THE EFFECTS OF GINSENG ON THE SYMPATHETIC NERVOUS SYSTEM AND THE GSR RESPONSES

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Abstract

Ginseng, the herbal remedies, is widely used to improve overall energy and vitality, particularly during times of fatigue or stress. While there is not much clinical evidence to support an energy boosting effect, it is stated that ginseng has various effects and studies show its potential value in stimulating immune function, improving memory and symptoms of attention deficit-hyperactivity disorder (ADHD) in children. This study examines the effects of ginseng on sympathetic nervous system by using galvanic skin response (GSR), which is a change in the electrical resistance of the skin, and it reflects sweat gland activity and changes in the sympathetic nervous system and measurement variables. In our study we tempted to observe if the effects of ginseng in the sympathetic nervous system would result in more arousal in the organism. This study considers the Galvanic Skin Response (GSR) of forty (40) participants which took place in a lab environment. The subjects were asked to receive a certain amount of ginseng, which is a stimulant that has many pharmacological effects. This study consisted of four groups of ten participants in each group. Moreover, each participant was exposed to a shock stimulus and a GSR measure thirty minutes after the transmission of the pill. Their reactions were then observed in a computer scope. These results indicated that there is a statistical significance in the second trial of rise time. The results of t-test confirm that particular point of significance. However, there is no significance on the other trials. More specifically, there is no significance between variables on the first trial of duration. The variation of scores between groups and the variation between the group means is less than 0.05. The F ratio should be less than 0.05>p. In the duration of the third trial, we observed that the F ratio is also less than 0.05. So, the first trial, and the second trial of the onset latency come up with the same results. Again, on the rise time of the first trial, the F ratio is less than 0.05. However, on the rise time of the second trial we observed a significance of two variables. Particularly, we see that the p-value in this specific point is 0.03724< 0.05. In this point, we used a t-test in order to see the interaction in rise time between ginseng and voltage variables. These results indicated that there is no significance in the first and second trial of duration. Similarly, there is no significance in the first and second trial of the onset latency, and also in the first trial of the rise time. However, we found that there is significance on the second trial of the rise time. Therefore, the present data suggest that factors such as noise, amount of ginseng, participants' emotional state, and age, might have influenced our results. Furthermore, much more research must be done to see the effects of ginseng on the sympathetic nervous system measured by the galvanic skin response.

Keywords: ginseng, sympathetic nervous system, galvanic skin response, physiological state.

1. INTRODUCTION

Most individuals in our culture learn to speak, read, and write, but these language skills are only part of what is learned. We acquire complex motor skills as in driving a car. We learn to react emotionally, so that some fear those who administer punishment, and others become ill when faced with an unpleasant task (Peterson, 1975).

Granted that learning influences almost everything we do, a distinction should be made between our activity and the learning that made it possible. The term learning is a scientific construct based on observations of behavior in repeated situations (Peterson, 1975). Accordingly, Ellis (1999) defines learning as the means through which we acquire skills, and knowledge as well as values, attitudes, and emotional reactions. Many psychologists conceptualize and define learning differently. We have the following two definitions that reflect two common, yet quite different conceptions of learning: A) Learning is a relatively permanent change in behavior due to experience. B) Learning is a relatively permanent change in mental associations due to experience (Ellis, 1999). Both speak of learning as involving a “relatively permanent” change – a change that will last for some time, although not necessarily forever. And both definitions attribute that change to experience. In other words, learning takes place as a result of one or more events in the learner’s life. Moreover, other changes, such as those due to maturational changes in the body, organic damage, or temporary body states are not attributable to experience, and so, do not reflect learning (Ellis, 1999).

