in a dual-task paradigm (Isreal et al., 1980a). According to this view, when one of several concurrent tasks utilises some proportion of the available resource pool, fewer resources are available for the performance of the other task. (Isreal et al., 1980a). Within this framework, the failure of rare, ignored events to elicit P300 is due to the fact that the subject's resources are not utilised to process the secondary task whenever those resources are demanded by a 'primary task'. Similarly a reduction in P300 amplitude to the attended secondary task demonstrates the demand by the primary task for processing resources and vice versa, that is a reduction in P300 amplitude to the attended primary task if processing resources are used on the secondary task.

Isreal et al. (1980a) suggest that P300 amplitude may be used as a reliable measure in the study of the allocation of processing resources among concurrently performed tasks. In a dual task paradigm the amplitude measurement to surprising, task relevant stimuli would index the amount of processing resources being allocated to performing the required task. If we assume that the individual being studied is performing the task to the best of his/her ability, then the recorded P300 amplitude would be an indicator of the total processing capacity available for allocation. Within a dual task paradigm, P300 has been found to increase in amplitude with increased processing demands when elicited by task relevant events in a primary task. On the other hand, P300s elicited by secondary task events decrease in amplitude with increases in perceptual/cognitive difficulty of a primary task (Isreal et al., 1980a; Isreal,

Wickens, Chesney, & Donchin, 1980b). This pattern of changes in P300 amplitude is consistent with predictions of resource models of attentional allocation (Navon & Gopher, 1979). Thus, it appears that while P300 latency provides information concerning the mental chronometry of information processing, P300 amplitude is sensitive to changes in the resource demands of processing (Kramer & Strayer, 1988).

However, current formulations of resource theory hold that a number of processing units have their own supply of resources that can be shared by several on going cognitive operations (Friedman & Polson, 1981). One such model proposed by Wickens (1980), the 'multiple attentional pool model' argues that processing resources may be represented by three dimensions: stages of processing (perceptual/central and response), codes of processing (verbal and spatial) and modalities (visual and auditory). In a multiple resource model, resources for task performance are not allocated in a continuous manner from one pool, but rather competition among tasks for attentional capacity occurs as a function of the tasks' stages of processing, codes of verbal and spatial processing, modalities of input, and response type (Fisk et al., 1987). Tasks that place demands on the same limited capacity processes are predicted to be more poorly time shared than tasks that do not overlap in their processing requirements (Kramer & Strayer, 1988).

Important substantiating data from the point of view of resource allocation theory was provided by Hoffman, Houck, MacMillan, Simons, and Oatman (1985), who showed in a dual task situation combining a Schneider and Shiffrin (1977) consistent-mapping search task with a discrimination task and by varying the relative importance of each task, that the P300 amplitude in each task was a function of the relative amount of attention allocated to that task, and thus that trade off in P300 amplitude

was closely related to the accuracy with which a given task was performed (Näätänen, 1988). Reductions in P300 amplitude resulted in linear reductions in accuracy, and the same linear relationship between the reduction in accuracy and the P300 amplitude held for both tasks, this suggests the presence of a single resource required by both tasks. Hoffman et al. (1985) suggests that this resource plays a pivotal role in the accuracy of performance.

A dual task paradigm in which subjects are instructed to attend to two tasks concurrently may be used to assess the effects of increased cognitive load on an individual's performance. Such a task may be a useful strategy to indicate if the affects of alcohol and/or temazepam impair the contextual updating of neuronal models in the brain and/or reduce availability of 'specific pools of resources'.

Chapter 7

Combined effects of Alcohol and Temazepam on information processing

The effects of alcohol and temazepam on information processing as indexed by P300

Effects of alcohol on early ERP components

The administration of alcohol has been associated with a decrease in amplitude of early ERP components, but no change in latency (in waveform components prior to 250ms) (Lewis, Dustman, & Beck, 1969; Lewis, Dustman, & Beck, 1970; Rhodes, Obitz, & Creel, 1975; Declerck, 1990).

Effects of alcohol on information processing as indexed by the P300

There have been a prolific number of studies designed to assess the effect that alcohol has on human information processing as indexed by P300. Alcohol consumption reduces the amplitude of the late components of evoked responses regardless of sensory modality (Salamy, Wright, & Faillace, 1986; Lewis et al., 1970; Wagman, Allen, Funderbunk, & Upright, 1978; Tharp, Rundell, Lester, & Williams, 1974; Teo, & Ferguson, 1986). In a review of five studies that considered the effects of alcohol on late ERP components related to cognitive processes Oscar-Berman (1987) noted a consistent finding of reduced P300 amplitude, but found the increase of latency due to alcohol less reliable. Campbell and Lowick (1987) examined the acute effects of alcohol on ERPs elicited by auditory stimuli. Using an oddball task they found that alcohol ingestion had a significant effect on a number of ERP components, P300 amplitude was reduced (in relation to alcohol dosage, task difficulty, stimulus meaning, and value) and P300 latency to targets was increased by alcohol.

Rohrbaugh et al. (1987) used three levels of alcohol dosage (BAC 0.00% - 0.05%, 0.05% - 0.08%, and above 0.08%) to evaluate dose related

interactions with ERPs in a visual sustained attention task. They demonstrated a dose dependent decline in detection performance and an increase in reaction time to detected targets. ERP components (N1 and P2) were not influenced by dose, but the latency's of N2 and P300 increased as a function of dose (paralleled by RT increases) whereas amplitude decreased. ERP and performance data were interpreted as demonstrating an adverse effect of ethanol on central processing capacity. Taken together these two studies show that alcohol reduces amplitude of P300, this reduction is not restricted to task difficulty or type of task (visual/auditory) as ERP impairment may be prominent before any particular performance decrement (Oscar-Berman, 1987).

Roth, Tinklenberg, and Kopell (1977) found that visual ERPs were effected by alcohol (using a 0.95 mg/kg of body weight dose of alcohol). They found a reduction in P300 amplitude, but no effect on latency. Zuzewicz (1981) using a 1 g/kg of body weight dose of alcohol, and a visual flash evoked potential found that P300 latency increased due to alcohol, and that P300 amplitude varied as a function of time. That is, 30 mins after ingestion of alcohol P300 increased, whereas after 60 mins P300 decreased. However, the results of this study were contaminated by a number of uncontrolled variables such as unclear alcohol administration procedures, unrecorded BAC, and insufficient recording sites which raise doubts concerning the validity of this research.

Teo and Ferguson (1986) using three levels of alcohol dosage (0 g/kg, .3 g/kg, and .5 g/kg) and auditorily evoked ERPs, found a dose related effect on P300. At the high dose latency became longer at N1, N2, and P2, and P300 increased additively with dose, the effects at the exogenous components of the ERP in this case are likely to be due to general neural depression. P300 amplitude decreased according to dose. Similarly Taylor (1988) found that

latency of P300 increased and amplitude decreased as a function of alcohol dosage.

Krein, Overton, Young, Spreior, and Yolton (1987) studied the effects on ERPs of using three dose levels of alcohol (0.00%, 0.06%, and 0.13%), in a simulated traffic signal task. A dose dependent effect of P300 latency was found. That is, as BAC increased, latency increased, P300 amplitude also decreased as a function of dosage. This finding indicates that an increase in mental processing time was required to determine if a green or a red light had been presented. Overall the finding of reduced P300 amplitude (Oscar-Berman, 1987; Martin et al., 1992b; Roth et al., 1977) across a wide range of blood alcohol concentrations (0.02% to 0.10%) has been found consistently, the increase of latency due to alcohol is less consistent.

In information processing terms, as P300 amplitude is a recognised physiological marker of the context updating process in the brain reduced P300 amplitude due to the ingestion of alcohol indicates an inability to update existing neuronal models in the brain. In terms of resource allocation theory, alcohol reduces the amount of resources available for allocation to specific tasks. Together this amounts to the total processing capacity of the individual being reduced.

The finding albeit less consistently of increased P300 latency after alcohol ingestion indicates an overall increase in the processing stage of stimulus evaluation. The increase in RT due to alcohol indicates the effect that alcohol has on psychomotor brain centres responsible for response organisation and execution. Thus alcohol appears to effect areas in the brain responsible for stimulus evaluation and psychomotor performance.

Physiologically the reduction in context updating and resource allocation can be accounted for by alcohol's potentiation of GABA in combination with alcohol's general depressing effect.

Effects of benzodiazepines on early ERP components

The ingestion of benzodiazepines has been associated with a decrease in amplitude of early ERP components, but no change in latency (in waveform components prior up to 250ms) (Ebe, Meirerewert, & Broughton, 1969; Boker & Heinze, 1984).

Effects of benzodiazepines on information processing as indexed by the P300

In comparison to the prolific number of studies on the effect that alcohol has on human information processing there have been relatively few studies conducted which have considered the effect that benzodiazepines have on such processing.

The available evidence suggests that temazepam decreases P300 amplitude (Martin et al., 1992a; Martin et al., 1992b). The results for P300 latency have been less consistent. P300 latency, in one experiment conducted by Martin et al. (1992b), was found to increase after a 10 mg dose of temazepam, while in other studies P300 latency has not been found to change with a 10 mg dose of temazepam (Martin et al., 1992a; Mills, 1990). This may suggest that information processing which is indexed by P300 amplitude may not occur at the same neural site as the processes denoted by P300 latency, namely stimulus evaluation. Martin et al. (1992a) also found that RT was unaffected by the ingestion of temazepam, suggesting a lack of significant effects on the psychomotor processes responsible for response execution.

As temazepam decreases P300 amplitude, but does not increase P300 latency, it can be suggested that the cognitive processes indexed by P300 amplitude do not occur within the series of stages measured by RT, since they do not increase RT or P300 latency. It would seem that certain

processes, denoted by P300 amplitude, are made less efficient by temazepam, while others, within the RT envelope, are not. Martin et al. (1992a) suggest therefore that temazepam acts selectively on specific areas of the brain, that is, at different neural locations.

In terms of theories of information processing a reduction of P300 amplitude after temazepam ingestion indicates a reduced ability to contextually update, or in terms of resource allocation theory, an impairment in the capacity of an individual to allocate resources. This is reflected at a physiological level by the amount of GABA potentiation caused by temazepam not being sufficient enough to cause generalised inhibition of neural firing, using low to moderate doses.

The effects of temazepam on information processing at higher doses remains to be investigated. It is suggested that increased GABA potentiation would effect either stimulus evaluation, as indexed by P300 latency, response execution, as indexed by RT, or both. P300 amplitude would be expected to be even further decreased.

Effects of alcohol and benzodiazepines on information processing as indexed by the P300

Recent studies have shown that at low dose levels alcohol and temazepam affect different levels of processing in the central nervous system or affect different pools of available resources (Martin et al., 1992b). In the case of temazepam, this has been shown by a reduction in the processes which index information processing (P300 amplitude) and no effect on processes which index speed of mental processing or psychomotor performance (P300 latency and RT). Temazepam at low doses appears to reduce the resources available in a particular pool which operates only with context updating or information processing per se and not with speed of

mental processing.

On the other hand, alcohol not only affects the pool of resources which are responsible for information processing but also affects the pool of resources which are responsible for speed of mental processing (Martin et al., 1992b). At lower doses the stimulus evaluation stage of processing is selectively affected by alcohol. The results of the study conducted by Martin et al. (1992b) indicated that temazepam, with or without the presence of alcohol reduces P300 amplitude, which although not directly tested by these authors could be explained in terms of resource allocation theory. That is, temazepam effects one or more of the pools of possible processing resources available. Alcohol on the other hand, with or without the presence of temazepam, affected information processing indexed by P300 amplitude and motor processing speed and speed of evaluation as indexed by RT and P300 latency. In summary of the results found by Martin et al. (1992a; 1992b), low doses of alcohol and temazepam have separately been shown to reduce P300 amplitude, however when ingested together no interaction has been evident, that is, there was no antagonistic or synergistic effect of the combined drugs. It can be concluded therefore, that at the low dose levels used in the Martin et al. (1992b) experiment (BAC 0.04% and temazepam 10 mg orally) alcohol and temazepam appeared to affect different levels of processing in the CNS or to affect different pools of available resources. In terms of the context updating theory, this could mean that each drug reduced the ability to update via a different neural mechanism.

Chapter 8

Summary and Hypothesis

Summary and Hypothesis

The physiological, behavioural and cognitive effects of alcohol and benzodiazepines have been considered both separately and in combination. In an attempt to define the extent of their effect/s on human cognitive processes, specifically information processing, the psychophysiological measurement of the ERP component known as P300 has been utilised.

The aim of the present study is to investigate the separate and interactive effects of high doses of temazepam and alcohol on human information processing. For this purpose dual task methodology will be combined with P300 amplitude and latency as an index of resource allocation. A dual task paradigm in which subjects are instructed to attend to two tasks concurrently is a useful strategy to indicate if the affects of alcohol and/or temazepam reduce specific 'pools of available resources'. The amount of attention given to either of the two tasks would be less than the amount available if only one task was being performed.

On the basis of the literature presented and adhering to dual task methodology the following hypotheses are made:

Firstly, at higher doses, widespread neural depression by alcohol may overlap the specific depressant effects of temazepam as benzodiazepines appear to potentiate the action of alcohol (O'Reilly, 1980) causing an increase in general CNS depression. This may result in specific sections of the brain being affected separately by each drug as well as areas of the brain affected by both drugs. The ingestion of both drugs simultaneously may reduce P300 amplitude more than the sum of their separate effects, thus the effect would be synergistic. In terms of context updating, the process of updating the pre-existing neuronal model may be restricted, or from the resource allocation perspective the actual pool of

resources may be reduced.

Secondly, temazepam/alcohol may show a dose dependent impairment of speed of mental processing thus separate temazepam/alcohol ingestion at higher doses may increase GABA potentiation which would affect stimulus evaluation as indexed by P300 latency. At high doses a synergistic effect may occur when temazepam and alcohol are combined.

Thirdly, similarly to P300 latency temazepam/alcohol may produce a dose dependent impairment on psychomotor performance as indexed by RT that is, at higher doses temazepam may effect areas of the brain responsible for psychomotor performance combined with alcohol may cause an overlap in the neural locus of effect. An interaction of the two drugs would therefore cause marked decrements in performance.

Fourthly, high doses of alcohol and/or temazepam may produce general neural depression of the primarily exogenous ERP components of P200 and N200, as indexed by a reduction in amplitude and an increase in latency.

However, the effects of alcohol and temazepam may be constrained if at high doses there is an antagonistic effect or the two tasks in the dual task paradigm require more cognitive processing. That is, the effects of the two drugs may be less in the presence of one another than separately or that a greater amount of attention and concentration may be required to complete both tasks and this may have the effect of reducing any effect of alcohol or temazepam, indexed by no changes in P300 amplitude or latency and RT.

Chapter 9

Method

Method

Subjects

The subjects were twelve male university undergraduates aged between 18 and 23, who were paid for their participation. All subjects had regular driving experience of at least one year, normal vision and a normal medical history. All subjects were 'normal' social drinkers, non-users of nicotine or other drugs and no subject was related in the first degree to any person who had been diagnosed as an alcoholic (Buffington, Martin, & Becker, 1981). Subjects were required to attend the Psychophysiology laboratory in the Department of Psychology at the University of Tasmania for 4 sessions each of which lasted approximately 2 to 4 hours. The experimental procedure was explained and informed consent was obtained from all subjects. Ethical approval was attained from the University of Tasmania's Ethics Committee.

Apparatus

Electroencephalographic (EEG) recordings were made using a Grass Model 12 Neurodata Acquisition System, connected to an IBM compatible 386 computer, using an electrode skull cap with tin electrodes and tin mastoid reference and EOG electrodes. Visual stimuli were presented by means of two slide projectors fitted with Uniblitz (Model 225) tachistoscopic shutters. The duration of each slide presentation was controlled by two interval generators and stimulus presentation was controlled by an IBM compatible 386 computer. The stimuli were slides of driving scenes and were made and presented as detailed by Martin et al. (1992b). Each condition contained 160 slides which depicted either safe driving (85%) or imminent accident (15%) scenes projected onto a screen 60 cm in front of the subject.

The space average luminance of each slide was measured using a Tektronix J16 photometer with a J6523-2 1 degree narrow angle luminance probe. The average luminance of the central spot was 40.7 cd/m^2 and 45.1 cd/m^2 for the imminent accident (rare) and safe driving (common) slides respectively. The average spot measured in each of the four quadrants for the rare slides was 32.4 cd/m^2 and 41.6 cd/m^2 for the common slides. Subjects were seated with their chins in a chin rest such that slides subtended a visual angle of 30^o horizontally x 20^o vertically. Auditory stimuli were presented in Bernoulli series of low-pitched (1000 Hz) (65%) and high-pitched (1200 Hz) (35%) tone bursts which were delivered bi aurally (75 dB). The duration, pitch and timing of the auditory tones were controlled by an IBM compatible 386 computer.

Design

A within subjects 2 {alcohol: yes/no} x 2 {temazepam: yes/no} x 2 (stimuli: common/rare) x 3 (site: Fz, Cz, Pz) repeated measures design was used, with drug treatment order and slide presentation order counterbalanced using a Latin square procedure. The design resulted in each subject completing four drug treatments: (i) Placebo: BAC 0.00% and Vitamin E tablet, (ii) Alcohol: BAC 0.10% and a Vitamin E tablet, (iii) Temazepam: BAC 0.00% and Temazepam 20 mg orally, and (iv) Alcohol/ Temazepam combined: BAC 0.10% and Temazepam 20 mg orally. All sessions for each subject were conducted during early evening to control for circadian variability. Independent variables were the two alcohol conditions and the two temazepam conditions, stimuli (rare and common), and sites (Fz, Cz, and Pz). Dependent variables were reaction time to rare stimuli, P300, N200 and P200 amplitude and latency to rare and common stimuli and a count to the high pitched tones.

Drug Administration

Subjects were given four drink combinations consisting of Vodka (37%) (in the alcohol and the alcohol/temazepam conditions only), unsweetened orange juice and peppermint water. Subjects received a 2.45 ml/kg of body weight dose of vodka calculated to give rise to BACs in the range of 0.08 to 1.0 %. Peppermint water was added in the ratio of 0.1 ml per kilogram of body weight to provide a mask to the alcohol and placebo conditions. Orange juice was added in the ratio of 5.71 mls per kilogram of body weight. The volume of each drink was calculated so that a 70 kg person would receive a total quantity of 400 ml of fluid. The premixed drink was divided into three equal parts and ingested at a rate of one part every five minutes. The drug dose consisted of two 10 mg tablets (Temazepam: NORMISON) that were consumed 30 minutes before the subject began the first drink portion. In the placebo and alcohol treatments two 100 mg Vitamin E tablets in the same shape and size as the temazepam tablets were substituted for the temazepam tablets.

EEG recordings

The EEG was recorded from midline (Fz, Cz and Pz) sites, referenced to the right ear. The EOG was recorded vertically, the electrodes placed at the superior and inferior margin of the right orbit at the midline of the eye (Jasper, 1958). The electrode impedances did not exceed 10 kOhms. The amplifiers were set to a high frequency cut off of 30 Hz and a time constant of 15s. The EEG was sampled at a rate of 500 Hz for a 1000 ms epoch commencing 100 ms prior to stimulus onset. Trials contaminated with EOG artifacts (greater than 70 uV) were excluded from the averages as were trials in which false alarms or misses were made.

Procedure

Prior to the commencement of the experiment subjects were asked to complete a medical history questionnaire and a consent form. Subjects who did not meet the preset criteria were rejected. Subjects were required not to drink alcohol for 24 hours prior to testing and to abstain from food for at least 4 hours prior to the time of experimentation. Sessions were conducted one week apart in order to avoid potential hang-over affects.

An oddball paradigm with the probability of the rare event being 15% was used to elicit the P300. Subjects were instructed to depress a hand-held microswitch as quickly as possible whenever they would normally brake in a car driving at 60 kilometres per hour, that is in response to imminent accident scenes. A small central fixation point was present continuously on the screen. Stimulus duration was 200 ms with an interstimulus interval (ISI) (offset to onset) of 1600 ms. In addition subjects were instructed to count covertly the number of higher pitched tones in the Bernoulli series and to report this count at the end of the trial. Tones were 60 ms in duration (including 10 ms rise/fall) and were presented during the ISI. The probability of occurrence of a high tone on any trial was 35%, and the low tone occurred with complimentary probability. The pre-determined slide stimulus presentation order allowed for 160 trials and at the end of each series it recommenced until 40 rare and at least 40 common responses had been accepted and averaged. The visual task was regarded as the "primary" task and the tone counting as "secondary".