The systematic study of human behavior, including human and animal learning processes, has emerged only within the last century, making psychology a relative newcomer to a scientific theory. But in a century’s time, thousands of experiments have been conducted on how people and animals learn, and the patterns in the results of these experiments have led psychologists to generalize about the learning process through the formulation of both principles and theories of learning (Ellis, 1999). Experimental psychology is interested in the observation and experimentation of many phenomena. The phenomena that are observed are the so called the associative and non associative phenomena. A case in point, by non-associative phenomena we mean sensitization and habituation. Many experiments have been conducted in explaining habituation, which is an extremely simple form of learning, in which an animal, after a period of exposure to a stimulus, stops responding. Moreover, sensitization is the progressive response increment as a function of repeated presentation of medium or strong stimuli (Fantino & Logan, 1979). Rinaldi and Thompson (1985) studied habituation and sensitization of the acoustic startle response in young and aged male and female rats. On the other hand, we then turn into account of what is traditionally regarded as the basis form of associative learning, known as classical conditioning. Therefore, classical conditioning procedures are used extensively in current research (McGaugh, Rose & Shaw, 1990).

Many studies have been conducted on the behalf of the galvanic skin response (GSR), which is a change in the electrical resistance of the skin, and it reflects sweat gland activity and changes in the sympathetic nervous system and measurement variables. Furthermore, GSR is determined as an instrument by passing a weak current through the skin by measuring the current generated by the body itself, and it has been correlated with emotion, attention, and stress. Accordingly, an example of habituation was provided by Koepke and Pribram (1966). Habituation of GSR to repeated stimulation with tones of either 2 or 20 sec duration was investigated with college students.

Another experiment of ten healthy men, examines the effects of ginseng, known as Kampo on autonomic nervous activity by using power spectral analysis of heart rate variability and cardiac depolarization-repolarization time intervals in humans. The results showed that there is an effect of ginseng on the parasympathetic nervous activity, and this may be useful for cardiovascular health.

Ginseng, the herbal remedies, is widely used to improve overall energy and vitality, particularly during times of fatigue or stress. While there is not much clinical evidence to support an energy boosting effect, it is stated that ginseng has various effects and studies show its potential value in stimulating immune function, improving memory and symptoms of attention deficit-hyperactivity disorder (ADHD) in children.

2. NON ASSOCIATIVE PHENOMENA

Experimental psychology is interested in the observation and experimentation of many phenomena. The phenomena that are observed are the so called the associative and non-associative phenomena. A case in point, non-associative phenomena is one of the most usual studies in experimental psychology. By non-associative phenomena we mean sensitization and habituation. Moreover, non-associative learning is said to occur when relatively permanent modifications in behavior take place with repetitive exposure to a single stimulus. Such changes in behavior presumably occur independently of associations between two or more distinct stimuli (Fantino & Logan, 1979).

Non-associative learning phenomena had been described long before the major era of learning theory, but for many years psychologists regarded them with little, if any interest. Learning theorists neglected to attempt to explain the relevant effects. Instead, interest was focused on classical and instrumental conditioning, while habituation and sensitization were often treated as confounding variables (Fantino & Logan, 1979). This situation has changed drastically within the last twenty years. Definitions of learning have broadened to include non-associative as well as associative learning processes.

2.1 Habituation

2.1.1 Defining habituation

Habituation is an extremely simple form of learning, in which an animal, after a period of exposure to a stimulus, stops responding. The most interesting thing about habituation is that it can occur at different levels in the nervous system. Sensory systems may stop, after a while, sending signals to the brain in response to a continuously present or often-repeated stimulus (Cohen et al. 1997). Lack of continued response to strong odours is a common example of sensory habitation. Habituation to complex stimuli may occur at the level of the brain; the stimulus is still perceived, but the animal has simply "decided" to no longer pay attention (Rose and Rankin, 2001). Even odour habituation can take place centrally, in the brain. In rats Deshmukh and Bhalla (2003) hypothesized that cells in the hippocampus could time the intervals between odor inputs; frequent stimuli resulted, in their study, in a cessation of response at the level of the hippocampus. Habituation is important in filtering the large amounts of information received from the surrounding environment. By habituating to less important signals, an animal can focus its attention on the most important features of its environment. A good example of this is species that rely on alarm calls to convey information about predators. In this case animals stop giving alarm calls when they become familiar with other species in their environment that turn out not to be predators. Habituation is an important component of "not crying wolf" when non-threatening animals come close. Moreover, in animal behaviour, studies in the field, investigators often rely on the study animals becoming habituated to the presence of the investigator. Jane Goodall's famous studies of chimpanzees, for example, depended on the chimpanzees learning to tolerate her presence. Werdenich et al (2003) and Van Krunkelsven et al. (1999) give a contemporary perspective on habituation of study animals. This complex level of habituation is far different than learning to ignore an odor, but has a similar role in helping the animal to ignore irrelevant stimuli.