Subjects Blood Alcohol Concentration (BAC) and Blood Pressure (BP) were taken upon entry to the laboratory at the commencement of each session using a Lion S-D2 Alcometer breathalyser and an Omron digital blood pressure monitor (Model HEM-403C). Electrodes were attached while the subject began drinking. Subjects BAC and BP were taken again 20

minutes after completion of the last drink. An assessment was made as to whether the desired BAC had been reached. If not breath analysis was repeated at 5 minute intervals until either the desired reading was obtained or it was apparent that the level had peaked, at which time the subject commenced the experiment.

On completion of each experimental condition subjects were required to fill out subjective ratings on their estimate BAC, 0 being totally unaffected, and 4 being extremely affected. Subjects were fed a substantial meal and then driven home after their BAC was recorded below .05, twice over a half hour period, and their blood pressure had reached pre-drug administration levels. In most cases this took approximately 3 to 5 hours.

Data Analysis

Grand Mean averages were computed for responses to both 'rare' and 'common' stimuli for each electrode site for each condition. The scoring of the records was carried out by the experimenter who was blind to both the subject and to the dose level associated with the data. P200 was defined as being the second and P300 as the third major positive peak following stimulus presentation, and N200 the negative peak preceding P300. The latency of P200, N200, and P300 was determined by measuring the time between stimulus onset and the maximum deflection within the search epoch. The search epochs for each target components were as follows: P200 (150-250 ms), N200 (250-350 ms) and P300 (350-550 ms). P200, N200, and P300 amplitude were quantified with a baseline to peak measure by subtracting the activity in the 100 ms prestimulus baseline from the amplitude of the largest positive peak within the search epoch at each of Fz, Cz and Pz for each subject in each condition. In addition to the ERP measures RT to rare stimuli was measured using a hand held response

button. The subjects estimated number of high pitched tones was recorded for each trial. A score was calculated by subtracting the actual number of high pitched tones from the estimated number of tones. The subject's actual BAC, estimated BAC and rating of subjective intoxication were also recorded.

To test for significant amplitude and latency differences across conditions repeated measures ANOVAs evaluated the effects of alcohol condition (2), temazepam condition (2), stimuli (2) and electrode site (3). A rejection region of $p < .05$ was used for all ANOVAS. A significance level of $p < .01$ was used for all Fisher LSD post-hoc tests. Reaction Time was subjected to a two-way ANOVA (Alcohol x Temazepam).

Chapter 10

Results

Results

Grand Mean Averages

Figure 1 displays the grand mean ERP waveforms elicited for rare and common stimuli for the three electrode sites and the two levels of each of the alcohol and temazepam conditions. P300 amplitude was larger at Pz, than at Cz, or at Fz for all conditions. The difference between the P300 amplitude for rare and common stimuli was largest at Pz and smallest at Cz and Fz.

The P300 amplitude differences between the alcohol and/or temazepam conditions at sites Fz and Cz were small in accordance with previous research (Donchin, Ritter, & McCallum, 1978) as P300 is maximally elicited at Pz. Figure 1 indicates that for the placebo condition P300 amplitude for rare stimuli decreased, particularly at Pz. Alcohol and temazepam separately increased the amplitude of P300 for rare stimuli at all electrode sites, principally at Pz. However, alcohol and temazepam in combination reduced P300 amplitude for rare stimuli at Pz. Overall there was a larger P300 amplitude at all sites measured when subjects were under the influence of alcohol when temazepam was not present.

Amplitude Results

P200: Figure 2 shows P200 amplitude for both rare and common stimuli at each site for all conditions.

The four-way ANOVA: Alcohol (2) x Temazepam (2) x Stimuli (2) x Site (3) showed that P200 amplitude was not influenced by the alcohol [$F(1, 11) = 0.18$, $MSe = 16.14$] or temazepam [$F(1, 11) = 0.15$, $MSe = 31.02$] condition or by stimuli [$F(1, 11) = .0008$, $MSe = 20.95$]. There was a significant main effect of site [$F(2, 22) = 66.50$, $MSe = 34.30$] indicating that P200 amplitude was

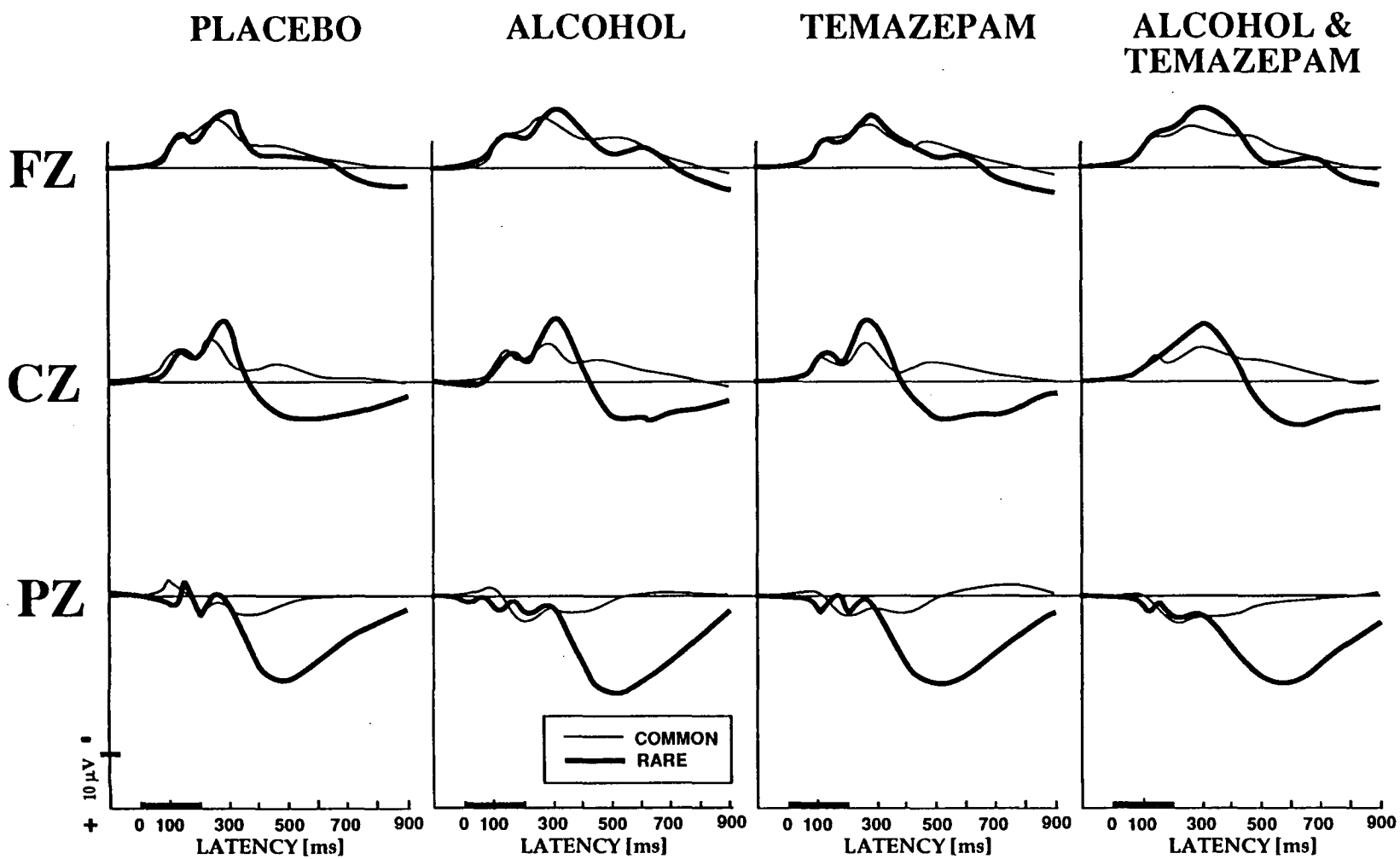

Figure 1: Shows the Grand Mean Average ERPS elicited by the Common and Rare stimuli at the Fz, Cz and Pz sites for each of the conditions, Placebo, Alcohol, Temazepam, and Alcohol/Temazepam. (▬ = Stimulus Duration).

larger at Pz than at Cz and Fz, further analysis showed P200 amplitude was significantly larger at Pz than at Cz, and at Fz (Fisher LSD). However there were no significant differences in P200 amplitude between Fz and Cz (Fisher LSD).

The alcohol x site interaction was significant [F(2, 22) = 15.77, MSe = 1.21] indicating that P200 amplitude at each site varied across alcohol conditions as can be seen in Figure 2. Fisher LSDs showed no significant differences of P200 amplitude for alcohol yes/no at Cz, whereas differences at Fz (alcohol yes was more negative than alcohol no) and Pz (alcohol yes had a larger amplitude than alcohol no) were significant.

N200: Figure 3 shows N200 amplitude for both rare and common stimuli at each site for all conditions.

The four-way ANOVA: Alcohol (2) x Temazepam (2) x Stimuli (2) x Site (3) showed that N200 amplitude was not influenced by alcohol [F(1, 11) = 0.61, MSe = 20.88] or temazepam [F(1, 11) = 0.77, MSe = 62.36] conditions. However a significant main effect of site was recorded [F(2, 22) = 71.41, MSe = 46.26]. N200 amplitude was significantly less negative at Pz than at Cz and Fz (Fisher LSD), but there were no significant differences in N200 amplitude between Fz and Cz (Fisher LSD). A significant main effect also occurred for stimuli [F(1, 11) = 6.52, MSe = 87.30] indicating that N200 amplitude was less negative for responses to common stimuli than to rare stimuli. The interaction between site and stimuli was also significant [F(2, 22) = 7.48, MSe = 6.45]. Fisher LSDs indicated that the largest differences between common and rare stimuli occurred at Cz than at Fz than at Pz.

The site x alcohol interaction was significant [F(2, 22) = 4.82, MSe = 4.61] indicating that N200 amplitude for each site varied across alcohol (yes/no) conditions. Fisher LSDs showed that the difference between

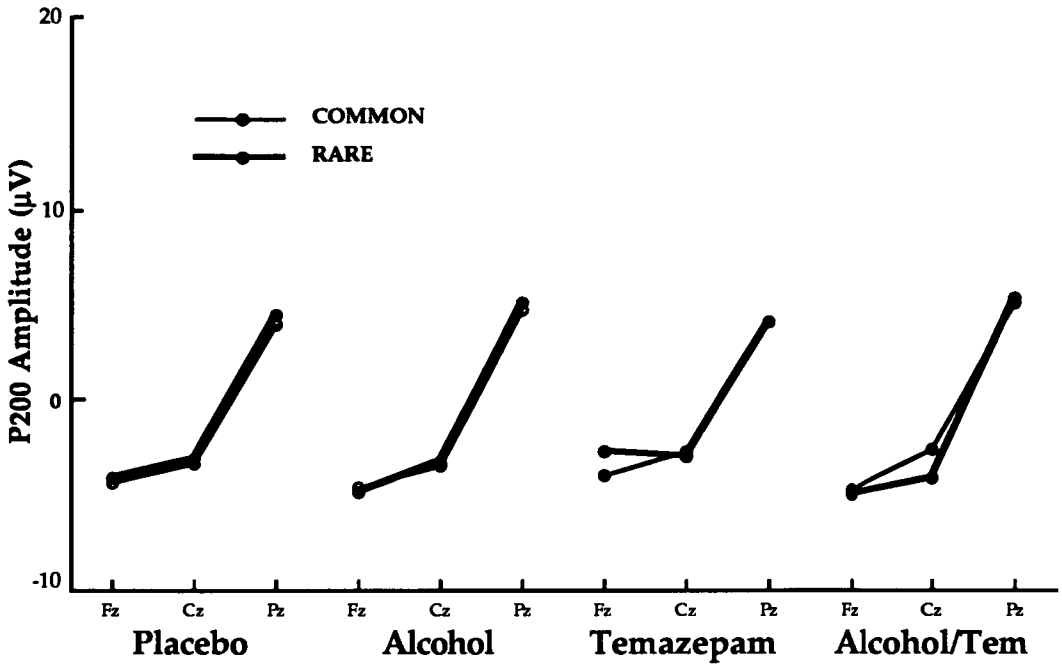

Figure 2: P200 amplitude for both common and rare stimuli at each site for all conditions.

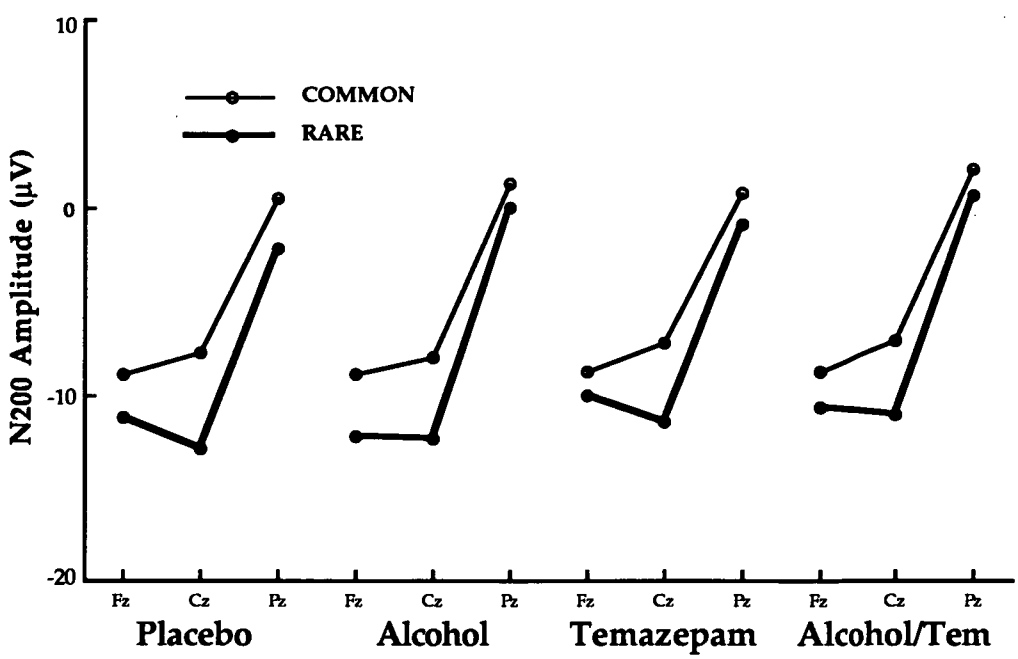

Figure 3: N200 amplitude for both common and rare stimuli at each site for all conditions.

alcohol (yes/no) at site Pz was significant (alcohol yes was less negative than alcohol no), while for Fz and Cz there were no significant differences between alcohol (yes/no).

The site x stimuli x alcohol interaction was significant (see Figure 3) [$F(2, 22) = 5.45$, $MSe = 0.944$]. N200 amplitude across sites and stimuli was influenced by whether alcohol was present or not. Fisher LSDs indicated that there were significant differences between common and rare stimuli across alcohol yes and alcohol no conditions. At site Fz for the rare stimuli alcohol yes was more negative than alcohol no, whereas for the common stimuli there were no significant differences. At site Cz there were no significant differences between alcohol yes and alcohol no conditions for either common or rare stimuli. At site Pz for the rare stimuli alcohol no was more negative than alcohol yes and for the common stimuli alcohol no was more negative than alcohol yes.

P300: Figure 4 shows P300 amplitude for both rare and common stimuli at each site for all conditions. A four-way ANOVA (Alcohol (2) x Temazepam (2) x Stimuli (2) x Site (3) was performed on the P300 amplitude data. Table 1 shows the results of this Anova.

The main effect of site was significant. P300 amplitude was significantly larger at Pz than at Cz and Fz (Fisher LSD). P300 amplitude was also significantly larger at Cz than at Fz (Fisher LSD). The main effect of stimuli was also significant. P300 amplitude to the rare stimuli was larger than P300 amplitude to the common stimuli. The interaction between site and stimuli was also significant. As can be seen in Figure 4 and confirmed by Fisher LSDs, the largest differences between common and rare stimuli occurred at Pz.

The main effects of alcohol and temazepam conditions on P300

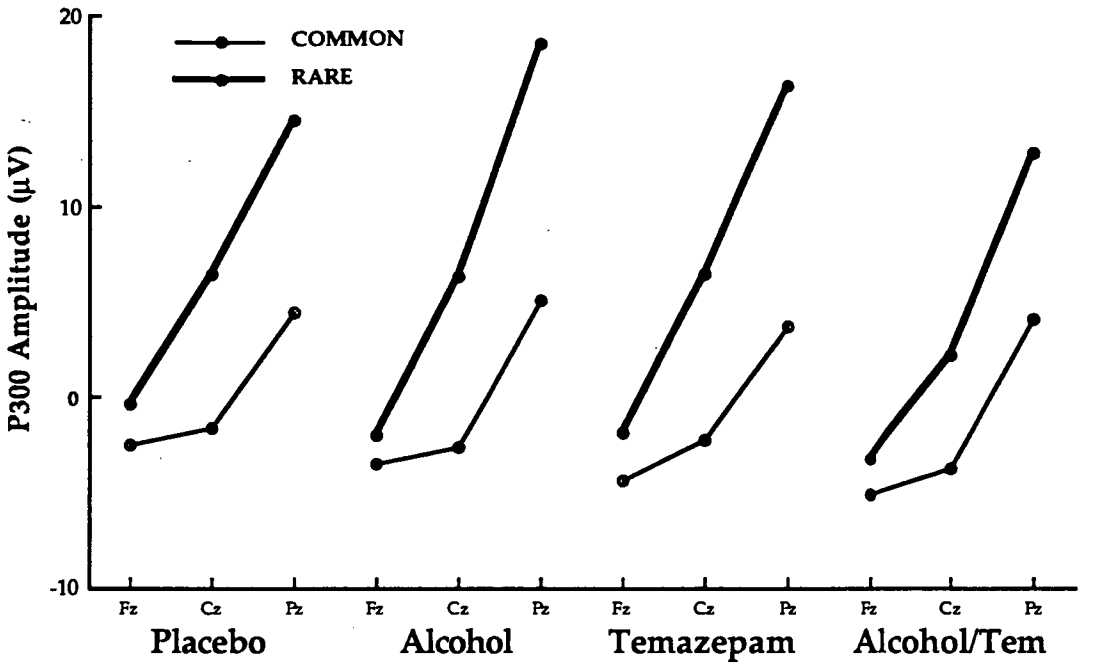

Figure 4: P300 amplitude for both common and rare stimuli at each site for all conditions.

Table 1: The results of the analysis of variance for P300 amplitude.

EFFECT	df	MSe	F-value	p-level
Site	2,22	66.58	60.66	**
STimuli	1,11	175.13	20.18	**
Alc	1,11	23.82	2.22	+
Tem	1,11	39.43	4.03	+
S x ST	2,22	19.46	26.80	**
S x Alc	2,22	7.28	4.09	*
ST x Alc	1,11	19.38	0.29	+
S x Tem	2,22	6.09	0.03	+
ST x Tem	1,11	23.66	0.31	+
Alc x Tem	1,11	37.79	1.77	+
S x ST x Alc	2,22	6.65	0.12	+
S x ST x Tem	2,22	5.21	0.85	+
S x Alc x Tem	2,22	6.46	3.87	*
ST x Alc x Tem	1,11	13.14	4.48	+
S x ST x Alc x Tem	2,22	4.88	3.82	*

+ $p>.05$

* $p<.05$

** $p<.01$

amplitude were not significant. However, the main effect of temazepam approached significance ($p = .06$). There was a trend for P300 amplitude to be less under the conditions in which temazepam was present compared to those in which temazepam was not present. No such trend was found for alcohol. The interaction between alcohol and temazepam was not significant indicating that overall the effect of temazepam in combination

with alcohol was not significantly larger than the effect of temazepam in isolation or vice-versa.

The site x alcohol treatment interaction was significant. Fisher LSDs indicated that overall Pz recorded the largest amplitude followed by Cz then Fz. However, no differences were found between alcohol yes and alcohol no at Fz and at Pz, whereas at Cz alcohol no recorded larger P300 amplitude than alcohol yes.