2.1.2 Sokolov Theory of Habituation

The comparator theory was developed by Sokolov to explain habituation and the orienting response. It explains habituation of the orienting response as the result of a decreasing mismatch between stimulation and an updated cognitive representation of the outside world.

The comparator theory was developed by Sokolov (1960, 1963). It is a theory based on psychology and emphasizes possible cognitive events related to habituation. The theory is based mainly on research with humans and is limited to explaining habituation of the orienting response (i.e., it does not deal with the adaptive response or the defense response). The comparator theory is often referred to as a two stage theory.

Moreover, habituation is the progressive response decrement as a function of repeated presentations of a single stimulus (Fantino & Logan, 1979). The reduction in the frequency and intensity of the arousal and orienting reaction to the noise is an example of habituation (Wickelgren, 1977). Habituation is a decrease in the strength of the orienting or activation response that results from repeated presentations of a stimulus. Moreover, repeated presentations of a neutral stimulus result in a marked decrease in the strength of the orienting or activation response. In other words, they result in extensive habituation. Much less reduction in the strength of the orienting response occurs when a primary reinforcer is repeatedly presented (King, 1979). This process is not the same as sensory adaptation, because the activity of the peripheral auditory sensory neurons is relatively or completely unaffected (Wickelgren, 1977). At one time it was thought that such habituation was produced by a process known as sensory gating wherein feedback from higher levels of the nervous system would actively inhibit the response of the peripheral auditory neurons to auditory input. However, careful studies of the physiological correlates of habituation to auditory stimuli have demonstrated that no such peripheral sensory gating occurs. The locus of various, changes in attention, including habituation and distraction, are at much higher levels, such as the auditory cortex (Wickelgren, 1977).

Almost any change in the characteristics of a habituated stimulus is frequently sufficient to restore part of all of the initial response. This is particularly true when the intensity of the stimulus is increased, but it can also happen when there is a decrease in the intensity, even without a change in quality (Wickelgren, 1977). Changes in the location of a stimulus can reduce habituation, and qualitative changes in a stimulus can reduce or eliminate habituation completely. Finally, habituation to a compound stimulus may transfer incompletely or not at all when the components of a compound stimulus are presented in isolation. Thus, habituation is extremely selective on the stimulus side to ways in which adaptation is not (Wickelgren, 1977).

In an experiment by Buck and Leaton (1971), the EEG arousal response initially produced in sleeping rats by the presentation of an auditory stimulus habituated to an asymptote after one or two stimulus presentation. The initial responsiveness to the tone did not recover over as long as 30 days without stimulation. Data showed a very rapid and surprisingly persistent habituation of the arousal response to an auditory stimulus (Buck & Leaton, 1971).

Additional research in habituation was made by Patterson and Petrinovich (1981). They recorded a song that was played in a field to mated pairs of white-crowned sparrows that were in breeding condition, and an extensive sample of behaviors was recorded. An attempt was made to manipulate the level of responding and the amount of habituation by varying the pattern of song presentations, and also the novelty of the song. No differences in rates of habituation were obtained, but the attempt to manipulate levels of responding was successful. The time between trial blocks was decreased to allow more sensitization to be accumulated (Patterson & Petrinovich, 1981).

An example of habituation was provided by Koepke and Pribram (1966). Habituation of GSR to repeated stimulation with tones of either 2 or 20 sec duration was investigated with college students. Subsequent to habituation, stimulus durations were reversed immediately for half the stimuli, and after a number of additional trials for the remaining stimuli. Speed of habituation did not vary with stimulus duration, but was significantly related to “spontaneous activity” as defined by spontaneous fluctuation scores (Koepke & Pribram, 1966, p.442).

Glanzman and Schmidt (1979) studied the habituation of the nictitating membrane reflex response in the intact bullfrog. A stimulus map was created, and stimulating electrode pairs directly opposed across the eye, which proved to be the optimal loci for cutaneous electrical stimulation. The response was found to exhibit all the parametric characteristics of habituation (Glanzman & Schmidt, 1979).

Another example of habituation was provided by Mackworth (1968) in which habituation of the arousal of the response leads to an increase in variance and amplitude of the spontaneous neutral rhythms; this increase in neutral noise may result in a decrease in sensitivity to the signal event. Habituation of the evoked responses to both signal and non-signal events of the task, produces a decrease in amplitude and an increase in latency of the evoked response (Mackworth, 1968).

Rinaldi and Thompson (1985) studied habituation and sensitization of the acoustic startle response in young and aged male and female rats. Tones were presented on 25 consecutive trials for a session. All aged rats demonstrated greater short-term relative habituation than their younger counterparts. Across sections, aged male rats of both strains habituated more quickly than younger males. On the other hand, aged females habituated more slowly. Sensitization was more likely to occur in younger rats (Rinaldi & Thompson, 1985).

Furthermore, Maldonado, Rakitin, and Tomsic (1991) studied the escape response of the crab Chasmagnathus granulatus, elicited by an electrical leg shock, wanes as a consequence of repeated stimulation, and the decrease persists after a 24-h rest interval. The shock curve shows an initial hump positively related to stimulus intensity, suggesting that a shock-induced sensitization along with habituation sub serves the response curve (Maldonado, Rakitin & Tomsic, 1991).

2.2 Sensitization

2.2.1 Defining sensitization

Fantino and Logan (1979) define sensitization as the progressive response increment as a function of repeated presentation of a medium or strong stimuli. Sensitization, like habituation, represents a process of non-associative behavior modification that occurs with repeated stimulus presentation. However, sensitization effects are incremental rather than decremental as in the case of habituation. Moreover, like habituation, sensitization can occur on a long-term as well as a short-term basis (Fantino & Logan,1979).

2.2.2 Experiments on sensitization

The study of Bronstein (1994), discusses the habituation and sensitization in male betas (fish). Experiments 1-5 designed explicitly to determine the test-retest reliability of measures of aggressiveness in these fish. These experiments provide plausible account of why continuous exposure to a conspecifics male sometimes has resulted in male betas exhibiting reduced aggression (habituation), although other studies have shown the elevation (sensitization) of aggressive display as a consequence of repeated social stimulation (Bronstein, 1994).

In another experiment by Gray, Lockery, and Rawlins (1985) the shortening reflex was elicited in food-sated Hirudo medicinalis by light flashes delivered at 20 sec intervals over a 40 trial session. Short-term, that is, within-sessions, habituation was readily observed. Dishabituation could be produced by a single electric shock at trial 30. However, the shock also enhanced responding when delivered before trial 1 (sensitization) (Gray, Lockery & Rawlins, 1985).

Natelson, Ottenweller and Pitman (1990) conducted a study for the effect of stressor intensity on habituation and sensitization of the adrenocortical stress response in rats. When lower intensity shock was given, response to shock probes followed a U-shaped curve. Responses in rats given higher intensity shock never habituated and instead demonstrated an increased response indicative of sensitization. The data are consistent with the rule from the habituation literature that stimulus intensity is inversely related to the magnitude of habituation (Natelson, Ottenweller & Pitman, 1990). Moreover, they proposed two kinds of sensitization, the absolute and the relative. Absolute sensitization is when we have frank increases over prestress control levels without ever showing any evidence of habituation; relative sensitization is when a group shows initial habituation to control levels and then a return on responsiveness to the same level shown after the initial presentation of the stressor (Natelson, Ottenweller & Pitman, 1990).

2.3 Associative phenomena: classical conditioning

The classic examples of classical conditioning are Pavlov's dogs and Watson's Little Albert. In the 1890's Pavlov, a Russian physiologist, was observing the production of saliva by dogs as they were fed when he noticed that saliva was also produced when the person who fed them appeared (without food). This is not surprising. Every farm boy for thousands of years has realized, of course, that animals become excited when they hear the sounds that indicate they are about to be fed. But Pavlov carefully observed and measured one small part of the process. He paired a sound, a tone, with feeding his dogs so that the tone occurred several times right before and during the feeding. Soon the dogs salivated to the tone, something like they did to the food (1 above). They had learned a new connection: tone with food or tone with saliva response.