The stimuli x alcohol x temazepam interaction showed a strong trend towards significance ($p = .057$) which indicated that there was a difference in P300 amplitude between the different stimuli over the alcohol and temazepam conditions. The site x alcohol x temazepam interaction was also significant which indicated that there was a difference in P300 amplitude between the different sites over the alcohol and temazepam conditions. As the four-way interaction of site x stimuli x alcohol x temazepam was significant further elucidation of the two previous three-way interactions is subsumed under analysis of this interaction.

The significant four-way interaction (Site x Stimuli x Alcohol x Temazepam) indicated that there was a difference in P300 amplitude between rare and common stimuli across the different sites over the alcohol and temazepam conditions. Further analysis, for these significant interactions was conducted by performing a three-way ANOVA (Alcohol x Temazepam x Stimuli) for each Site.

The three-way ANOVA (Alcohol x Temazepam x Stimuli) for P300 amplitude at Fz indicated that the main effect of temazepam showed a trend towards significance [$F(1,11) = 3.88$, $MSe = 15.53$, $p=.074$], that is P300 amplitude at Fz decreased more under conditions in which temazepam was present than in conditions in which temazepam was not present. There was no effect of alcohol [$F(1,11) = 2.99$, $MSe = 11.64$] or stimuli [$F(1,11) = 1.81$,

MSe = 51.14] and no interaction was significant for P300 amplitude at Fz.

The three-way ANOVA (Alcohol x Temazepam x Stimuli) for P300 amplitude at Cz indicated that the main effect of stimuli was significant [F(1,11) = 15.27, MSe = 97.83] with P300 amplitude greater for rare stimuli than for common stimuli. The main effect of alcohol showed a trend towards significance [F(1,11) = 4.80, MSe = 15.44, p=.050], that is P300 amplitude decreased more under conditions in which alcohol was present than in conditions in which alcohol was not present at Cz as can be seen in Figure 4. There was no effect of temazepam [F(1,11) = 2.43, MSe = 21.35] and there were no significant interactions on P300 amplitude at Cz.

The three-way ANOVA (Alcohol x Temazepam x Stimuli) for P300 amplitude at Pz indicated that the main effect of stimuli was significant [F(1,11) = 45.95, MSe = 65.07] with P300 amplitude being larger for rare stimuli than for common stimuli. The alcohol x temazepam interaction was significant [F(1,11) = 7.33, MSe = 12.02], indicating that P300 amplitude at Pz was selectively influenced by alcohol or temazepam in the presence of the other drug. Fisher LSDs indicated that P300 amplitude at Pz was significantly greater in the alcohol yes/temazepam no condition than the alcohol yes/temazepam yes condition indicating that the effect of alcohol was less when temazepam was not in the system.

The stimuli x alcohol x temazepam interaction also was significant for Pz [F(1,11) = 11.12, MSe = 6.89] which indicated that there was a difference in P300 amplitude at Pz between the common and rare stimuli over the alcohol and temazepam conditions. Further analysis using Fisher LSDs revealed that P300 amplitude at Pz was significantly greater for rare stimuli than for common stimuli for all conditions. Fisher LSDs also revealed that for the rare stimuli P300 amplitude was significantly greater for the alcohol yes/temazepam no condition than the alcohol no/temazepam yes

condition, the alcohol no/temazepam no condition, and the alcohol yes/temazepam yes condition at Pz. There were no significant differences between conditions for common stimuli at Pz, that is all the effects from the interaction took place on the rare stimuli.

Latency Results

P200: Figure 5 shows P300 latency for both rare and common stimuli at each site for all conditions.

The four-way ANOVA: Alcohol (2) x Temazepam (2) x Stimuli (2) x Site (3)] performed on P200 latency data revealed no significant main effect for alcohol [F(1, 11) = 1.44, MSe = 1646.45] or temazepam [F(1, 11) = 4.27, MSe = 1430.85] conditions, stimuli [F(1, 11) = 3.58, MSe = 1239.42] or site [F(2, 22) = 0.90, MSe = 1156.43], that is, P200 latency was not significantly influenced by alcohol or temazepam condition and did not vary across site or stimuli.

The stimuli x alcohol interaction was significant [F(1, 11) = 16.49, MSe = 282.71]. Further analysis using Fisher LSDs revealed that P200 latency was significantly longer for rare stimuli than for common stimuli in conditions where alcohol was present. No significant differences in P200 latency were found between rare and common stimuli in conditions where alcohol was not present.

N200: Figure 6 shows N200 latency for both rare and common stimuli at each site for all conditions.

The four-way ANOVA: Alcohol (2) x Temazepam (2) x Stimuli (2) x Site (3) showed that N200 was not influenced by alcohol [F(2, 22) = 2.82, MSe = 2751.95] or temazepam [F(2, 22) = 2.21, MSe = 521.57] conditions. A significant main effect of site occurred [F(2, 22) = 10.58, MSe = 912.08] indicating that N200 latency varied across sites. Fisher LSDs revealed that

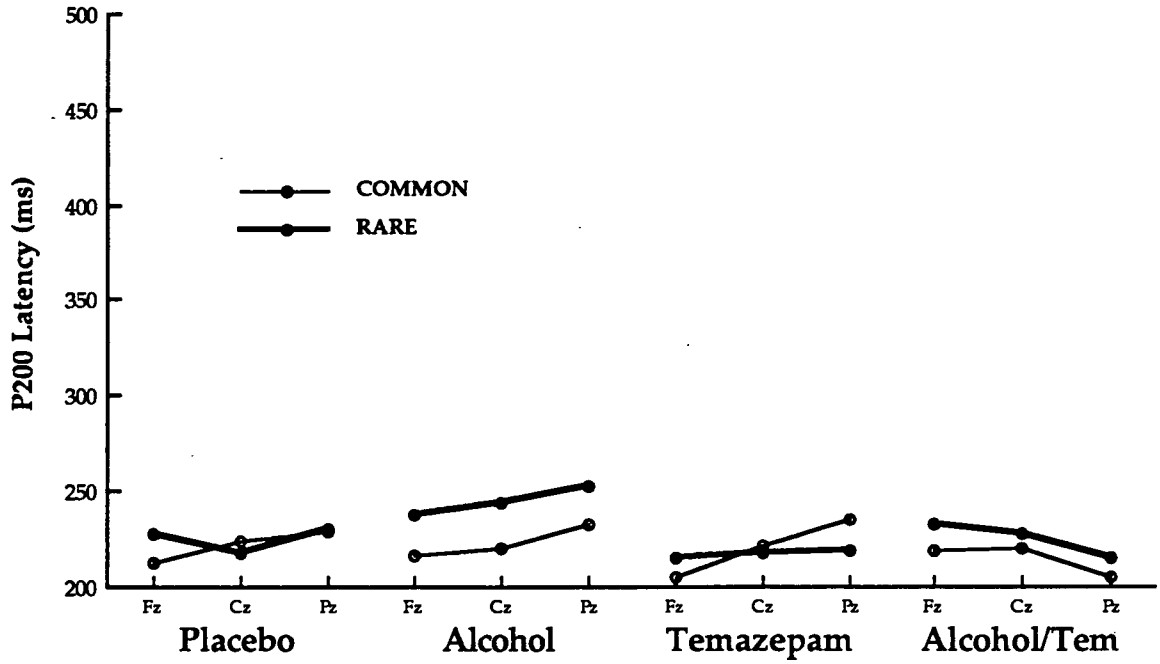

Figure 5: P200 latency for both common and rare stimuli at each site for all conditions.

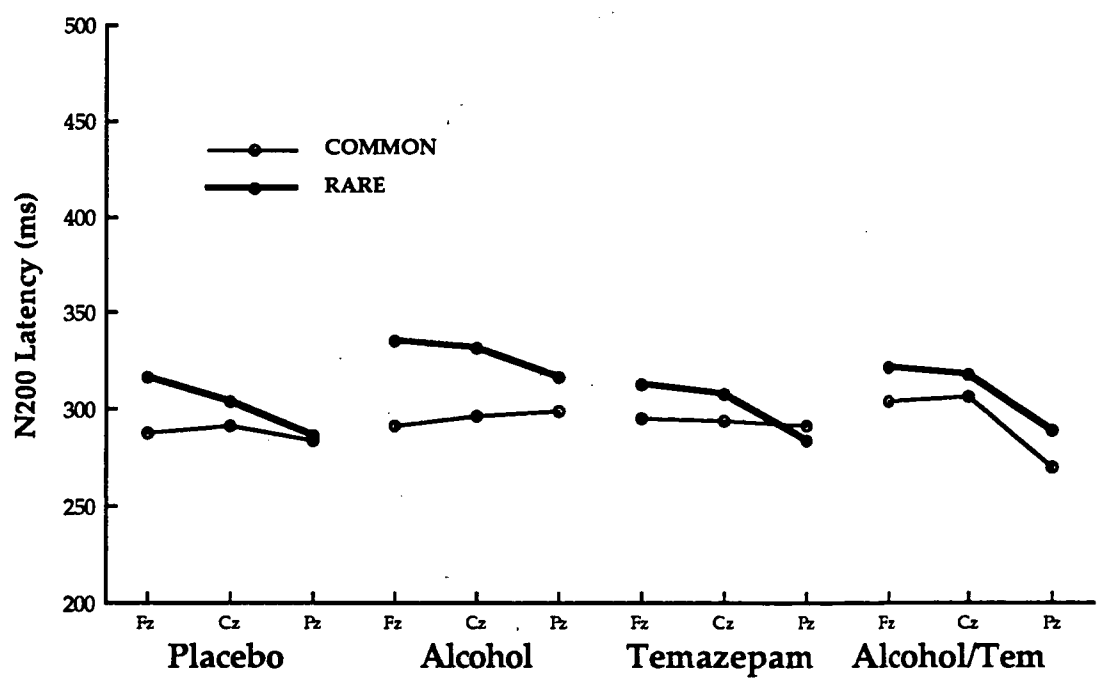

Figure 6: N200 latency for both common and rare stimuli at each site for all conditions.

longer N200 latencies occurred at Fz than at Pz , and at Cz than at Pz, while no significant differences in N200 latency occurred between Fz and Cz.

A significant main effect of stimuli [F(1, 11) = 20.41, MSe = 1113.77] indicated that N200 latency was longer for rare stimuli than for common stimuli.

The stimuli x alcohol interaction approached significance [F(1, 11) = 3.23, MSe = 833.51, p = .09] indicated that there was a trend for the N200 latency for common and rare stimuli to differ across alcohol conditions. Further analysis revealed that N200 latency was significantly longer for rare stimuli when alcohol was present than for common stimuli when alcohol was present, and also that N200 latency was significantly longer for rare stimuli when alcohol was present than in conditions in which alcohol was not present. No significant differences in N200 latency were found for common stimuli whether alcohol was present or not.

P300: Figure 7 shows P300 latency for both rare and common stimuli at each site for all conditions.

The four-way ANOVA: Alcohol (2) x Temazepam (2) x Stimuli (2) x Site (3) performed on the P300 latency data revealed no significant main effects for alcohol [F(1, 11) = 1.62, MSe = 4457.65] or for temazepam [F(1, 11) = 0.057, MSe = 6193.78] conditions, that is P300 latency did not vary significantly across alcohol conditions or temazepam conditions.

The main effect of stimuli was significant [F(1, 11) = 78.19, MSe = 3836.6], that is P300 latency was shorter for common stimuli than for rare stimuli.

The main effect of site showed a trend towards significance [F(2, 22) = 3.32, MSe = 2869.23, p = .054], indicating that the shortest latencies were recorded at Fz and the longest at Cz, however further analysis showed that

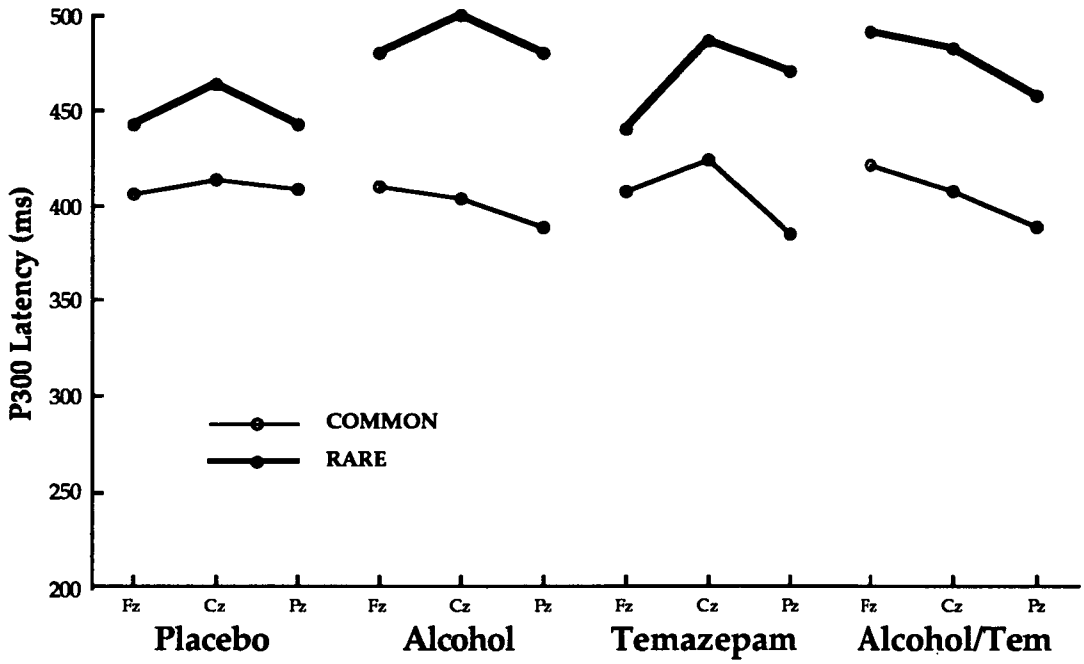

Figure 7: P300 latency for both common and rare stimuli at each site for all conditions.

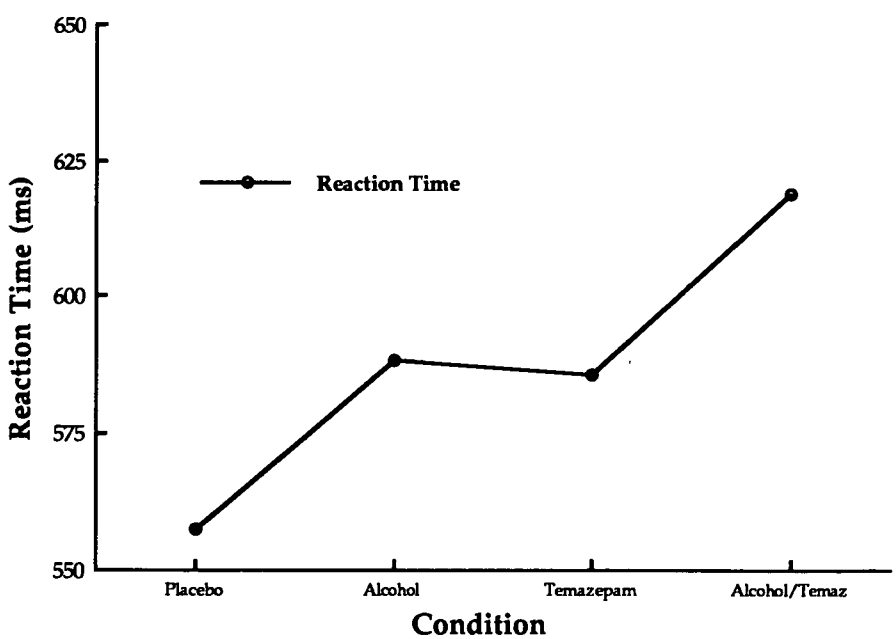

Figure 8: Mean reaction time recorded from rare stimuli for all conditions.

their were no significant differences between sites (Fisher LSD).

The interaction of stimuli x alcohol was significant [F(1, 11) = 6.86, MSe = 2111.02] which indicated that P300 latency was longer for rare stimuli than for common stimuli and there was a larger difference in P300 latency to rare stimuli between alcohol conditions in which alcohol was present and those in which alcohol was not present than there was for the common stimuli (Fisher LSD). That is, P300 latency was longer to rare stimuli than to common stimuli overall, but the P300 latency effect to rare stimuli intensified under conditions in which alcohol was present.

Reaction Time

Figure 8 shows mean reaction time recorded for rare stimuli across the two levels of each of the alcohol and temazepam conditions.

The main effect of alcohol was significant [F(1, 11) = 16.912, MSe = 724.65]. Thus, reaction time was less under conditions in which there was no alcohol than in conditions with alcohol. Similar results were obtained for temazepam, the main effect of reaction time for temazepam was significant [F(1, 11) = 5.077, MSe = 2016.24]. Which indicated that reaction time was less under conditions in which there was no temazepam than in conditions with temazepam. The interaction was not significant [F(1, 11) = 0.009, MSe = 1544.37], indicating that alcohol and temazepam in combination had an effect that was no greater than either alcohol or temazepam separately, that is the effect was additive.

Reaction Time/P300 latency

In all conditions RT was longer than P300 latency (see table 2). Correlations were computed between P300 latency and RT to the rare stimuli at each electrode site, for the four treatment conditions (placebo,

alcohol, temazepam, and alcohol/temazepam). For the placebo condition at Fz and Cz, there was a significant positive correlation (r=.682, p<.01 and r=.710, p<.01 respectively), although at Pz the correlation was negative, but did not approach significance (r=-.09, p=.77), indicating that as RT increased P300 latency increased at Fz and Cz. Similarly, in the temazepam condition there was a significant positive correlation at Pz (r=.668, p<.01) and a trend towards a significant positive correlation at Fz (r=.531, p=.07). At Cz the correlation was positive, but did not approach significance (r=.261, p=.41). The correlations for the alcohol/temazepam condition although positive did not approach significance, at Fz (r=.115, p=.72), at Cz (r=.447, p=.144) and at Pz (r=519, p=.08). The correlations for the alcohol condition also did not approach significance, at Fz (r=.017, p=.958), at Cz (r=-.09, p=.76) and at Pz (r=.445, p=.148).

Table 2: Mean reaction time and P300 latency recorded at each site for all conditions.

Condition		P300 Lat		
	RT	**Fz**	**Cz**	**Pz**
A: Placebo	557	442	463	443
B: Alcohol	588	479	500	480
C: Temazepam	586	440	486	471
D: Alc/Tem	619	491	482	457

Tone Counting

The mean for the alcohol no/temazepam no condition was 27.33, for the alcohol yes/temazepam no condition 44.41, 31.75 for the alcohol no/temazepam yes condition and 16.25 for the alcohol yes/temazepam yes condition, Review of the means of the difference between the number of high pitched tones estimated from the actual number of tones that occurred

suggests that alcohol had the biggest effect on the ability of subject's to accurately perform the secondary task.

A two-way ANOVA: 2 (temazepam: yes/no) x 2 (alcohol: yes/no) was performed on the tone counting data. Neither the main effect of temazepam [F(1, 11) = .0076, MSe = 984.0] , nor the main effect of alcohol [F(1, 11) = 0.9981, MSe = 1695.4], nor the interaction between alcohol and temazepam [F(1, 11) = 1.85, MSe = 1721.2] were significant. This indicated that the number of tones counted remained consistent under all conditions. That is, subjects were able to discriminate the high pitched tones from the low pitched tones and were able to keep a progressive count of the occurrence of high pitched tones in all experimental conditions. Thus although the means suggest that subjects had most difficulty under alcohol conditions it would seem that alcohol or temazepam ingested separately or in combination had no significant effect on the subject's ability to perform the required secondary task.

Misses, Correct Rejections and False Alarms

Two-way ANOVAs: 2 (temazepam: yes/no) x 2 (alcohol: yes/no) were performed separately on hits, misses, correct rejections and false alarms. In all but the false alarms there were no significant differences between the alcohol and temazepam conditions (all $p > .05$). For false alarms neither the main effect of temazepam [F(1, 11) = 0.344, MSe = 24.19] nor the main effect of alcohol [F(1, 11) = 0.658, MSe = 17.50] were significant, but the interaction between alcohol and temazepam [F(1, 11) = 8.017, MSe = 12.01] was significant. This indicated that there were differences in the number of false alarms recorded depending on whether alcohol or temazepam were in the system, Although, further analysis revealed that there were no significant differences between false alarms for alcohol

(yes/no) and temazepam (yes/no) conditions (Fisher LSDs), there was a strong trend for the number of false alarms to be greatest for the combined alcohol/temazepam condition.

Blood alcohol concentration

The anticipated range of BACs was achieved over the alcohol/temazepam conditions. Mean BACs attained over the conditions were 0.0% for the alcohol no/temazepam no condition, 0.0% for the alcohol no/temazepam yes condition, 0.10% (range: 0.08% - 0.12%) for the alcohol yes/temazepam no condition, and 0.11% (range: 0.09% - 0.14%) for the alcohol yes/temazepam yes condition.

Subjective Ratings

Overall the subject's were inaccurate at estimating their BAC. Four of the twelve subjects believed that they had ingested alcohol in the alcohol no/temazepam no condition, and six of the subjects believed they had ingested alcohol in the alcohol no/temazepam yes condition. In the alcohol yes/temazepam no condition all subject's accurately assessed that they had been given alcohol but only three subject's were able to correctly judge their BAC with estimates ranging from 0.02% to 0.10%. In the alcohol yes/temazepam yes condition again all subject's accurately assessed that they had ingested alcohol. Although subject BACs were generally higher in this condition only one subject correctly judged their BAC, with estimates ranging from 0.02% to 0.10%.

Chapter 11

Discussion

Discussion

This experiment was designed to investigate the interactive effects of high doses of alcohol and temazepam on information processing. The results obtained for the interaction of alcohol and temazepam appear to support the hypothesis of a synergistic effect at some sites of the two drugs. That is, the effect of alcohol on P300 amplitude and latency was larger when combined with temazepam. The RT data suggested that alcohol and temazepam may have had an additive effect on psychomotor processing. Both alcohol and temazepam significantly increased RT separately, but there was no interaction between the two drugs.

Alcohol and temazepam individually or in combination had no greater effect on subject's ability to accurately perform the required tasks comprising the dual task paradigm. That is, the ability of subject's to accurately complete the tone counting or 'secondary task' did not vary depending on the alcohol/temazepam condition, in other words performance remained constant.

The results of this experiment replicate the effects of stimuli and scalp topography reported by Martin et al. (1992a, 1992b). The results demonstrated that rare 'driving' stimuli result in greater P300 amplitudes and longer P300 latencies than common stimuli. The scalp topography of the P300 also conformed to expectations with the smallest P300 being elicited at the frontal site and the largest at central and parietal sites (Donchin, 1981). For P300 amplitude there was also an interaction between stimuli and site. The largest differences between common and rare stimuli were found at parietal sites as was expected.

The results for the exogenous ERP component P200 demonstrated that there was a main effect of site. The amplitude of P200 was affected by

electrode site with the majority of the effect occurring at parietal sites. Conditions in which alcohol was present had their greatest affect on P200 amplitude at parietal and frontal sites. Alcohol reduced P200 amplitude at frontal sites, whereas at parietal sites alcohol increased P200 amplitude. There was an interaction between stimuli and alcohol for P200 latency. P200 latency was longer for rare stimuli in conditions where alcohol was present, no such difference was found for common stimuli. No significant effects of temazepam were found for P200, that is, amplitude and latency were unaffected by whether temazepam was present or not.

The results obtained for the primarily exogenous ERP component N200 demonstrated that there were main effects for stimuli and site. Rare stimuli resulted in greater N200 amplitude and longer N200 latency under all conditions. Scalp topography for N200 demonstrated that N200 amplitude was greatest at parietal sites and smallest at central and frontal sites. For N200 amplitude there was also an interaction between stimuli and site. The largest differences between common and rare stimuli were found at central sites and the smallest at parietal sites. There was also an interaction between site and alcohol for N200 amplitude. The greatest difference between alcohol yes and alcohol no conditions occurred at parietal sites, ingestion of alcohol resulted in a smaller N200 amplitude than when alcohol was not ingested. For N200 amplitude an interaction was recorded between site, stimuli, and alcohol conditions. The largest differences for common stimuli between alcohol yes and alcohol no conditions were recorded at parietal sites, alcohol no recorded a larger N200 amplitude than alcohol yes. The largest differences for rare stimuli were recorded at frontal sites where alcohol yes had a larger N200 than alcohol no, and parietal sites where alcohol no recorded a larger N200 amplitude than alcohol yes. N200 latency was longer for rare stimuli in conditions

where alcohol was present, no such difference was found for common stimuli. No significant effects of temazepam were found for the N200, that is, amplitude and latency of N200 were unaffected by whether temazepam was present or not.

In summary the results obtained for the early components of the ERP showed no effect of temazepam on the P200 or N200 component of the ERP. As the P200 and part of the N200 component are considered to be primarily exogenous in origin and related to the quality of sensory input they are considered to be insensitive to changes in information processing demands (Rohrbaugh et al., 1987, Hillyard & Kutas, 1983). The lack of effect of temazepam on P200 and N200 suggests that temazepam did not affect the quality of sensory input in this study. However, alcohol caused significant variations in the recording of P200 and N200 amplitude from electrode sites and increased P200 and N200 latency to rare stimuli. Alcohol also caused a reduction in N200 amplitude at Pz for both rare and common stimuli, and an increase in amplitude at Fz for rare stimuli. The effect of alcohol to reduce N200 amplitude at parietal sites is in concordance with previous studies (Rohrbaugh et al., 1987; Teo & Ferguson, 1986) who found large N200 amplitude and latency related effects. This suggests that at high doses alcohol impedes sensory input as indexed by effects on the P200 and N200 components of ERP. However, the effects on the exogenous components of the ERP could be as a result of general neural depression, that is at high doses alcohol may have a general depressing effect. In addition although N200 is partly exogenous in nature it also has an endogenous component and thus considered to be important in early stimulus processing, thus any effects of alcohol on the later ERP component P300 may also be apparent at N200.

Temazepam showed a strong trend to reduce the amplitude of P300,

that is conditions with temazepam present recorded less P300 amplitude than conditions without temazepam. Temazepam affected the recording of P300 amplitude across electrode sites, this effect was most marked at frontal sites where temazepam reduced the amplitude of P300. Temazepam, caused no effect on P300 latency, this indicated that temazepam did not impair the time required for stimulus evaluation, that is stimulus encoding, recognition and classification (Hillyard, 1985). It seems that temazepam interfered with overall cognitive processing more so than the speed of mental processing (Duncan-Johnson & Donchin, 1982). In terms of information processing it would appear that the reduction of P300 amplitude following the ingestion of temazepam indicated that temazepam interfered with the ability to contextually update pre-existing neuronal models in the brain, or from the perspective of resource allocation, the reduced activity at P300 due to temazepam may indicate a reduction of the limited capacity perceptual-cognitive resources or a decline in the availability of one or more of the pools of available resources. Together this amounted to a reduction in total processing capacity.

Temazepam significantly increased RT, that is conditions with temazepam had longer reaction times than conditions where temazepam was not present. In terms of previous research, RT effects after temazepam ingestion have been inconsistent (Martin et al., 1992a, 1992b; Kleinknecht & Donaldson, 1975). At doses of benzodiazepines under 15 mg there have been little if any conclusive findings (Kleinknecht & Donaldson, 1975), in this study which used an oral dose of 20 mg of temazepam the increase of RT was clearly apparent. This suggests that the effects of temazepam/benzodiazepines on RT are dose dependent (O'Reilly, 1980).

Therefore at higher doses temazepam appears to affect areas of the brain responsible for response selection, evaluation time and psychomotor

performance as indexed by RT. RT and P300 latency recorded significant positive correlations at Pz and positively correlated at Fz and Cz indicating that as RT increased so did P300 latency, however P300 latency did not increase to the same magnitude as RT. The results indicated that RT was significantly affected by high doses of temazepam in this study but P300 latency was not. This represents a dissociation between RT and P300 latency or in other words a dissociation between performance and physiological measures, suggesting that RT and P300 latency deal with two independent processing stages.

In an attempt to explain the anomaly of the RT effect but no P300 latency effect for the temazepam conditions it is suggested that the processes which affect P300 latency are not the same as the processes that affect RT. McCarthy and Donchin (1981) suggested that P300 latency comprises a subset of the processes which affect RT. The effects of temazepam are likely to have been on the latter stages of RT processing (response selection, stimulus execution and the decision to respond) than on the earlier processes which affect both RT and P300 latency.

There was no significant main effect of alcohol on P300 amplitude, that is P300 amplitude did not significantly vary according to whether alcohol was present or not. However, alcohol affected the recording of P300 amplitude across varying electrode sites, generally alcohol reduced the amplitude of P300 recordings at frontal and central sites. Alcohol impaired P300 amplitude for rare and common stimuli, that is, alcohol decreased P300 amplitude to rare stimuli more than for common stimuli. Alcohol resulted in P300 latency for rare stimuli being longer in the conditions in which alcohol was present than for those in which alcohol was not present. These effects were present in the alcohol conditions whether temazepam was present or not and indicated that alcohol interfered with overall cognitive

processing as well as the speed of mental processing (Duncan-Johnson & Donchin, 1982). In information processing terms, the findings of reduced P300 amplitude would seem to indicate the reduced ability of the subject's to update their schema under the influence of alcohol. Using the resource allocation model (Isreal et al., 1980), the alcohol seems to be reducing the amount of resources available for allocation to the required tasks. The total processing capacity of the individual was reduced. The effect of alcohol on the speed of mental processing as indexed by the P300 latency and RT results requires further elucidation.

The effect of alcohol on RT was significant, that is subjects had longer reaction times under the effect of alcohol than when alcohol was not present. In terms of previous research increased RT's in a dose dependant fashion after alcohol ingestion have been well documented (Declerck, 1990; Rohrbaugh et al., 1987; Ross & Pihl, 1987; Linnoila et al., 1980; Young, 1970; Franks et al., 1976a; McKim, 1986; Taylor, 1988). The results of this study therefore replicate those of previous findings. An increase in RT after alcohol ingestion is not due to behaviour impairment as such, but generally to a reduction in processing resources leading to an increase in encoding and processing time reflected by a decrease in P300 amplitude, and an increase in P300 latency and RT. Alcohol may effect some of the earlier components of RT if they index the same processes as P300 latency. However no RT-latency correlation was found after alcohol ingestion, as Kutas et al. (1977) suggest this may be due to the fact that P300 latency and RT are indices of timing of different aspects of processing. While RT encompasses all the processes leading to a cognitive decision and behavioural response, the P300 latency is a pure measure of the duration of stimulus evaluation processes, independent of response selection and execution. Thus alcohol may have influenced the time between stimulus

evaluation and execution.

The inconsistency concerning the effects of alcohol/temazepam on RT and P300 latency may be related to possible trade-offs between speed and accuracy. The term 'speed-accuracy trade-off' refers to the observation that subjects can achieve increases in speed at the cost of decreases in accuracy, and vice versa (Jennings, Wood, & Lawrence, 1976). Donchin (1984) has suggested that the RT/P300 latency correlation is determined by the strategies each subject adopts when attending to an task. In tasks where accuracy is emphasised, there is a high correlation because the response is contingent on stimulus evaluation and in tasks where speed is emphasised there is no correlation since result execution is being elicited. RT and latency call upon qualitatively different processing resources, as well as the same quantitative ones as both RT and P300 latency index stimulus categorisation or evaluation (Martin et al., 1992b). Kutas et al. (1977) suggested that events that index stimulus evaluation will produce an association between RT and P300 latency whereas stimuli reflecting response execution produce a reaction time/P300 latency dissociation (Tueting et al. 1971; Duncan-Johnson, 1981).

The results of the present study indicated a dissociation between RT and P300 latency regardless of whether alcohol or temazepam were present. This would be expected since speed rather than accuracy was emphasised in the instructions to the subjects. This assumption is supported by the fact that no significant differences in error rates between the conditions occurred and a strong trend occurred for the number of false alarms to be greatest for the combined alcohol/temazepam condition, that is, the number of false alarms were greater due to the subjects attempting to respond to stimuli as quickly as possible.

P300 latency and RT are indices of timing of different aspects of

processing. The effects of temazepam are likely to have been on the latter stages of RT processing (response selection, stimulus execution and the decision to respond) than on the earlier processes which affect both RT and P300 latency, whereas the effects of alcohol may have influenced the time between stimulus evaluation and execution. Alcohol and temazepam appear to affect different aspects of RT/P300 processing and consequently no RT interaction occurred between the two drugs.

There was a strong indication in the analyses of an interaction between alcohol and temazepam. At the most sensitive electrode recording site of Pz P300 amplitude was significantly larger in the alcohol yes/temazepam no condition than the alcohol yes/temazepam yes condition. That is, the combined alcohol and temazepam condition recorded less P300 amplitude than the condition with alcohol alone. It seems that alcohol has a smaller effect when there is no temazepam in the system. This suggests that high doses of temazepam have a synergistic effect on alcohol, in other words temazepam increases the effect of alcohol. In turn this synergistic effect of temazepam increases the effect that alcohol has on P300 latency but not on RT. Thus if temazepam interacts with alcohol as indexed by P300 amplitude and increases the alcohol effect for P300 latency, and both alcohol and temazepam separately effect RT then the areas of the brain controlling psychomotor processing (response selection and execution) must be different than those of cognitive processing as indexed by P300 amplitude and latency. That is, whatever components comprise the RT response cannot be made up of the same components that comprise P300 latency, as temazepam does not increase the effect that alcohol has on RT. On the other hand, the additional components that make up the RT response may mask the effects of temazepam. Unlike alcohol, temazepam tends to produce a greater dissociation between performance and

physiological measures, suggesting that RT and P300 latency deal with two independent processing stages.

As hypothesised the overall effect of combined high doses of alcohol and temazepam appears to be synergistic, that is the combined effects of the two drugs were greater than their summated individual effects (Mhatre et al., 1988). Previous research has suggested that benzodiazepines may cause the brain to become more receptive to the effects of alcohol (Linnoila et al., 1974), and that alcohol accelerates the availability of benzodiazepines (Laisi et al., 1979). In addition, O'Reilly (1980) suggested that at high doses widespread neural depression by alcohol may overlap the specific depressant effects of temazepam as benzodiazepines potentiate the action of alcohol. Thus in this experiment at the high doses used, specific areas of the brain may have been affected separately by each drug as well as areas of the brain affected by both drugs, causing an increase in general CNS depression. In terms of context updating, the process of updating the pre-existing neuronal model appears to have been restricted, or from the resource allocation perspective the actual pool of resources appears to have been reduced.

However, the effect that the dual task paradigm had on the reduction of P300 amplitude must be taken in to consideration. Competition among tasks in the dual task paradigm for attentional capacity may have occurred as a function of the task's stages of processing, codes of verbal and spatial processing, and modalities of input and response type (Fisk et al., 1987). In this case, the tasks placed demands on the same limited capacity processes, and were more poorly time shared than tasks that for example, do not overlap in their processing requirements (Kramer & Strayer, 1988). Reductions in P300 amplitude may also be due to the relative amount of attention allocated to each task in a dual task situation, the

results of this experiment indicated the presence of a single resource required by both of the tasks (Hoffman et al., 1985; Näätänen, 1988).

The effect of the dual task in the placebo condition was to decrease P300 amplitude. Although this reduction was not significant, it seems that asking subjects to complete the tone counting task increased the demand for cognitive processing resources and reduced the overall processing capacity to perform the visual task, as indexed by a reduction in P300 amplitude. Thus the components of the dual task placed demands on the same limited capacity pool of available resources. The reduced P300 amplitude elicited from the primary visual task indicated that the secondary tone counting task increased the demand for available processing resources (Isreal et al., 1980a).

Although the subjects were formally blind to the condition on each session, all subjects were able to guess that they had ingested alcohol in the combined condition. This was an inherent problem with the high doses of alcohol used in the experiment. It is possible therefore that the effects of alcohol and temazepam in combination may have been mediated by increased levels of attention and concentration on the part of the subjects, that is, they may have been able to compensate for some of the effects (Williams, Goldman, & Williams, 1981). The increased attention would have the effect of increasing P300 amplitude and decreasing P300 latency, and thus any impairment due to the effects of either or both of the two drugs would be reduced. In other words rather than the dual task being a more sensitive index of the combined effects of alcohol and temazepam ingestion, it may have counteracted the effects that the drugs may ordinarily have had. Thus the effects of the ingestion of the combined drugs on information processing or the cognitive component of the required experimental task may have been attenuated, as indexed by the relatively

small changes in P300 amplitude and latency. The additional demands of the experimental task had no effect on psychomotor processing reflected in RT, which was affected by alcohol and temazepam. The suggestion that subjects increased concentration, attention and motivation in the combined alcohol/temazepam condition is supported by the fact that their mean performance did not deteriorate on the secondary tone counting task.

In summary, the nature of the dual-task paradigm used in this experiment may have caused an overall increase in attention, concentration, and motivational level across drug conditions which may have masked some of the information processing effects of the drugs. At low doses the combined effects of alcohol and temazepam are additive in nature (Martin et al., 1992b). In information processing terms alcohol and temazepam affect different levels of processing within the CNS. Temazepam affects processes which have little or nothing to do with speed of mental processing or psychomotor performance as indexed by P300 latency and RT. Temazepam appears to have a specific effect, that is, it reduces the resources available in a particular pool which operates only with the processing of information and not speed of mental processing. Alcohol on the other hand has a more generalised effect and not only affects the pool of resources responsible for information processing but also the pool of resources which are responsible for speed of mental processing (Martin et al., 1992b).

At the high doses used in this experiment, the relatively wide range of effects found for alcohol, compared to the more specific findings for temazepam, attest to the different neural actions of the two drugs. The specific physiological actions by which temazepam produces its effects (Costa et al., 1975; Iversen, 1983) do not appear to be changed by the presence of alcohol. However, alcohol has a smaller effect when there is no temazepam

in the system. That is, the combined effect of alcohol and temazepam appears to be synergistic. It would seem therefore that at high doses temazepam's locus of effect becomes more generalised and global, in turn overlapping with those of alcohol in an synergistic manner. Such that the effect that alcohol has on information processing is increased when ingested in combination with temazepam. Such an effect did not occur for the psychomotor measure of RT. Consequently the synergistic effect of temazepam increased the effect that alcohol had on P300 amplitude and latency but not on RT. It may therefore be assumed that as both alcohol and temazepam separately effect RT then the areas of the brain controlling psychomotor processing must be different than those of cognitive processing as indexed by P300 amplitude and latency.

Chapter 12

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Chapter 13

Appendix

Appendix

Table of contents:

Appendix A

Medical history questionnaire

University of Tasmania
Department of Psychology

Medical History Questionnaire

NAME.....

AGE.....PHONE.....

Do you; A. Smoke Cigarettes..... Yes ☐ No ☐
B. Use or have experimented with either drugs or marijuana .....
.....Yes ☐ No ☐

Have you recently lost a lot of weight ?..... Yes ☐ No ☐

Have you ever had any operations ?..... Yes ☐ No ☐

Have you ever been a patient in a Mental hospital?..... Yes ☐ No ☐

Have you ever been a patient in any other hospital ?..... Yes ☐ No ☐

HAVE YOU EVER HAD OR ARE YOU NOW SUFFERING FROM ANY OF THE FOLLOWING;

Tumour, Growth, Cyst, Cancer.....Yes ☐ No ☐

Paralysis (Including Polio)..... Yes ☐ No ☐

Shortness of Breath..... Yes ☐ No ☐

Palpitations or Pounding Heart..... Yes ☐ No ☐

High or Low Blood Pressure..... Yes ☐ No ☐

Heart Disease..... Yes ☐ No ☐

Severe Reactions to Drugs or Injections... Yes ☐ No ☐

Frequent Colds or Nasal Obstructions... Yes ☐ No ☐

Troat troubles..... Yes ☐ No ☐

Fainting Attacks..... Yes ☐ No ☐

Fits or Convulsions..... Yes ☐ No ☐

Epilepsy.....	Yes ☐	No ☐
Giddiness.....	Yes ☐	No ☐
Severe Headache.....	Yes ☐	No ☐
Migraines.....	Yes ☐	No ☐
Nervous Trouble.....	Yes ☐	No ☐
Severe Depression.....	Yes ☐	No ☐
Mental Illness.....	Yes ☐	No ☐
Attempted Suicide.....	Yes ☐	No ☐
Frequent Indigestion.....	Yes ☐	No ☐
Heartburn.....	Yes ☐	No ☐
Ulcer of the Stomach.....	Yes ☐	No ☐
Ulcer of the Duodenum.....	Yes ☐	No ☐
Gall Bladder Trouble.....	Yes ☐	No ☐
Gall Stones.....	Yes ☐	No ☐
Vomiting Blood.....	Yes ☐	No ☐
Passing Blood Through the Bowels.....	Yes ☐	No ☐
Sugar Diabetes.....	Yes ☐	No ☐
Concussion.....	Yes ☐	No ☐
Severe Head injury.....	Yes ☐	No ☐
Loss of Consciousness.....	Yes ☐	No ☐
Any other Illness or Disability.....	Yes ☐	No ☐

HAVE ANY OF YOUR IMMEDIATE FAMILY OR PEOPLE LIVING WITH YOU;

Been a Heavy Drinker.....	Yes ☐	No ☐
Had Fits.....	Yes ☐	No ☐
Had Epilepsy.....	Yes ☐	No ☐
Had Nervous Illness.....	Yes ☐	No ☐
Had Mental Illness.....	Yes ☐	No ☐

CURRENT MEDICATION

Are you taking any medications at present ? ..... Yes ☐ No ☐

If YES, which Drugs are you taking?