Similarly, John B. Watson, an early American psychologist, presented an 11-month-old child, Albert, with a loud frightening bang and a rat at the same time. After six or seven repetitions of the noise and rat together over a period of a week, the child became afraid of the rat, which he hadn't been, something like his fear of the noise (2 above). Actually, although very famous, Watson's experiment didn't work very well (Samuelson, 1980); yet, the procedure shows how one might learn to associate a neutral event, called the conditioned stimulus (strange as it may seem--the rat), with another event to which one has a strong automatic reaction, called the unconditioned stimulus (the scary loud sound). (What I find even more amazing is that Watson described three ways to remove this learned fear but it was 40 years later before psychology took his therapeutic ideas seriously.)

Eventually both the unconditioned (UCS) and the conditioned stimulus (CS) elicit similar (but we now know not the same) responses--an automatic, involuntary response which the person *frequently (but not always) can*not control. Examples of unconditioned stimuli and resp*onses are: pain*, a puff of air to the eye and a blink, approaching danger and fear, light and pupil constriction. Classical conditioning sounds simple. Actually, there are many complexities. Pavlov discovered many of the basic learning processes, such as the necessary timing when pairing the conditioned stimulus with the unconditioned stimulus, inhibition, extinction, generalization, discrimination, higher *order conditioning, and others.*

Pavlov's experiments dramatically demonstrated the environment's control over behaviour. We are highly responsive to cues in our environment. For instance, we see dessert and can't avoid eating it. We have a place where we can really concentrate and study. Thus, changing our environment is one of the most effective self-help methods. Changing our reaction to the environment is another self-help approach based on classical conditioning methods. Indeed, learning to reduce our fears and other unwanted emotions are a major part of gaining control over your life. Furthermore, classical conditioning is a powerful procedure for modifying behavior, and it is not surprising, therefore, that as soon as it was discovered there should have been a great deal of speculation as to how it works (Bitterman et al, 1979).

2.3.1 The Goals of Research on Classical Conditioning and Pavlov’s experiment

Pavlov’s immediate goal was to understand how the various experimentally arranged temporal relationships between CSs and UCSs determine changes in the probability of salivary responses to the CSs (Bitterman et al, 1979). In pursuit of this goal, Pavlov decided to study the effects of a great variety of environmental changes upon a single response system, instead of exploring the effects of a limited range of environmental changes upon many different responses. Pavlov’s decision was a wise one, for he was able to formulate fairly quickly a surprisingly enduring set of statements describing the correlation between changes in the environmental and changes in the probability of salivation (Bitterman et al, 1979).

Ivan Pavlov, a Russian physiologist whose work on digestion earned him a Nobel Prize in 1904, was conducting a series of experiment related to salivation in dogs. To study a dog's salivation responses, he would make a surgical incision in the dog's mouth, thus enabling him to collect and measure its saliva. After strapping the dog into an immobile position, he would give it some powdered meat and observe its resulting salivation (Ellis, 1999). Pavlov noticed that the dog soon begun to salivate before it saw or smelled the meat- in fact, it salivated as soon as the laboratory assistant meant food was on the way and responded accordingly. Pavlov devoted a good part of his later years to a systematic study of this learning process upon which he had so inadvertently stumbled, and he eventually summarized his research in his book *Conditioned Reflexes* in 1927 (Ellis, 1999).

In Pavlov's original studies of classical conditioning, he first observed whether the dog salivated in response to a particular stimulus, which in this case is the bell. The dog did not find a bell especially appetizing and so did not salivate (Ellis, 1999). Pavlov then rang the bell again and this time followed it immediately with the presentation with some powdered meat. The dog, of course, salivated. Pavlov rang the bell several more times, always presenting the meat immediately afterward. The dog salivated on each occasion. Pavlov then rang the bell again without presenting any meat. Nevertheless, the dog salivated. The bell, to which the dog was previously been unresponsive, now led to a salivation response. There has been a change in the behavior due to experience; from the behaviorist perspective, learning has taken place (Ellis, 1999).

Pavlov refers to two critical aspects of classical conditioning. First, he points out that the ability to respond to signaling stimuli is adaptive for the organism because it allows the individual to anticipate significant changes in the environment (Fantino & Logan, 1979). Secondly, he emphasizes the flexibility that characterizes this reliance on signals. Behavioral anticipation can be effective only if the organism is able to take advantage of whatever stimuli happen to be predictive of the relevant event. The same signal can be used flexibly as an indicator of many different events. Similarly, as the environment changes such as that one signaling stimulus no longer occurs reliably, novel stimuli may acquire new signaling value and therefore take on the essential predictive function (Fantino & Logan, 1979).

Generally, in a classical conditioning experiment an organism is presented with a stimulus which elicits, or is reliably followed by a response. The stimulus is called the unconditioned stimulus (UCS), and the response, the unconditioned response (UCR) (Bitterman et al, 1979).

An example of classical conditioning is the experiment by Colebrook and Lukowiak (1988). A semi-intact preparation of Aplysia californinca was used to monitor simultaneously behavioral and motor neuronal responses during classical conditioning of the gill withdrawal reflex. They did an experiment with Aplysia about classical conditioning and observed all the qualities of classical conditioning in Aplysia (Colebrook & Lukowiak, 1988).

Ungless (1998) food-attraction conditioning as an example of Pavlovian conditioning. Following brief pairing of an odor with a feeding experience (food-attraction conditioning), snails with lower their tentacles when subsequently presented with that odor alone. Three experiments investigated the possible behavioral mechanism mediating food-attraction conditioning in the snail Helix aspersa. In this case, the odor (CS) is paired with oral stimulation (UCS), which elicits lowering of the tentacles (UCR). Following conditioning, the odor comes to elicit lowering of the tentacles (CR). Results showed that it exhibited significant association pairing, meaning conditioning (Ungless, 19980.

<u>Training and CR Strength</u>: CR strength increases over trials. This result fit in with the idea that learning improves with practice. With continued training, CR strength eventually, levels off, that is, reaches asymptote (King, 1979). One possible reason why CR strength increases as training continues is based on two ideas that will be subsequently supported: (a) better classical conditioning results in a CS that is more strongly attended to and (b) a CS that is more strongly attended to results in better classical conditioning. At the start of trainings, a CS-UCS pairing should increase the extent to which the CS is attended to (King, 1979). This increase in attention should improve the classical conditioning that occurs when the next CS-UCS pairing is received. This improved classical conditioning should result in a further increase in attention to the CS. And this further increase in attention should lead to an additional improvement in the classical conditioning that occurs when the subsequent CS-UCS pairing is received. Thus, the increase in attention to the CS that should result through classical conditioning is viewed as facilitating this classical conditioning, and so on, the outcome being a gradual increase in CR strength (King, 1979).

2.3.2 Extinction

Extinction is a series of trials in which the CS appears without the UCS (Gardner, 1998). The Pavlov's dog learned to salivate at the sound of the bell alone after the bell had rung in conjunction with meat powder on several occasions. Pavlov discovered that repeated presentations of the conditioned stimulus alone led to successfully weaker and weaker conditioned responses. Eventually, the dog no longer salivated at the sound of the bell; in other words, the conditioned response disappeared. The disappearance of a conditioned response when a conditioned stimulus is repeatedly presented without the unconditioned stimulus is a phenomenon called extinction (Ellis, 1999).

2.3.3 Spontaneous recovery

Even though Pavlov quickly extinguished his dog's conditioned salivation response by repeatedly presenting the bell in the absence of meat powder, when he entered his laboratory the following day he discovered that the bell once again elicited salivation in the dog, almost as if extinction had never taken place (Ellis, 1999). This reappearance of the salivation response after it had been previously extinguished is something Pavlov called spontaneous recovery. In more general terms, spontaneous recovery, it is typically weaker than the original conditioned response and extinguishes more quickly. In situations in which a CR spontaneously recovers several times, each time after a period of rest has elapsed, the response appears in a weaker form than it had previously and disappears more rapidly (Ellis, 1999).