.....

.....

VISION

Do you wear spectacles?..... Yes ☐ No ☐

Are you Colour Blind?..... Yes ☐ No ☐

Indicate your visual Defect .....

.....

If able, indicate below the exact visual conditions that apply to you;

DISTANT VISION		COLOUR VISION
UNAIDED	CORRECTED TO	
RIGHT 6/	6/	RIGHT:
LEFT 6/	6/	LEFT:

AMSLER FULL FIELD
AMSLER CHART

HEARING

Have you any hearing difficulties? ..... Yes ☐ No ☐
If YES, indicate hearing defects .....

.....

DRINKING HISTORY

On how many days last week did you drink alcohol ?... One or Two days ☐
Five or Six Days ☐
Every Day ☐

Do you usually drink..... During the Week ☐
Friday Night ☐
Week Ends Only ☐

When you drink is it Normally..... Light Beer ☐
Beer or Cider ☐
Wine ☐
Mixed spirits ☐
Straight Spirits ☐

On a day when you drink, how many drinks would you usually have?

- One or Two ☐
- Three to Five ☐
- Five to Eight ☐
- Eight to Twelve ☐
- More than Twelve ☐

How long have you been drinking at this level ?.....

- Weeks ☐
- Months ☐
- Years ☐

Do you get drunk?.....

- Never ☐
- Rarely ☐
- Once a Month ☐
- Once a Week ☐
- More Frequently ☐

Does your father get drunk?.....

- Never ☐
- Rarely ☐
- Once a Month ☐
- Once a Week ☐
- More Frequently ☐

Does your Mother get drunk?.....

- Never ☐
- Rarely ☐
- Once a Month ☐
- Once a Week ☐
- More Frequently ☐

Do you have any relatives whom you would consider to be alcoholic?

Yes ☐ No ☐

If YES, How many and what relationship are they to you? .....

.....

.....

OTHER INFORMATION

How often do you smoke Cigarettes ?..... Never ☐

Less than 10 per day ☐

10 to 20 per day ☐

20 to 40 per day ☐

Over 40 per day ☐

Do you Drive Regularly ? Yes ☐ No ☐

If YES, for how many years have you done so ? .....

.....

Have you ever been involved in a serious road traffic accident ?

Yes ☐ No ☐

If YES, did you sustain any head injuries ? Yes ☐ No ☐

Note:

It is a formal requirement of the Ethics Committee of the University of Tasmania that the information provided on this questionnaire be held under security to comply with confidentiality regulations and to protect your privacy. You can be assured that information will be available only to the principal researcher and not to any other party. The questionnaire will be destroyed following the completion of the project.

Thankyou for your assistance,

Version 1.0 mvg: 3/92

Appendix B

Informed consent form

University of Tasmania

Department of Psychology

Cognitive Psychophysiology Laboratory

Participant Consent Form

Information for participation in studies investigating the interactive effects of alcohol and a minor tranquillizer, temazepam in the Cognitive Psychophysiology Laboratory.

NAME:.....

Telephone Number:.....

The research carried out in the Cognitive Psychophysiological Laboratory includes a number of continuing research projects. Our studies are concerned with understanding more about the nature of cognitive processes, brain activity and a variety of related phenomena. The success of our research depends, in large measure, upon the assistance of volunteers such as yourself. We would like to extend our appreciation to you for your participation in this experiment over the next few weeks. The purpose of the research in which you will be involved is to ascertain the separate and interactive effects of alcohol (in varying doses) and of temazepam (a minor tranquillizer - also in varying doses) on the electrical activity of your brain and on motor reaction time. The main aim of the experimentation is to enable us to learn more about how these two drugs, separately and in combination, affect the mental processes involved in driving. In particular, we are interested in finding out the effects on attention and information processing of the two drugs and how these effects relate to the driving process.

Please sign and date this form after carefully reading the following section:

Today I am volunteering to participate in a research study that involves the presentation of visual stimuli. I understand that this experiment involves the recording of event-related potentials from my brain which will be detected via sensors harmlessly placed on my scalp. These event-related potentials will occur in response to the scenes of normal traffic and imminent accidents that I will view. Because we are interested in the nature of your brain's response to the traffic scenes we will give you specific instruction about what you are to attend to during the duration of the experiment. Listen carefully to the instructions given and don't be afraid to ask the experimenter to repeat them.

As part of this experiment I understand that I will be asked to drink either alcohol (calculated to give me a blood alcohol concentration of either .1 or .04) and orange juice

masked with peppermint water or just the orange juice and peppermint water. I also understand that I will be asked to take a pill (either 20 or 10 mg) of temazepam or a placebo pill. I understand that the pill may make me feel drowsy. I also understand that I will be asked to remain in the laboratory until my Blood Alcohol level has been measured as below .05 on two separate occasions at least half an hour apart. I understand that I will be driven home following completion of the experiment and that I should not drive, but remain at home, until the following morning. I also understand that should I drink on arrival at home following an experimental session, I am likely to feel the effects of alcohol more quickly owing to the residual alcohol which may be in my system.

The psychological and physiological side effects of alcohol consumption and temazepam consumption are minimal and include sedative, anxiolytic and depressive effects. The two drugs taken in combination are likely to have no more effect than the sum of the two drugs taken in isolation. If you have any medical problems, including any form of heart or respiration disease, are taking medication of any kind, or have high blood pressure, then you should not be a volunteer for this study. If you are pregnant or suspect that you may be pregnant then you should not participate in this study.

I understand that I may withdraw from the experiment at any time with no prejudice. I also understand that following completion of all experimental sessions (or before if I withdraw from the experiment) the full procedure of the experiment will be explained to me.

I.....have read and understood the above information in regard to this research project and agree to participate in the exeriment of my own free will and choice. I understand my rights in regard to my ongoing participation in this project.

Signed.....

Date.....

I have explained this project and the implication of participation in it to this volunteer and am satisfied that the consent is informed and that she/he understands the implications of participation.

Signed.....

Date.....

Appendix C

Scales administered during experimentation required subjective (i) Estimated rating of intoxication, (ii) Estimated Blood Alcohol Level

Name:..... Date:.....

Subjective Intoxication Rating:

Circle one:

0. Totally unaffected by alcohol, sober
1. Slightly affected by alcohol, still capable of driving
2. Affected by alcohol; dubious whether or not I would drive
3. Intoxicated, probably unable to drive
4. Very intoxicated, definitely unable to drive

Estimated Blood Alcohol Level:

Circle one:

0. 0.00
1. 0.00 to 0.02
2. 0.02 to 0.04
3. 0.04 to 0.06
4. 0.06 to 0.08
5. 0.08 to 0.10
6. above 0.10

Subjective Sedation Rating:

Circle one:

0. Totally unaffected by temazepam, i.e. not sedated
1. Slightly sedated, still capable of driving
2. Moderately sedated; dubious whether or not I would drive
3. Very sedated, probably unable to drive
4. Definitely unable to drive

Appendix D

Raw data

	1 AP2FZCD	2 AP2FZCB	3 AP2FZCC	4 AP2FZCA	5 AP2FZRD	6 AP2FZRB	7 AP2FZRC	8 AP2FZRA
1	-5.300	-5	-5.600	-4.400	-6.900	-4.400	-5.900	-8.400
2	-1.900	-2.500	-2.500	-.600	.300	.900	.600	-3.400
3	-4.400	-5.600	-3.800	-2.200	-5.300	-6.300	-1.600	-.300
4	-7.500	-4	-6.500	-6.500	-10	-5.500	-7	-9
5	-10.300	-3.800	-5.600	-5	-7.200	-8.800	-1.600	-3.100
6	-3.800	-.300	-.600	-2.800	-2.500	-1.600	-2.200	-6.600
7	-3.400	-2.500	-1.300	-3.400	-5.300	-.300	-.600	.300
8	-4.700	-5.900	-6.300	-6.600	-8.400	-5	-5	-4.100
9	-3.800	-7.200	-2.500	-3.800	-5	-6.300	-2.200	-.300
10	-5	-10	-8	-10.500	-7	-12	-7	-14
11	-5.900	-6.900	-4.100	-5	-4.400	-6.900	-3.400	-3.400
12	-.900	-.900	-.600	-1.600	1.600	-2.200	3.400	2.800

	9 AP2CZCD	10 AP2CZCB	11 AP2CZCC	12 AP2CZCA	13 AP2CZRD	14 AP2CZRB	15 AP2CZRC	16 AP2CZRA
1	-3.100	-3.800	-4.100	-3.800	-5	-4.100	-4.700	-7.200
2	-.900	-4.400	-2.200	-.900	1.900	-.600	2.200	-2.800
3	-2.200	-5.300	-3.800	0	-4.700	-5.900	-2.800	-1.900
4	-1.600	-.900	-4.700	-4.100	-5	-3.100	-5.600	-4.100
5	-5.900	-1.900	-2.200	0	-8.100	0	-3.800	-2.500
6	-2.500	1.600	-.900	-3.100	-1.900	-1.900	-2.800	.300
7	-4.400	-4.700	-.300	-5.600	-6.600	-1.900	-3.100	-3.400
8	-.900	-1.900	-2.500	-4.100	-3.400	-.600	-2.800	-3.100
9	-1.300	-5.600	-1.300	-3.100	-3.100	-4.700	-.600	.900
10	-5	-10.900	-7.800	-10.600	-12.500	-14	-12.500	-15.300
11	-4.400	-5	-2.500	-3.100	-2.800	-5	-2.800	0
12	.900	.900	0	-1.300	2.200	2.500	3.800	2.500

	17 AP2PZCD	18 AP2PZCB	19 AP2PZCC	20 AP2PZCA	21 AP2PZRD	22 AP2PZRB	23 AP2PZRC	24 AP2PZRA
1	5.300	1.600	2.200	.600	5.300	-.600	1.300	-2.500
2	6.300	-2.200	2.200	2.800	7.500	-1.600	6.600	.600
3	7.500	7.800	7.500	13.800	4.700	6.600	4.700	11.300
4	8.800	5.600	4.700	2.500	5.600	3.400	1.900	.300
5	5.300	9.100	5	12.800	5	23.100	6	22.500
6	3.100	7.200	1.600	.900	3.400	2.800	1.900	2.800
7	2.800	.300	6.300	1.300	4.700	6.900	3.400	3.800
8	8.400	10	9.400	4.700	7.500	10.600	9.100	5
9	7.200	2.500	3.800	1.600	6.600	2.200	6.900	5
10	.300	1.900	.600	-.300	.900	-6.600	-5.900	-6.300
11	2.800	.900	3.100	1.300	4.100	2.200	2.200	3.800
12	2.500	12.200	8.800	5.600	8.800	11.300	10.300	7.500

	25 AN2FZCD	26 AN2FZCB	27 AN2FZCC	28 AN2FZCA	29 AN2FZRD	30 AN2FZRB	31 AN2FZRC	32 AN2FZRA
1	-7.800	-7.800	-9.100	-8.100	-14.700	-11.900	-13.800	-12.500
2	-4.400	-5	-7.500	-4.700	-3.800	-4.400	-4.100	-4.100
3	-10.600	-13.100	-10	-6.900	-18.400	-23.800	-17.200	-12.500
4	-10.600	-7.200	-9.400	-8.100	-15	-12.500	-13.400	-11.900
5	-15.600	-5.900	-12.200	-8.400	-13.400	-10	-8.800	-10.300
6	-10	-4.700	-7.500	-13.400	-5.300	-3.800	-6.900	-9.100
7	-4.700	-9.100	-5.900	-10.600	-1.500	-10.300	-6.900	-9.700
8	-7.500	-8.800	-8.100	-8.100	-11.600	-12.800	-6.900	-9.700
9	-7.800	-11.600	-6.300	-8.400	-11.300	-16.900	-6.300	-11.900
10	-8.400	-13.400	-10.600	-12.800	-11.300	-18.100	-14.700	-18.400
11	-15.300	-15.900	-14.100	-13.400	-21.900	-18.100	-21.300	-21.300
12	-2.800	-3.800	-4.400	-4.100	0	-3.800	0	-2.800

	33 AN2CZCD	34 AN2CZCB	35 AN2CZCC	36 AN2CZCA	37 AN2CZRD	38 AN2CZRB	39 AN2CZRC	40 AN2CZRA
1	-5	-6.900	-7.800	-8.400	-8.500	-14.100	-11.600	-12.500
2	-3.400	-6.300	-5	-5.300	-2.500	-6.900	-1.900	-6.900
3	-10.600	-13.400	-11.300	-5.300	-22.200	-28.100	-23.100	-16.900
4	-5	-5.300	-6.300	-6.300	-10.900	-12.200	-13.100	-15
5	-14.100	-5.300	-7.800	-1.600	-15	-3.100	-9.400	-6.600
6	-9.700	-3.400	-8.400	-13.100	-8.800	-3.800	-9.400	-10
7	-6.300	-10.300	-1.900	-10.300	-9.400	-12.500	-9.100	-8.800
8	-3.100	-4.400	-5	-5.900	-6.900	-8.800	-6.300	-10.360
9	-5.300	-11.300	-6.300	-8.100	-8.100	-14.100	-7.500	-13.400
10	-7.500	-13.100	-10.900	-13.100	-17.800	-22.500	-24.100	-27.800
11	-13.800	-15.600	-13.100	-12.200	-22.200	-17.200	-20.600	-20
12	-1.300	-.900	-2.800	-3.400	-.600	-5	-1.900	-6.300

	41 AN2PZCD	42 AN2PZCB	43 AN2PZCC	44 AN2PZCA	45 AN2PZRD	46 AN2PZRB	47 AN2PZRC	48 AN2PZRA
1	5	1.300	1.600	-1.600	3.800	-3.100	.600	-6.300
2	4.400	-2.800	-1.300	1.600	3.400	-4.100	4.400	-1.900
3	.600	1.600	.300	4	-4.100	-5.300	-7.200	-.600
4	8	1.900	2.800	1.600	2.500	-3.400	-3.400	-6.900
5	4.100	9.100	2.500	12.200	3.100	21.600	5	19.400
6	-1.900	2.500	-3.800	-4.400	-1.300	2.500	-1.600	-2.500
7	-2.500	-3.800	.600	-4.700	-1.300	-.600	-1.300	-.300
8	6	7.500	6.200	2.500	5.600	7.800	6.900	2.500
9	3.100	-2.200	-.900	-2.500	2.200	-1.600	.300	-8.100
10	-1.600	.600	-1	-.600	-4.700	-12.800	-13.400	-15
11	-2.200	-7.200	-3.100	-4.100	-8.400	-7.200	-9.100	-9.400
12	2	8.400	6.300	3.100	7.500	7.200	7.800	3.100

	49 AP3FZCD	50 AP3FZCB	51 AP3FZCC	52 AP3FZCA	53 AP3FZRD	54 AP3FZRB	55 AP3FZRC	56 AP3FZRA
1	-5.300	-3.100	-3.800	-2.500	-9	-5.300	-7.500	-6
2	-3.800	-2.800	-1.900	-.900	5	3.800	4.100	0
3	-2.800	-4.700	-2.500	1.300	-4.700	-15	-10	-.300
4	-5.900	-2.800	-5	-2.800	-4.100	3.800	-7	9.700
5	-10.900	-3.800	-11.600	-4.100	.600	1.300	-1.600	-2.800
6	-6.300	.900	-5.300	-5	-.600	11.600	0	-1.600
7	-1.300	-3.400	-3.800	-5.300	-11.600	-3.400	-.600	-4.100
8	-4.900	-4.100	-5	-3.800	-6	.800	1.600	4.700
9	-5.300	-6.600	-5.700	-2.800	.800	-8.800	.300	-2
10	-5.900	-4.400	-5	-2.500	-12.200	-12.500	-8.800	-9.100
11	-9	-9	-4.400	-4	-4.900	-11	-5	-5
12	0	1.900	2.200	3.400	7.500	11.300	11.900	11.900

	57 AP3CZCD	58 AP3CZCB	59 AP3CZCC	60 AP3CZCA	61 AP3CZRD	62 AP3CZRB	63 AP3CZRC	64 AP3CZRA
1	-1.900	-2.500	-1.600	-1.600	-6.500	-6	-4.700	-5
2	-1.900	-4.100	0	-.900	15	9.400	12.200	11
3	-3.400	-6.300	-3.100	.600	-5.100	-6.300	-8.900	.900
4	-2.800	-.600	-4.400	-1.900	3.500	15.600	10.300	14.400
5	-10.100	-2.200	-4.700	-7.600	10.500	19.400	9	5.300
6	-5.300	2.500	-.600	-2.200	3.800	19.100	7.200	9.400
7	-4.100	-2.800	-5.600	-2.800	-7.800	7.800	19.400	8.400
8	-1.600	-2.500	-3.100	-2.500	-6.300	7	3	10
9	-5	-5	-.600	-2.200	10	-.600	13.600	4
10	-5.300	-3.800	-5	-1.300	-9.100	-10	-4.100	-3.400
11	-5.600	-8	-2.800	-1.900	.700	4	4.200	7.800
12	2.500	3.800	4.700	5.900	18	15.900	16.300	15.300

	65 AP3PZCD	66 AP3PZCB	67 AP3PZCC	68 AP3PZCA	69 AP3PZRD	70 AP3PZRB	71 AP3PZRC	72 AP3PZRA
1	5.900	2.800	3.800	2.800	10	9	8	5.600
2	5.300	0	5.900	2.800	20.500	13	17.800	22.500
3	2.500	4.400	2.800	5	8	16.300	4.400	11.600
4	4.400	4.400	3.400	3.100	13.400	24.700	22.500	20.300
5	10.300	17.200	9.100	16.300	32	40.300	33.800	23.400
6	.900	9.100	3.900	4.600	16.300	28.400	20	19.500
7	-.300	.600	2.200	1.900	16.400	22.800	24.500	17
8	7	7.500	3.400	2.500	8	16.600	11.800	8.100
9	3.800	1.900	.600	1.900	13.100	11.300	16.800	8.900
10	.600	4.100	2.200	5	3.800	8.400	7.500	9.100
11	.600	-.900	0	.300	3.500	14	5.700	7.500
12	7.800	9.400	7.200	6.900	8.400	16.600	21.600	20

	73 LP2FZCD	74 LP2FZCB	75 LP2FZCC	76 LP2FZCA	77 LP2FZRD	78 LP2FZRB	79 LP2FZRC	80 LP2FZRA
1	204	238	230	228	248	230	226	222
2	248	244	198	218	238	274	228	224
3	200	190	190	220	198	198	202	194
4	237	237	225	210	249	235	243	250
5	284	212	178	196	218	238	160	188
6	180	194	186	184	192	188	200	292
7	194	244	246	232	260	244	240	248
8	214	208	212	218	254	254	250	252
9	214	228	234	234	244	232	226	216
10	224	180	195	210	220	248	195	235
11	188	208	192	184	188	212	192	186
12	238	220	180	218	280	296	224	228

	81 LP2CZCD	82 LP2CZCB	83 LP2CZCC	84 LP2CZCA	85 LP2CZRD	86 LP2CZRB	87 LP2CZRC	88 LP2CZRA
1	206	232	190	232	222	230	226	200
2	246	242	230	218	236	256	224	204
3	196	188	212	224	198	200	202	192
4	246	246	336	194	250	238	234	198
5	192	198	178	296	202	306	194	304
6	186	200	198	192	196	284	204	190
7	266	240	246	234	266	234	242	244
8	238	220	218	220	254	248	234	244
9	214	216	226	222	218	240	222	204
10	242	238	250	236	265	270	220	224
11	188	202	192	194	182	206	192	190
12	224	224	184	218	248	210	210	214

	89 LP2PZCD	90 LP2PZCB	91 LP2PZCC	92 LP2PZCA	93 LP2PZRD	94 LP2PZRB	95 LP2PZRC	96 LP2PZRA
1	204	228	228	232	308	306	226	212
2	314	268	164	232	240	276	138	224
3	236	254	242	232	226	232	220	224
4	246	260	332	238	200	240	236	226
5	214	204	216	216	206	308	225	304
6	214	210	210	208	230	278	218	208
7	134	244	246	246	138	236	240	246
8	234	224	280	252	258	250	276	248
9	220	216	228	224	214	258	224	216
10	116	238	250	234	158	234	236	234
11	194	208	192	204	176	198	182	194
12	130	242	240	232	226	222	212	220

	97 LN2FZCD	98 LN2FZCB	99 LN2FZCC	100 LN2FZCA	101 LN2FZRD	102 LN2FZRB	103 LN2FZRC	104 LN2FZRA
1	320	304	302	302	382	392	384	352
2	298	290	288	270	376	390	302	268
3	300	272	304	274	366	354	328	310
4	302	312	302	276	300	312	352	340
5	372	268	268	256	306	266	262	326
6	260	240	256	248	266	240	314	326
7	238	310	310	304	335	314	298	310
8	328	300	300	324	300	378	322	356
9	318	306	312	306	320	328	282	310
10	304	276	296	276	285	368	296	312
11	306	316	308	308	314	358	312	316
12	308	304	304	304	308	334	308	278

	105 LN2CZCD	106 LN2CZCB	107 LN2CZCC	108 LN2CZCA	109 LN2CZRD	110 LN2CZRB	111 LN2CZRC	112 LN2CZRA
1	296	308	302	296	278	366	354	275
2	302	290	272	268	332	376	300	268
3	300	308	302	298	360	330	330	308
4	294	368	360	268	296	312	300	308
5	370	262	252	340	294	334	272	338
6	260	256	262	258	336	328	316	318
7	310	306	304	302	328	312	308	304
8	324	312	298	332	300	372	322	354
9	304	288	296	302	324	328	276	296
10	304	276	302	272	336	312	302	302
11	304	318	306	306	310	352	310	302
12	310	274	270	260	316	264	306	280

	113 LN2PZCD	114 LN2PZCB	115 LN2PZCC	116 LN2PZCA	117 LN2PZRD	118 LN2PZRB	119 LN2PZRC	120 LN2PZRA
1	254	310	320	296	338	364	270	266
2	384	332	194	276	328	352	240	266
3	306	312	308	296	308	308	298	294
4	285	366	368	282	290	300	294	276
5	256	230	246	260	225	332	243	340
6	262	264	260	260	274	296	312	272
7	206	300	304	300	194	312	306	294
8	330	326	340	300	348	332	332	286
9	290	278	286	290	332	328	276	286
10	208	276	280	275	202	300	296	286
11	308	316	304	308	308	314	302	302
12	160	278	284	262	316	264	242	272

	121 LP3FZCD	122 LP3FZCB	123 LP3FZCC	124 LP3FZCA	125 LP3FZRD	126 LP3FZRB	127 LP3FZRC	128 LP3FZRA
1	432	460	458	446	515	482	462	430
2	324	376	388	348	548	522	484	380
3	456	392	420	386	556	430	404	436
4	452	460	404	404	430	514	410	480
5	450	320	318	404	486	442	488	430
6	420	396	316	408	444	518	422	424
7	362	360	394	368	542	422	378	376
8	425	484	476	470	500	515	510	522
9	396	456	370	398	500	510	348	510
10	456	398	402	384	458	462	408	400
11	430	425	524	470	500	510	540	500
12	454	396	414	388	420	426	430	416

	129 LP3CZCD	130 LP3CZCB	131 LP3CZCC	132 LP3CZCA	133 LP3CZRD	134 LP3CZRB	135 LP3CZRC	136 LP3CZRA
1	404	460	454	448	440	570	454	425
2	450	406	372	372	542	570	484	425
3	456	392	432	386	520	510	550	530
4	352	516	410	498	465	514	490	482
5	450	318	432	370	490	498	460	458
6	416	390	430	410	444	510	448	486
7	352	364	368	352	534	482	556	376
8	434	410	416	470	362	520	505	528
9	330	410	470	392	494	458	502	475
10	362	374	398	372	458	420	422	400
11	424	400	520	508	500	504	530	560
12	454	396	386	378	540	442	436	416

	137 LP3PZCD	138 LP3PZCB	139 LP3PZCC	140 LP3PZCA	141 LP3PZRD	142 LP3PZRB	143 LP3PZRC	144 LP3PZRA
1	400	356	368	442	470	460	400	436
2	448	410	356	436	480	470	542	458
3	454	374	370	325	460	528	508	500
4	474	480	404	472	424	508	496	486
5	498	322	424	324	440	474	512	416
6	380	456	375	410	480	472	462	405
7	340	416	328	346	540	522	495	350
8	325	364	484	470	483	522	410	500
9	320	348	390	462	494	456	475	475
10	314	412	404	370	458	526	422	432
11	414	406	416	458	420	500	480	426
12	298	308	302	378	338	322	444	426

	1 DRT	2 BRT	3 CRT	4 ART	5 DHIT	6 BHIT	7 CHIT	8 AHIT
1	637	621	595	628	40	40	40	40
2	576	623	569	582	40	40	40	40
3	570	499	485	491	40	40	40	40
4	561	584	527	518	40	40	40	40
5	708	613	572	612	40	40	40	40
6	584	625	585	540	40	40	40	40
7	685	649	703	556	40	40	40	40
8	705	630	727	614	40	40	40	40
9	581	564	611	571	40	40	40	40
10	600	511	539	488	40	40	40	40
11	606	663	627	624	40	40	40	40
12	610	477	486	465	40	40	40	40

	9 DMISS	10 BMISS	11 CMISS	12 AMISS	13 DFA	14 BFA	15 CFA	16 AFA
1	11	7	9	12	4	3	2	10
2	11	6	8	5	15	2	1	8
3	9	9	19	3	8	5	4	8
4	12	12	5	9	6	5	7	9
5	10	10	5	10	9	5	4	3
6	10	6	16	6	6	5	2	3
7	37	10	8	3	24	4	6	2
8	13	4	12	6	6	8	4	7
9	4	15	3	5	3	6	5	2
10	12	10	3	5	3	3	7	11
11	8	9	16	11	14	3	8	4
12	8	15	5	8	5	10	7	14

	17 DCR	18 BCR	19 CCR	20 ACR
1	184	205	166	309
2	179	165	172	152
3	61	158	164	121
4	147	148	143	142
5	214	164	140	144
6	164	138	182	154
7	231	184	162	161
8	172	163	188	165
9	157	206	135	165
10	158	169	118	155
11	155	187	191	207
12	273	208	168	165

Tone Counting Raw Data

A	B	C	D
129	70	15	-11
12	9	-8	13
14	12	107	37
18	60	17	8
18	201	119	90
5	-32	13	13
17	133	30	-29
13	16	9	1
8	0	6	3
44	13	22	32
38	40	38	14
12	11	13	24

Appendix E

Means Tables

Means Table for P200 Amplitude

css/3: general manova				MEANS
site/fcp	stc/r	alcy/n	temy/n	Depend. Var. 1
1	1	1	1	-4.74167
1	1	1	2	-4.55000
1	1	2	1	-3.95000
1	1	2	2	-4.36667
1	2	1	1	-5.00833
1	2	1	2	-4.86667
1	2	2	1	-2.70833
1	2	2	2	-4.12500
2	1	1	1	-2.60833
2	1	1	2	-3.49167
2	1	2	1	-2.69167
2	1	2	2	-3.30833
2	2	1	1	-4.08333
2	2	1	2	-3.27500
2	2	2	1	-2.95833
2	2	2	2	-3.05000
3	1	1	1	5.02500
3	1	1	2	4.74167
3	1	2	1	4.60000
3	1	2	2	3.96667
3	2	1	1	5.34167
3	2	1	2	5.02500
3	2	2	1	4.03333
3	2	2	2	4.48333

Means Table for N200 Amplitude

css/3: general manova				MEANS
site/fcp	stc/r	alcy/n	temy/n	Depend. Var.1
1	1	1	1	-8.7917
1	1	1	2	-8.8583
1	1	2	1	-8.7583
1	1	2	2	-8.9167
1	2	1	1	-10.6833
1	2	1	2	-12.2000
1	2	2	1	-10.0250
1	2	2	2	-11.1833
2	1	1	1	-7.0917
2	1	1	2	-8.0167
2	1	2	1	-7.2167
2	1	2	2	-7.7500
2	2	1	1	-11.0750
2	2	1	2	-12.3583
2	2	2	1	-11.5000
2	2	2	2	-12.8800
3	1	1	1	2.0833
3	1	1	2	1.4083
3	1	2	1	.8500
3	1	2	2	.5917
3	2	1	1	.6917
3	2	1	2	.0833
3	2	2	1	-.9167
3	2	2	2	-2.1667

Means Table for P300 Amplitude

css/3: general manova				MEANS
site/fcp	stc/r	alcy/n	temy/n	Depend. Var.1
1	1	1	1	-5.11667
1	1	1	2	-3.49167
1	1	2	1	-4.31667
1	1	2	2	-2.41667
1	2	1	1	-3.26667
1	2	1	2	-1.95000
1	2	2	1	-1.88333
1	2	2	2	-.38333
2	1	1	1	-3.70833
2	1	1	2	-2.62500
2	1	2	1	-2.23333
2	1	2	2	-1.53333
2	2	1	1	2.22500
2	2	1	2	6.27500
2	2	2	1	6.45833
2	2	2	2	6.50833
3	1	1	1	4.06667
3	1	1	2	5.04167
3	1	2	1	3.70833
3	1	2	2	4.42500
3	2	1	1	12.78333
3	2	1	2	18.45000
3	2	2	1	16.20000
3	2	2	2	14.45833

Means Table for P200 Latency

css/3: general manova				MEANS
site/fcp	stc/r	alcy/n	temy/n	Depend. Var.1
1	1	1	1	218.7500
1	1	1	2	216.9167
1	1	2	1	205.5000
1	1	2	2	212.6667
1	2	1	1	232.4167
1	2	1	2	237.4167
1	2	2	1	215.5000
1	2	2	2	227.9167
2	1	1	1	220.3333
2	1	1	2	220.5000
2	1	2	1	221.6667
2	1	2	2	223.3333
2	2	1	1	228.0833
2	2	1	2	243.5000
2	2	2	1	217.0000
2	2	2	2	217.3333
3	1	1	1	204.6667
3	1	1	2	233.0000
3	1	2	1	235.6667
3	1	2	2	229.1667
3	2	1	1	215.0000
3	2	1	2	253.1666
3	2	2	1	219.4167
3	2	2	2	229.6667

Means Table for N200 Latency

css/3: general manova				MEANS
site/fcp	stc/r	alcy/n	temy/n	Depend. Var.1
1	1	1	1	304.5000
1	1	1	2	291.5000
1	1	2	1	295.8333
1	1	2	2	287.3333
1	2	1	1	321.5000
1	2	1	2	336.1667
1	2	2	1	313.3333
1	2	2	2	317.0000
2	1	1	1	306.5000
2	1	1	2	297.1667
2	1	2	1	293.8333
2	1	2	2	291.8333
2	2	1	1	317.5000
2	2	1	2	332.1667
2	2	2	1	308.0000
2	2	2	2	304.4167
3	1	1	1	270.7500
3	1	1	2	299.0000
3	1	2	1	291.1667
3	1	2	2	283.7500
3	2	1	1	288.5833
3	2	1	2	316.8333
3	2	2	1	284.2500
3	2	2	2	286.6666

Means Table for P300 Latency

css/3: general manova				MEANS
site/fcp	stc/r	alcy/n	temy/n	Depend. Var.1
1	1	1	1	421.4167
1	1	1	2	410.2500
1	1	2	1	407.0000
1	1	2	2	406.1666
1	2	1	1	491.5834
1	2	1	2	479.4167
1	2	2	1	440.3333
1	2	2	2	442.0000
2	1	1	1	407.0000
2	1	1	2	403.0000
2	1	2	1	424.0000
2	1	2	2	413.0000
2	2	1	1	482.4167
2	2	1	2	499.8333
2	2	2	1	486.4167
2	2	2	2	463.4167
3	1	1	1	388.7500
3	1	1	2	387.6667
3	1	2	1	385.0833
3	1	2	2	407.7500
3	2	1	1	457.2500
3	2	1	2	480.0000
3	2	2	1	470.5000
3	2	2	2	442.5000

Mean Summary Tables for RT, Misses, Correct Rejections & False Alarms

css/3: general manova		MEANS
alcy/n	temy/n	Depend. Var.1
1	1	618.5834
1	2	588.2500
2	1	585.5000
2	2	557.4167

css/3: general manova		MEANS
alcy/n	temy/n	Depend. Var.1
1	1	12.08333
1	2	9.41667
2	1	9.08333
2	2	6.91667

css/3: general manova		MEANS
alcy/n	temy/n	Depend. Var.1
1	1	174.5833
1	2	174.5833
2	1	160.7500
2	2	170.0000

css/3: general manova		MEANS
alcy/n	temy/n	Depend. Var.1
1	1	8.583333
1	2	4.916667
2	1	4.750000
2	2	6.750000

Condition Means for Tone Counting

Condition	Mean	Std
Placebo	27.33	34.02
Alcohol	44.41	64.89
Temazepam	31.74	39.74
Alc/Tem	16.25	29.34

Appendix F

ANOVA summary tables

P200 Amplitude ANOVA Summary Table

css/3: general manova	Summary of all Effects; design: 1-site/fcp, 2-stc/r, 3-alcy/n, 4-temy/n					
Effect	df Effect	MS Effect	df Error	MS Error	F	p-level
*1	2	2281.135	22	34.30105	66.50337	.000000
2	1	.017	11	20.95567	.00080	.977928
3	1	2.920	11	16.14552	.18086	.678833
4	1	4.702	11	31.02472	.15156	.704477
12	2	2.029	22	3.81976	.53126	.595215
*13	2	19.194	22	1.21700	15.77154	.000056
23	1	3.556	11	2.50609	1.41876	.258675
14	2	.257	22	10.83499	.02370	.976603
24	1	2.457	11	6.97506	.35223	.564859
34	1	2.840	11	10.71915	.26496	.616919
123	2	2.914	22	2.01756	1.44447	.257383
124	2	4.111	22	3.88268	1.05869	.363930
134	2	2.532	22	3.62355	.69871	.507927
234	1	.500	11	4.34295	.11513	.740769
1234	2	2.383	22	1.68087	1.41767	.263560

*Marked effects significant at p≤.0500

N200 Amplitude ANOVA Summary Table

css/3: general manova	Summary of all Effects; design: 1-site/fcp, 2-stc/r, 3-alcy/n, 4-temy/n					
Effect	df Effect	MS Effect	df Error	MS Error	F	p-level
*1	2	3303.892	22	46.26043	71.41940	.000000
*2	1	569.419	11	87.30785	6.52196	.026812
3	1	12.819	11	20.88140	.61388	.449873
4	1	48.151	11	62.36133	.77212	.398349
*12	2	48.249	22	6.45007	7.48040	.003323
*13	2	22.300	22	4.61898	4.82789	.018267
23	1	.716	11	4.04397	.17706	.682015
14	2	.818	22	9.98233	.08197	.921578
24	1	10.488	11	6.83396	1.53472	.241190
34	1	.057	11	20.27610	.00280	.958775
*123	2	5.150	22	.94471	5.45180	.011939
124	2	.989	22	4.03925	.24472	.785024
134	2	.128	22	3.43873	.03729	.963455
234	1	.601	11	6.54976	.09181	.767542
1234	2	.870	22	1.28365	.67786	.517995

*Marked effects significant at p≤.0500

P300 Amplitude ANOVA Summary Table

css/3: general manova	Summary of all Effects; design: 1-site/fcp, 2-stc/r, 3-alcy/n, 4-temy/n					
- Effect	df Effect	MS Effect	df Error	MS Error	F	p-level
*1	2	4039.223	22	66.5862	60.66161	.000000
*2	1	3534.302	11	175.1355	20.18038	.000913
3	1	53.131	11	23.8263	2.22992	.163479
4	1	159.163	11	39.4304	4.03654	.069706
*12	2	521.721	22	19.4608	26.80885	.000001
*13	2	29.798	22	7.2831	4.09136	.030354
23	1	5.695	11	19.3858	.29379	.598611
14	2	.202	22	6.0988	.03308	.967511
24	1	7.379	11	23.6609	.31187	.587720
34	1	67.183	11	37.7902	1.77780	.209374
123	2	.847	22	6.6565	.12718	.881217
124	2	4.453	22	5.2182	.85332	.439622
*134	2	25.059	22	6.4691	3.87373	.036199
234	1	58.952	11	13.1469	4.48409	.057813
*1234	2	18.683	22	4.8846	3.82477	.037536

*Marked effects significant at p≤.0500

P300 Amplitude three-way ANOVA Summary Tables for sites Fz, Cz & Pz

css/3: general manova	Summary of all Effects; design: 1-stim, 2-alcy/n, 3-temy/n					
Effect	df Effect	MS Effect	df Error	MS Error	F	p-level
1	1	92.63013	11	51.14761	1.811035	.205466
2	1	34.92092	11	11.64753	2.998140	.111272
3	1	60.32511	11	15.53033	3.884342	.074421
12	1	1.73344	11	6.19367	.279872	.607295
13	1	.75261	11	11.86328	.063440	.805783
23	1	.31510	11	17.03397	.018499	.894271
123	1	.01261	11	6.61692	.001905	.965967

*Marked effects significant at p≤.0500

css/3: general manova	Summary of all Effects; design: 1-stim, 2-alcy/n, 3-temy/n					
Effect	df Effect	MS Effect	df Error	MS Error	F	p-level
*1	1	1494.682	11	97.83076	15.27824	.002440
2	1	74.202	11	15.44985	4.80274	.050834
3	1	51.920	11	21.35405	2.43141	.147215
12	1	5.415	11	17.52455	.30900	.589424
13	1	8.050	11	13.32269	.60426	.453350
23	1	28.820	11	21.66633	1.33019	.273216
123	1	19.620	11	9.40678	2.08577	.176550

*Marked effects significant at p≤.0500

css/3: general manova	Summary of all Effects; design: 1-stim, 2-alcy/n, 3-temy/n					
Effect	df Effect	MS Effect	df Error	MS Error	F	p-level
*1	1	2990.433	11	65.07874	45.95100	.000030
2	1	3.604	11	11.29512	.31905	.583515
3	1	47.320	11	14.74360	3.20956	.100730
12	1	.240	11	8.98046	.02672	.873117
13	1	7.482	11	8.91121	.83959	.379165
*23	1	88.167	11	12.02803	7.33010	.020385
*123	1	76.684	11	6.89238	11.12586	.006646

*Marked effects significant at p≤.0500

P200 Latency ANOVA Summary Table

css/3: general manova	Summary of all Effects; design: 1-site/fcp, 2-stc/r, 3-alcy/n, 4-temy/n					
Effect	df Effect	MS Effect	df Error	MS Error	F	p-level
1	2	1041.565	22	1156.434	.90067	.420760
2	1	4441.526	11	1239.425	3.58354	.084947
3	1	2374.711	11	1646.450	1.44232	.254986
4	1	6114.362	11	1430.852	4.27323	.063079
12	2	892.665	22	628.447	1.42043	.262916
13	2	1128.995	22	1416.234	.79718	.463190
*23	1	4664.209	11	282.716	16.49788	.001878
14	2	1264.201	22	810.855	1.55910	.232690
24	1	1382.509	11	1081.049	1.27886	.282165
34	1	1794.969	11	796.079	2.25476	.161353
123	2	618.358	22	415.211	1.48926	.247409
124	2	93.520	22	202.787	.46117	.636502
134	2	2396.179	22	795.166	3.01343	.069715
234	1	63.264	11	564.478	.11208	.744090
1234	2	212.386	22	376.004	.56485	.576474

*Marked effects significant at p≤.0500

N200 Latency ANOVA Summary Table

css/3: general manova	Summary of all Effects; design: 1-site/fcp, 2-stc/r, 3-alcy/n, 4-temy/n					
Effect	df Effect	MS Effect	df Error	MS Error	F	p-level
*1	2	9655.46	22	912.085	10.58615	.000602
*2	1	22737.78	11	1113.774	20.41508	.000874
3	1	7781.34	11	2751.955	2.82757	.120797
4	1	1155.97	11	521.571	2.21632	.164658
12	2	2236.08	22	716.321	3.12161	.064061
13	2	254.14	22	724.457	.35080	.707990
23	1	2694.98	11	833.511	3.23329	.099625
14	2	1418.72	22	803.947	1.76469	.194629
24	1	2598.02	11	1108.132	2.34450	.153964
34	1	3113.86	11	2118.215	1.47004	.250738
123	2	268.22	22	727.687	.36859	.695903
124	2	340.45	22	212.333	1.60336	.223857
134	2	1400.80	22	689.738	2.03091	.155094
234	1	488.24	11	1115.622	.43764	.521882
1234	2	499.41	22	669.414	.74604	.485863

*Marked effects significant at p≤.0500

P300 Latency ANOVA Summary Table

css/3: general manova	Summary of all Effects; design: 1-site/fcp, 2-stc/r, 3-alcy/n, 4-temy/n					
Effect	df Effect	MS Effect	df Error	MS Error	F	p-level
1	2	9550.5	22	2869.232	3.32858	.054586
*2	1	299989.7	11	3836.633	78.19089	.000002
3	1	7250.1	11	4457.655	1.62643	.228473
4	1	357.8	11	6193.789	.05776	.814487
12	2	2784.7	22	959.206	2.90312	.076047
13	2	5056.5	22	1987.742	2.54383	.101429
*23	1	14492.5	11	2111.024	6.86515	.023823
14	2	718.7	22	1160.972	.61901	.547594
24	1	126.6	11	2624.722	.04823	.830194
34	1	1262.6	11	1101.524	1.14621	.307273
123	2	334.4	22	1684.893	.19845	.821452
124	2	544.9	22	1614.466	.33750	.717182
134	2	2039.8	22	1586.878	1.28539	.296510
234	1	5451.4	11	1841.669	2.96004	.113316
1234	2	2283.7	22	1311.341	1.74151	.198559

*Marked effects significant at p≤.0500

RT ANOVA Summary Table
&
Misses, Correct Rejections & False Alarms ANOVA Summary Tables

css/3: general manova	Summary of all Effects; design: 1-alcy/n, 2-temy/n					
Effect	df Effect	MS Effect	df Error	MS Error	F	p-level
*1	1	12255.69	11	724.657	16.91240	.001723
*2	1	10237.56	11	2016.249	5.07753	.045622
12	1	15.13	11	1544.370	.00979	.922948

*Marked effects significant at p≤.0500

css/3: general manova	Summary of all Effects; design: 1-alcy/n, 2-temy/n					
Effect	df Effect	MS Effect	df Error	MS Error	F	p-level
1	1	90.75006	11	37.56818	2.415610	.148413
2	1	70.08333	11	41.17425	1.702115	.218647
12	1	.74998	11	23.29545	.032194	.860864

*Marked effects significant at p≤.0500

css/3: general manova	Summary of all Effects; design: 1-alcy/n, 2-temy/n					
Effect	df Effect	MS Effect	df Error	MS Error	F	p-level
1	1	1017.484	11	1338.339	.760259	.401878
2	1	256.688	11	1222.142	.210031	.655665
12	1	256.688	11	996.960	.257470	.621882

*Marked effects significant at p≤.0500

css/3: general manova	Summary of all Effects; design: 1-alcy/n, 2-temy/n					
Effect	df Effect	MS Effect	df Error	MS Error	F	p-level
1	1	12.00000	11	17.50000	.685714	.425228
2	1	8.33331	11	24.19697	.344395	.569152
*12	1	96.33333	11	12.01515	8.017654	.016327

*Marked effects significant at p≤.0500

Tone Counting ANOVA Summary Table

Effect	df	MSe	F-value	p-value
Alcohol	1,11	984.0	0.007	0.93
Temazepam	1,11	1695.4	0.998	0.34
Alc x Tem	1,11	1721.2	1.850	0.20

Appendix G

Fisher LSDs

Fisher LSDs for P200 Amplitude

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test MAIN EFFECT: site/fcp	
site/fcp	stc/r	alcy/n	temy/n		{1} -4.28958	{2} -3.18333
1	****	****	****	{1}		.204163
2	****	****	****	{2}	.204163	
3	****	****	****	{3}	.000000	.000000

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test MAIN EFFECT: site/fcp
site/fcp	stc/r	alcy/n	temy/n		{3} 4.652083
1	****	****	****	{1}	.000000
2	****	****	****	{2}	.000000
3	****	****	****	{3}	

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test INTERACTION: 1 x 3	
site/fcp	stc/r	alcy/n	temy/n		{1} -4.79167	{2} -3.78750
1	****	1	****	{1}		.000196
1	****	2	****	{2}	.000196	
2	****	1	****	{3}	.000002	.073688
2	****	2	****	{4}	.000000	.002084
3	****	1	****	{5}	.000000	.000000
3	****	2	****	{6}	.000000	.000000

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test INTERACTION: 1 x 3	
site/fcp	stc/r	alcy/n	temy/n		{3} -3.36458	{4} -3.00208
1	****	1	****	{1}	.000002	.000000
1	****	2	****	{2}	.073688	.002084
2	****	1	****	{3}		.121701
2	****	2	****	{4}	.121701	
3	****	1	****	{5}	.000000	.000000
3	****	2	****	{6}	.000000	.000000

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test INTERACTION: 1 x 3	
site/fcp	stc/r		alcy/n	temy/n	(5) 5.033333	(6) 4.270833
1	****		1	**** (1)	.000000	.000000
1	****		2	**** (2)	.000000	.000000
2	****		1	**** (3)	.000000	.000000
2	****		2	**** (4)	.000000	.000000
3	****		1	**** (5)		.002658
3	****		2	**** (6)	.002658	

Fisher LSDs for N200 Amplitude

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test MAIN EFFECT: site/fcp	
site/fcp	stc/r	alcy/n	temy/n		{1} -9.92708	{2} -9.73604
1	****	****	****	{1}		.847491
2	****	****	****	{2}	.847491	
3	****	****	****	{3}	.000000	.000000

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test MAIN EFFECT: site/fcp
site/fcp	stc/r	alcy/n	temy/n		{3} .3281251
1	****	****	****	{1}	.000000
2	****	****	****	{2}	.000000
3	****	****	****	{3}	

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test INTERACTION: 1 x 2	
site/fcp	stc/r	alcy/n	temy/n		{1} -8.83125	{2} -11.0229
1	1	****	****	{1}		.000346
1	2	****	****	{2}	.000346	
2	1	****	****	{3}	.018999	.000001
2	2	****	****	{4}	.000005	.086449
3	1	****	****	{5}	.000000	.000000
3	2	****	****	{6}	.000000	.000000

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test INTERACTION: 1 x 2	
site/fcp	stc/r	alcy/n	temy/n		{3} -7.51875	{4} -11.9533
1	1	****	****	{1}	.018999	.000005
1	2	****	****	{2}	.000001	.086449
2	1	****	****	{3}		.000000
2	2	****	****	{4}	.000000	
3	1	****	****	{5}	.000000	.000000
3	2	****	****	{6}	.000000	.000000

css/3:
general
manova

LSD TEST; variable Var.1
Probabilities for Post-Hoc Test
INTERACTION: 1 x 2

site/fcp	stc/r	alcy/n	temy/n		{5} 1.233333	{6} -.577083
1	1	****	****	{1}	.000000	.000000
1	2	****	****	{2}	.000000	.000000
2	1	****	****	{3}	.000000	.000000
2	2	****	****	{4}	.000000	.000000
3	1	****	****	{5}		.002062
3	2	****	****	{6}	.002062	

css/3:
general
manova

LSD TEST; variable Var.1
Probabilities for Post-Hoc Test
INTERACTION: 1 x 3

site/fcp	stc/r	alcy/n	temy/n		{1} -10.1333	{2} -9.72083
1	****	1	****	{1}		.357283
1	****	2	****	{2}	.357283	
2	****	1	****	{3}	.268597	.847413
2	****	2	****	{4}	.505933	.794208
3	****	1	****	{5}	.000000	.000000
3	****	2	****	{6}	.000000	.000000

css/3:
general
manova

LSD TEST; variable Var.1
Probabilities for Post-Hoc Test
INTERACTION: 1 x 3

site/fcp	stc/r	alcy/n	temy/n		{3} -9.63542	{4} -9.83667
1	****	1	****	{1}	.268597	.505933
1	****	2	****	{2}	.847413	.794208
2	****	1	****	{3}		.650921
2	****	2	****	{4}	.650921	
3	****	1	****	{5}	.000000	.000000
3	****	2	****	{6}	.000000	.000000

css/3:
general
manova

LSD TEST; variable Var.1
Probabilities for Post-Hoc Test
INTERACTION: 1 x 3

site/fcp	stc/r	alcy/n	temy/n		{5} 1.066667	{6} -.410417
1	****	1	****	{1}	.000000	.000000
1	****	2	****	{2}	.000000	.000000
2	****	1	****	{3}	.000000	.000000
2	****	2	****	{4}	.000000	.000000
3	****	1	****	{5}		.002782
3	****	2	****	{6}	.002782	

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test INTERACTION: 1 x 2 x 3	
site/fcp	stc/r	alcy/n	temy/n		(1) -8.82500	(2) -8.83750
1	1	1	• • • •	(1)		.964871
1	1	2	• • • •	(2)	.964871	
1	2	1	• • • •	(3)	.000000	.000000
1	2	2	• • • •	(4)	.000002	.000002
2	1	1	• • • •	(5)	.000166	.000149
2	1	2	• • • •	(6)	.000089	.000080
2	2	1	• • • •	(7)	.000000	.000000
2	2	2	• • • •	(8)	.000000	.000000
3	1	1	• • • •	(9)	.000000	.000000
3	1	2	• • • •	(10)	.000000	.000000
3	2	1	• • • •	(11)	.000000	.000000
3	2	2	• • • •	(12)	.000000	.000000

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test INTERACTION: 1 x 2 x 3	
site/fcp	stc/r	alcy/n	temy/n		(3) -11.4417	(4) -10.6042
1	1	1	• • • •	(1)	.000000	.000002
1	1	2	• • • •	(2)	.000000	.000002
1	2	1	• • • •	(3)		.006830
1	2	2	• • • •	(4)	.006830	
2	1	1	• • • •	(5)	.000000	.000000
2	1	2	• • • •	(6)	.000000	.000000
2	2	1	• • • •	(7)	.337690	.000657
2	2	2	• • • •	(8)	.014079	.000011
3	1	1	• • • •	(9)	.000000	.000000
3	1	2	• • • •	(10)	.000000	.000000
3	2	1	• • • •	(11)	.000000	.000000
3	2	2	• • • •	(12)	.000000	.000000

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test INTERACTION: 1 x 2 x 3	
site/fcp	stc/r	alcy/n	temy/n		(5) -7.55417	(6) -7.48333
1	1	1	• • • •	(1)	.000166	.000089
1	1	2	• • • •	(2)	.000149	.000080
1	2	1	• • • •	(3)	.000000	.000000
1	2	2	• • • •	(4)	.000000	.000000
2	1	1	• • • •	(5)		.803037
2	1	2	• • • •	(6)	.803037	
2	2	1	• • • •	(7)	.000000	.000000
2	2	2	• • • •	(8)	.000000	.000000
3	1	1	• • • •	(9)	.000000	.000000
3	1	2	• • • •	(10)	.000000	.000000
3	2	1	• • • •	(11)	.000000	.000000
3	2	2	• • • •	(12)	.000000	.000000

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test INTERACTION: 1 x 2 x 3	
site/fcp	stc/r	alcy/n	temy/n		(7) -11.7167	(8) -12.1900
1	1	1	....	(1)	.000000	.000000
1	1	2	....	(2)	.000000	.000000
1	2	1	....	(3)	.337690	.014079
1	2	2	....	(4)	.000657	.000011
2	1	1	....	(5)	.000000	.000000
2	1	2	....	(6)	.000000	.000000
2	2	1	....	(7)		.105740
2	2	2	....	(8)	.105740	
3	1	1	....	(9)	.000000	.000000
3	1	2	....	(10)	.000000	.000000
3	2	1	....	(11)	.000000	.000000
3	2	2	....	(12)	.000000	.000000

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test INTERACTION: 1 x 2 x 3	
site/fcp	stc/r	alcy/n	temy/n		(9) 1.745833	(10) .7208333
1	1	1	....	(1)	.000000	.000000
1	1	2	....	(2)	.000000	.000000
1	2	1	....	(3)	.000000	.000000
1	2	2	....	(4)	.000000	.000000
2	1	1	....	(5)	.000000	.000000
2	1	2	....	(6)	.000000	.000000
2	2	1	....	(7)	.000000	.000000
2	2	2	....	(8)	.000000	.000000
3	1	1	....	(9)		.001400
3	1	2	....	(10)	.001400	
3	2	1	....	(11)	.000077	.247498
3	2	2	....	(12)	.000000	.000000

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test INTERACTION: 1 x 2 x 3	
site/fcp	stc/r	alcy/n	temy/n		(11) .3875001	(12) -1.54167
1	1	1	....	(1)	.000000	.000000
1	1	2	....	(2)	.000000	.000000
1	2	1	....	(3)	.000000	.000000
1	2	2	....	(4)	.000000	.000000
2	1	1	....	(5)	.000000	.000000
2	1	2	....	(6)	.000000	.000000
2	2	1	....	(7)	.000000	.000000
2	2	2	....	(8)	.000000	.000000
3	1	1	....	(9)	.000077	.000000
3	1	2	....	(10)	.247498	.000000
3	2	1	....	(11)		.000001
3	2	2	....	(12)	.000001	

Fisher LSDs for P300 Amplitude

css/3: general manova				LSD TEST; variable Var.1 Probabilities for Post-Hoc Test MAIN EFFECT: site/fcp	
site/fcp	stc/r	alcy/n	temy/n	{1} -2.85313	{2} 1.420833
1	****	****	**** {1}		.001485
2	****	****	**** {2}	.001485	
3	****	****	**** {3}	.000000	.000000

css/3: general manova				LSD TEST; variable Var.1 Probabilities for Post-Hoc Test MAIN EFFECT: site/fcp
site/fcp	stc/r	alcy/n	temy/n	{3} 9.891666
1	****	****	**** {1}	.000000
2	****	****	**** {2}	.000000
3	****	****	**** {3}	

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test INTERACTION: 1 x 2	
site/fcp	stc/r	alcy/n	temy/n		{1} -3.83542	{2} -1.87083
1	1	****	****	{1}		.040093
1	2	****	****	{2}	.040093	
2	1	****	****	{3}	.159724	.475213
2	2	****	****	{4}	.000000	.000000
3	1	****	****	{5}	.000000	.000001
3	2	****	****	{6}	.000000	.000000

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test INTERACTION: 1 x 2	
site/fcp	stc/r	alcy/n	temy/n		{3} -2.52500	{4} 5.366667
1	1	****	****	{1}	.159724	.000000
1	2	****	****	{2}	.475213	.000000
2	1	****	****	{3}		.000000
2	2	****	****	{4}	.000000	
3	1	****	****	{5}	.000000	.253346
3	2	****	****	{6}	.000000	.000000

css/3:
general
manova

LSD TEST; variable Var.1
Probabilities for Post-Hoc Test
INTERACTION: 1 x 2

site/fcp	stc/r	alcy/n	temy/n		(5) 4.310417	(6) 15.47292
1	1	****	****	(1)	.000000	.000000
1	2	****	****	(2)	.000001	.000000
2	1	****	****	(3)	.000000	.000000
2	2	****	****	(4)	.253346	.000000
3	1	****	****	(5)	. .	.000000
3	2	****	****	(6)	.000000	

css/3:
general
manova

LSD TEST; variable Var.1
Probabilities for Post-Hoc Test
INTERACTION: 1 x 3

site/fcp	stc/r	alcy/n	temy/n		(1) -3.45625	(2) -2.25000
1	[illegible]	1	[illegible]	(1)	[illegible]	.039440
1	[illegible]	2	[illegible]	(2)	.039440	[illegible]
2	****	1	****	(3)	.000000	.000045
2	****	2	****	(4)	.000000	.000000
3	****	1	****	(5)	.000000	.000000
3	****	2	****	(6)	.000000	.000000

css/3:
general
manova

LSD TEST; variable Var.1
Probabilities for Post-Hoc Test
INTERACTION: 1 x 3

site/fcp	stc/r	alcy/n	temy/n		(3) .5416666	(4) 2.300000
1	****	1	****	(1)	.000000	.000000
1	****	2	****	(2)	.000045	.000000
2	[illegible]	1	[illegible]	(3)	[illegible]	.004212
2	[illegible]	2	[illegible]	(4)	.004212	[illegible]
3	****	1	****	(5)	.000000	.000000
3	****	2	****	(6)	.000000	.000000

css/3:
general
manova

LSD TEST; variable Var.1
Probabilities for Post-Hoc Test
INTERACTION: 1 x 3

site/fcp	stc/r	alcy/n	temy/n		(5) 10.08542	(6) 9.697916
1	****	1	****	(1)	.000000	.000000
1	****	2	****	(2)	.000000	.000000
2	****	1	****	(3)	.000000	.000000
2	****	2	****	(4)	.000000	.000000
3	****	1	****	(5)	[illegible]	.489167
3	****	2	****	(6)	.489167	[illegible]

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test INTERACTION: 1 x 3 x 4	
site/fcp	stc/r	alcy/n	temy/n		(1) -4.19167	(2) -2.72083
1	****	1	1	(1)		.057622
1	****	1	2	(2)	.057622	
1	****	2	1	(3)	.151254	.610716
1	****	2	2	(4)	.000976	.085762
2	****	1	1	(5)	.000110	.013209
2	****	1	2	(6)	.000000	.000003
2	****	2	1	(7)	.000000	.000001
2	****	2	2	(8)	.000000	.000000
3	****	1	1	(9)	.000000	.000000
3	****	1	2	(10)	.000000	.000000
3	****	2	1	(11)	.000000	.000000
3	****	2	2	(12)	.000000	.000000

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test INTERACTION: 1 x 3 x 4	
site/fcp	stc/r	alcy/n	temy/n		(3) -3.10000	(4) -1.40000
1	****	1	1	(1)	.151254	.000976
1	****	1	2	(2)	.610716	.085762
1	****	2	1	(3)		.030307
1	****	2	2	(4)	.030307	
2	****	1	1	(5)	.004017	.379621
2	****	1	2	(6)	.000001	.000231
2	****	2	1	(7)	.000000	.000089
2	****	2	2	(8)	.000000	.000026
3	****	1	1	(9)	.000000	.000000
3	****	1	2	(10)	.000000	.000000
3	****	2	1	(11)	.000000	.000000
3	****	2	2	(12)	.000000	.000000

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test INTERACTION: 1 x 3 x 4	
site/fcp	stc/r	alcy/n	temy/n		(5) -.741667	(6) 1.825000
1	****	1	1	(1)	.000110	.000000
1	****	1	2	(2)	.013209	.000003
1	****	2	1	(3)	.004017	.000001
1	****	2	2	(4)	.379621	.000231
2	****	1	1	(5)		.002045
2	****	1	2	(6)	.002045	
2	****	2	1	(7)	.000794	.699145
2	****	2	2	(8)	.000228	.376666
3	****	1	1	(9)	.000000	.000000
3	****	1	2	(10)	.000000	.000000
3	****	2	1	(11)	.000000	.000000
3	****	2	2	(12)	.000000	.000000

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test INTERACTION: 1 x 3 x 4	
site/fcp	stc/r	alcy/n	temy/n		{7} 2.112500	{8} 2.487500
1	****	1	1	{1}	.000000	.000000
1	****	1	2	{2}	.000001	.000000
1	****	2	1	{3}	.000000	.000000
1	****	2	2	{4}	.000089	.000026
2	****	1	1	{5}	.000794	.000228
2	****	1	2	{6}	.699145	.376666
2	****	2	1	{7}		.614619
2	****	2	2	{8}	.614619	
3	****	1	1	{9}	.000000	.000000
3	****	1	2	{10}	.000000	.000000
3	****	2	1	{11}	.000000	.000000
3	****	2	2	{12}	.000000	.000000

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test INTERACTION: 1 x 3 x 4	
site/fcp	stc/r	alcy/n	temy/n		{9} 8.425000	{10} 11.74583
1	****	1	1	{1}	.000000	.000000
1	****	1	2	{2}	.000000	.000000
1	****	2	1	{3}	.000000	.000000
1	****	2	2	{4}	.000000	.000000
2	****	1	1	{5}	.000000	.000000
2	****	1	2	{6}	.000000	.000000
2	****	2	1	{7}	.000000	.000000
2	****	2	2	{8}	.000000	.000000
3	****	1	1	{9}		.000168
3	****	1	2	{10}	.000168	
3	****	2	1	{11}	.049115	.023194
3	****	2	2	{12}	.180036	.004778

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test INTERACTION: 1 x 3 x 4	
site/fcp	stc/r	alcy/n	temy/n		{11} 9.954166	{12} 9.441666
1	****	1	1	{1}	.000000	.000000
1	****	1	2	{2}	.000000	.000000
1	****	2	1	{3}	.000000	.000000
1	****	2	2	{4}	.000000	.000000
2	****	1	1	{5}	.000000	.000000
2	****	1	2	{6}	.000000	.000000
2	****	2	1	{7}	.000000	.000000
2	****	2	2	{8}	.000000	.000000
3	****	1	1	{9}	.049115	.180036
3	****	1	2	{10}	.023194	.004778
3	****	2	1	{11}		.492481
3	****	2	2	{12}	.492481	

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test INTERACTION: 2 x 3 x 4	
site/fcp	stc/r	alcy/n	temy/n		{1} -1.58611	{2} -.358333
****	1	1	1	{1}		.178650
****	1	1	2	{2}	.178650	
****	1	2	1	{3}	.470401	.505059
****	1	2	2	{4}	.065969	.557739
****	2	1	1	{5}	.000048	.000403
****	2	1	2	{6}	.000000	.000002
****	2	2	1	{7}	.000001	.000004
****	2	2	2	{8}	.000001	.000004

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test INTERACTION: 2 x 3 x 4	
site/fcp	stc/r	alcy/n	temy/n		{3} -.947222	{4} .1583331
****	1	1	1	{1}	.470401	.065969
****	1	1	2	{2}	.505059	.557739
****	1	2	1	{3}		.222301
****	1	2	2	{4}	.222301	
****	2	1	1	{5}	.000141	.001073
****	2	1	2	{6}	.000001	.000003
****	2	2	1	{7}	.000002	.000007
****	2	2	2	{8}	.000002	.000008

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test INTERACTION: 2 x 3 x 4	
site/fcp	stc/r	alcy/n	temy/n		{5} 3.913889	{6} 7.591667
****	1	1	1	{1}	.000048	.000000
****	1	1	2	{2}	.000403	.000002
****	1	2	1	{3}	.000141	.000001
****	1	2	2	{4}	.001073	.000003
****	2	1	1	{5}		.001249
****	2	1	2	{6}	.001249	
****	2	2	1	{7}	.004771	.451807
****	2	2	2	{8}	.005442	.410878

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test INTERACTION: 2 x 3 x 4	
site/fcp	stc/r	alcy/n	temy/n		{7} 6.924999	{8} 6.861111
****	1	1	1	{1}	.000001	.000001
****	1	1	2	{2}	.000004	.000004
****	1	2	1	{3}	.000002	.000002
****	1	2	2	{4}	.000007	.000008
****	2	1	1	{5}	.004771	.005442
****	2	1	2	{6}	.451807	.410878
****	2	2	1	{7}		.941751
****	2	2	2	{8}	.941751	

Fisher LSDs for P300 Amplitude three-way ANOVA

css/3: general manova			LSD TEST; variable Var.1 Probabilities for Post-Hoc Tests INTERACTION: 2 x 3		
stim	alcy/n	temy/n	[1] 8.425000	[2] 11.74583	[3] 9.954166
....	1	1 [1]		.006868	.154895
....	1	2 [2]	.006868		.101057
....	2	1 [3]	.154895	.101057	
....	2	2 [4]	.331693	.041923	.618839

css/3: general manova			LSD TEST; variable Var.1 Probabilities for Post-Hoc Tests INTERACTION: 2 x 3
stim	alcy/n	temy/n	[4] 9.441666
....	1	1 [1]	.331693
....	1	2 [2]	.041923
....	2	1 [3]	.618839
....	2	2 [4]	

Fisher LSDs for P300 Amplitude three-way ANOVA

css/3: general manova				LSD TEST; variable Var.1 Probabilities for Post-Hoc Tests INTERACTION: 1 x 2 x 3		
stim	alcy/n	temy/n		[1] 4.066667	[2] 5.041667	[3] 3.708333
1	1	1	[1]		.382484	.744416
1	1	2	[2]	.382484		.239347
1	2	1	[3]	.744416	.239347	
1	2	2	[4]	.744417	.576626	.517496
2	1	1	[5]	.000006	.000017	.000004
2	1	2	[6]	.000000	.000000	.000000
2	2	1	[7]	.000000	.000000	.000000
2	2	2	[8]	.000001	.000003	.000001

css/3: general manova				LSD TEST; variable Var.1 Probabilities for Post-Hoc Tests INTERACTION: 1 x 2 x 3		
stim	alcy/n	temy/n		[4] 4.425000	[5] 12.78333	[6] 18.45000
1	1	1	[1]	.744417	.000006	.000000
1	1	2	[2]	.576626	.000017	.000000
1	2	1	[3]	.517496	.000004	.000000
1	2	2	[4]		.000008	.000000
2	1	1	[5]	.000008		.000257
2	1	2	[6]	.000000	.000257	
2	2	1	[7]	.000000	.008640	.059673
2	2	2	[8]	.000001	.146391	.003357

css/3: general manova				LSD TEST; variable Var.1 Probabilities for Post-Hoc Tests INTERACTION: 1 x 2 x 3	
stim	alcy/n	temy/n		[7] 16.20000	[8] 14.45833
1	1	1	[1]	.000000	.000001
1	1	2	[2]	.000000	.000003
1	2	1	[3]	.000000	.000001
1	2	2	[4]	.000000	.000001
2	1	1	[5]	.008640	.146391
2	1	2	[6]	.059673	.003357
2	2	1	[7]		.132442
2	2	2	[8]	.132442	

Fisher LSDs for P200 Latency

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test INTERACTION: 2 x 3	
site/fcp	stc/r	alcy/n	temy/n		(1) 219.0278	(2) 221.3333
****	1	1	****	(1)		.428142
****	1	2	****	(2)	.428142	
****	2	1	****	(3)	.000143	.000509
****	2	2	****	(4)	.467070	.945924

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test INTERACTION: 2 x 3	
site/fcp	stc/r	alcy/n	temy/n		(3) 234.9306	(4) 221.1389
****	1	1	****	(1)	.000143	.467070
****	1	2	****	(2)	.000509	.945924
****	2	1	****	(3)		.000456
****	2	2	****	(4)	.000456	

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test INTERACTION: 1 x 3 x 4	
site/fcp	stc/r	alcy/n	temy/n		(1) 225.5833	(2) 227.1667
1	****	1	1	(1)		.847565
1	****	1	2	(2)	.847565	
1	****	2	1	(3)	.077354	.052740
1	****	2	2	(4)	.522383	.407443
2	****	1	1	(5)	.867407	.719759
2	****	1	2	(6)	.438955	.558731
2	****	2	1	(7)	.450774	.346359
2	****	2	2	(8)	.525632	.410246
3	****	1	1	(9)	.065972	.044662
3	****	1	2	(10)	.042825	.063368
3	****	2	1	(11)	.812115	.963674
3	****	2	2	(12)	.642340	.784816

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test INTERACTION: 1 x 3 x 4	
site/fcp	stc/r	alcy/n	temy/n		(3) 210.5000	(4) 220.2917
1	****	1	1	(1)	.077354	.522383
1	****	1	2	(2)	.052740	.407443
1	****	2	1	(3)		.241813
1	****	2	2	(4)	.241813	
2	****	1	1	(5)	.106316	.635163
2	****	1	2	(6)	.014916	.164417
2	****	2	1	(7)	.289608	.907351
2	****	2	2	(8)	.239878	.995963
3	****	1	1	(9)	.935470	.212237
3	****	1	2	(10)	.000599	.010439
3	****	2	1	(11)	.048048	.382763
3	****	2	2	(12)	.029766	.274387

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test INTERACTION: 1 x 3 x 4	
site/fcp	stc/r	alcy/n	temy/n		{5} 224.2083	{6} 232.0000
1	****	1	1	{1}	.867407	.438955
1	****	1	2	{2}	.719759	.558731
1	****	2	1	{3}	.106316	.014916
1	****	2	2	{4}	.635163	.164417
2	****	1	1	{5}		.348879
2	****	1	2	{6}	.348879	
2	****	2	1	{7}	.555373	.133965
2	****	2	2	{8}	.638747	.165858
3	****	1	1	{9}	.091286	.012417
3	****	1	2	{10}	.030092	.187124
3	****	2	1	{11}	.686142	.589418
3	****	2	2	{12}	.528892	.753970

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test INTERACTION: 1 x 3 x 4	
site/fcp	stc/r	alcy/n	temy/n		{7} 219.3333	{8} 220.3333
1	****	1	1	{1}	.450774	.525632
1	****	1	2	{2}	.346359	.410246
1	****	2	1	{3}	.289608	.239878
1	****	2	2	{4}	.907351	.995963
2	****	1	1	{5}	.555373	.638747
2	****	1	2	{6}	.133965	.165858
2	****	2	1	{7}		.903344
2	****	2	2	{8}	.903344	
3	****	1	1	{9}	.255690	.210486
3	****	1	2	{10}	.007976	.010561
3	****	2	1	{11}	.324243	.385455
3	****	2	2	{12}	.228510	.276524

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test INTERACTION: 1 x 3 x 4	
site/fcp	stc/r	alcy/n	temy/n		{9} 209.8333	{10} 243.0833
1	••••	1	1	{1}	.065972	.042825
1	••••	1	2	{2}	.044662	.063368
1	••••	2	1	{3}	.935470	.000599
1	••••	2	2	{4}	.212237	.010439
2	••••	1	1	{5}	.091286	.030092
2	••••	1	2	{6}	.012417	.187124
2	••••	2	1	{7}	.255690	.007976
2	••••	2	2	{8}	.210486	.010561
3	••••	1	1	{9}		.000491
3	••••	1	2	{10}	.000491	
3	••••	2	1	{11}	.040625	.069360
3	••••	2	2	{12}	.024986	.107322

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test INTERACTION: 1 x 3 x 4	
site/fcp	stc/r	alcy/n	temy/n		{11} 227.5417	{12} 229.4167
1	••••	1	1	{1}	.812115	.642340
1	••••	1	2	{2}	.963674	.784816
1	••••	2	1	{3}	.048048	.029766
1	••••	2	2	{4}	.382763	.274387
2	••••	1	1	{5}	.686142	.528892
2	••••	1	2	{6}	.589418	.753970
2	••••	2	1	{7}	.324243	.228510
2	••••	2	2	{8}	.385455	.276524
3	••••	1	1	{9}	.040625	.024986
3	••••	1	2	{10}	.069360	.107322
3	••••	2	1	{11}		.819956
3	••••	2	2	{12}	.819956	

Fisher LSDs for N200 Latency

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test MAIN EFFECT: site/fcp	
site/fcp	stc/r	alcy/n	temy/n		{1} 308.3958	{2} 306.4271
1	••••	••••	••••	{1}		.655948
2	••••	••••	••••	{2}	.655948	
3	••••	••••	••••	{3}	.000378	.001135

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test MAIN EFFECT: site/fcp
site/fcp	stc/r	alcy/n	temy/n		{3} 290.1250
1	••••	••••	••••	{1}	.000378
2	••••	••••	••••	{2}	.001135
3	••••	••••	••••	{3}	

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test INTERACTION: 1 x 2	
site/fcp	stc/r	alcy/n	temy/n		{1} 294.7917	{2} 322.0000
1	1	••••	••••	{1}		.000055
1	2	••••	••••	{2}	.000055	
2	1	••••	••••	{3}	.646342	.000171
2	2	••••	••••	{4}	.000995	.248289
3	1	••••	••••	{5}	.128666	.000001
3	2	••••	••••	{6}	.898012	.000040

css/3: general manova.					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test INTERACTION: 1 x 2	
site/fcp	stc/r	alcy/n	temy/n		{3} 297.3333	{4} 315.5208
1	1	••••	••••	{1}	.646342	.000995
1	2	••••	••••	{2}	.000171	.248289
2	1	••••	••••	{3}		.003044
2	2	••••	••••	{4}	.003044	
3	1	••••	••••	{5}	.053109	.000021
3	2	••••	••••	{6}	.557988	.000726

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test INTERACTION: 1 x 2	
site/fcp	stc/r	alcy/n	temy/n		{5} 286.1667	{6} 294.0833
1	1	****	****	{1}	.128666	.898012
1	2	****	****	{2}	.000001	.000040
2	1	****	****	{3}	.053109	.557988
2	2	****	****	{4}	.000021	.000726
3	1	****	****	{5}		.161420
3	2	****	****	{6}	.161420	

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test INTERACTION: 2 x 3	
site/fcp	stc/r	alcy/n	temy/n		{1} 294.9028	{2} 290.6250
****	1	1	****	{1}		.393011
****	1	2	****	{2}	.393011	
****	2	1	****	{3}	.000426	.000110
****	2	2	****	{4}	.153593	.033903

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test INTERACTION: 2 x 3	
site/fcp	stc/r	alcy/n	temy/n		{3} 318.7917	{4} 302.2778
****	1	1	****	{1}	.000426	.153593
****	1	2	****	{2}	.000110	.033903
****	2	1	****	{3}		.005603
****	2	2	****	{4}	.005603	

Fisher LSDs for P300 Latency

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test MAIN EFFECT: site/fcp	
site/fcp	stc/r	alcy/n	temy/n		{1} 437.2708	{2} 447.3854
1	••••	••••	••••	{1}		.204296
2	••••	••••	••••	{2}	.204296	
3	••••	••••	••••	{3}	.216706	.017081

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test MAIN EFFECT: site/fcp
site/fcp	stc/r	alcy/n	temy/n		{3} 427.4375
1	••••	••••	••••	{1}	.216706
2	••••	••••	••••	{2}	.017081
3	••••	••••	••••	{3}	

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test INTERACTION: 1 x 2	
site/fcp	stc/r	alcy/n	temy/n		{1} 411.2083	{2} 463.3333
1	1	••••	••••	{1}		.000000
1	2	••••	••••	{2}	.000000	
2	1	••••	••••	{3}	.932493	.000000
2	2	••••	••••	{4}	.000000	.005055
3	1	••••	••••	{5}	.006766	.000000
3	2	••••	••••	{6}	.000000	.904060

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test INTERACTION: 1 x 2	
site/fcp	stc/r	alcy/n	temy/n		{3} 411.7500	{4} 483.0208
1	1	••••	••••	{1}	.932493	.000000
1	2	••••	••••	{2}	.000000	.005055
2	1	••••	••••	{3}		.000000
2	2	••••	••••	{4}	.000000	
3	1	••••	••••	{5}	.005544	.000000
3	2	••••	••••	{6}	.000000	.003795

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test INTERACTION: 1 x 2	
site/fcp	stc/r	alcy/n	temy/n		{5} 392.3125	{6} 462.5625
1	1	••••	••••	{1}	.006766	.000000
1	2	••••	••••	{2}	.000000	.904060
2	1	••••	••••	{3}	.005544	.000000
2	2	••••	••••	{4}	.000000	.003795
3	1	••••	••••	{5}		.000000
3	2	••••	••••	{6}	.000000	

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test INTERACTION: 2 x 3	
site/fcp	stc/r	alcy/n	temy/n		{1} 403.0139	{2} 407.1667
••••	1	1	••••	{1}		.598424
••••	1	2	••••	{2}	.598424	
••••	2	1	••••	{3}	.000001	.000001
••••	2	2	••••	{4}	.000019	.000040

css/3: general manova					LSD TEST; variable Var.1 Probabilities for Post-Hoc Test INTERACTION: 2 x 3	
site/fcp	stc/r	alcy/n	temy/n		{3} 481.7500	{4} 457.5277
••••	1	1	••••	{1}	.000001	.000019
••••	1	2	••••	{2}	.000001	.000040
••••	2	1	••••	{3}		.009028
••••	2	2	••••	{4}	.009028	

Fisher LSDs for False Alarms

css/3: general manova			LSD TEST; variable Var.1 Probabilities for Post-Hoc Tests INTERACTION: 1 x 2			
alcy/n	temy/n		{1} 8.583333	{2} 4.916667	{3} 4.750000	{4} 6.750000
1	1	{1}		.025089	.020332	.221660
1	2	{2}	.025089		.908368	.221659
2	1	{3}	.020332	.908368		.185229
2	2	{4}	.221660	.221659	.185229	

Appendix H

P300 Latency/RT Correlations

P300 Latency/RT correlations
Condition A (Fz, Cz & Pz)

css/3: basic stats	Correlations r(x,y) N. of Cases = 12 (MD casewise deleted)
standard mode	LP3FZRA
RTA	.6824 N=12 p<.014

css/3: basic stats	Correlations r(x,y) N. of Cases = 12 (MD casewise deleted)
standard mode	LP3CZRA
RTA	.7104 N=12 p<.010

css/3: basic stats	Correlations r(x,y) N. of Cases = 12 (MD casewise deleted)
standard mode	LP3PZRA
RTA	-.0914 N=12 p<.778

P300 Latency/RT correlations
Condition B (Fz, Cz & Pz)

css/3: basic stats	Correlations r(x,y) N. of Cases = 12 (MD casewise deleted)
standard mode	LP3FZRB
RTB	.0172 N=12 p<.958

css/3: basic stats	Correlations r(x,y) N. of Cases = 12 (MD casewise deleted)
standard mode	LP3CZRB
RTB	-.0985 N=12 p<.761

css/3: basic stats	Correlations r(x,y) N. of Cases = 12 (MD casewise deleted)
standard mode	LP3PZRB
RTB	.4445 N=12 p<.148

P300 Latency/RT correlations
Condition C (Fz, Cz & Pz)

css/3: basic stats	Correlations r(x,y) N. of Cases = 12 (MD casewise deleted)
standard mode	LP3FZRC
RTC	.5316 N=12 p<.075

css/3: basic stats	Correlations r(x,y) N. of Cases = 12. (MD casewise deleted)
standard mode	LP3CZRC
RTC	.2614 N=12 p<.412

css/3: basic stats	Correlations r(x,y) N. of Cases = 12 (MD casewise deleted)
standard mode	LP3PZRC
RTC	.6680 N=12 p<.018

P300 Latency/RT correlations
Condition D (Fz, Cz & Pz)

css/3: basic stats	Correlations r(x,y) N. of Cases = 12 (MD casewise deleted)
standard mode	LP3FZRD
RTD	.1159 N=12 p<.720

css/3: basic stats	Correlations r(x,y) N. of Cases = 12 (MD casewise deleted)
standard mode	LP3CZRD
RTD	.4477 N=12 p<.144

css/3: basic stats	Correlations r(x,y) N. of Cases = 12 (MD casewise deleted)
standard mode	LP3PZRD
RTD	.5191 N=12 p<.084