Spontaneous recovery after a rest can be tested with or without the UCS. With the UCS, it is called reacquisition; without the UCS it is called re-extinction. Spontaneous recovery is a robust phenomenon that appears in virtually all experiments. Plainly the CR is neither forgotten nor eliminated by extinction (Gardner, 1998). Because extinction does not appear to the result of simple reduction in the strength of the positive association from the CS to the CR, Pavlov suggested that extinction resulted from inhibition of the CR that inhibition builds up over the course of successive extinction trials, reducing the level of performance of the CR to CS. If inhibition is assumed to dissipate over a retention interval faster than excitatory trace strength, then spontaneous recovery will be observed (Wickelgren, 1977).

2.4 What is ginseng?

Ginseng, the herbal remedies, is the dried root of one of several species of the Araliaceae family of herbs. It is widely used in order to improve overall energy and vitality, particularly during times of fatigue or stress. While there is not much clinical evidence to support an energy boosting effect, it is stated that ginseng has various effects and studies show its potential value in stimulating immune function, improving memory and symptoms of attention deficit-hyperactivity disorder (ADHD) in children. For instance, Panax ginseng is one of the most commonly used and highly researched species of plants. Ginsenosides, the plant chemicals, play a major role in ginseng's activity. In Panax ginseng, also called Korean or Asian ginseng, which has been an important herbal remedy in traditional Chinese medicine and where it has been used primarily as a treatment for weakness and fatigue, these plant chemicals show to have a variety of beneficial effects including antioxidant and anti-inflammatory effects. Therefore, their presence or absence and their chemical profiles can indicate the type and quality of ginseng in a product. In addition, research show that Panax ginseng may have beneficial effects on immune function, physical and psychological function as well.

2.4.1 Effects of Panax ginseng on psychological function and physical performance

In relation to the medicinal activity of Panax ginseng, research has focused on ginsenosides which are the main active agents in Panax, called the triterpene saponins. Studies demonstrate that the extracts of Panax ginseng affect the hypothalamus-pituitary-adrenal axis and the immune system, and also increase resistance to exogenous stress factors.

As mentioned earlier, Panax ginseng has various effects and studies show its potential value in stimulating immune function, improving memory and symptoms of attention deficit-hyperactivity disorder (ADHD) in children. Because of the limitations of some studies, and difficulties on conducting experiments in relation to ginseng such as varying doses or small sample sizes, it is difficult to come up to conclusions about some of the clinical effects of ginseng. However, many studies and trials show the effects of Panax ginseng on various psychological parameters.

In one study of 112 healthy volunteers older than 40 years, the administration of 400 mg per day of the standardized ginseng product Gerimax for eight weeks resulted in better and faster simple reactions and abstract thinking. On the other hand, the study showed no change in concentration and memory.

In other two small studies, each including about 30 young, healthy volunteers who received 200 mg of G115 daily for eight weeks resulted in better certain psychomotor functions, such as better attention, processing, and auditory reaction time. In addition, there was improvement in social functioning, and mental health. However, studies indicated that some of the effects present at the fourth week disappeared by the eighth week.

2.5 The galvanic skin response and GSR physiology

Galvanic skin response (GSR) is a change in the electrical resistance of the skin and it reflects sweat gland activity and changes in the sympathetic nervous system and measurement variables. A case in point, GSR is determined as an instrument by passing a weak current through the skin by measuring the current generated by the body itself. Furthermore, it has been correlated with emotion, attention, and stress. Accordingly, the GSR is highly sensitive to emotions in some people. This means that the magnitude of this electrical resistance is affected, not only by the subject's general mood, but also by immediate emotional reactions.

Research shows that the underlying causes of this change in skin resistance have been discovered and therefore, this change was found to be related to the level of cortical arousal. So, the emotional charge on a word, heard by a subject, would have an immediate effect on the subject's level of arousal, and cause this physiological response. In addition, the GSR feedback has been used in the treatment of excessive sweating, called hyperhydorses, and related dermatological conditions, and also for desensitization training.

Also, it has been used in important research on anxiety and stress levels (Fenz & Epstein, 1967), and it has been a part of lie detection (Raskin, 1973). Although GSR is the oldest term, yet most investigators accept the phenomenon without understanding exactly what it means. In any case, GSR is a generalized measure of autonomic arousal (Reeves, Lang & Rothchild, 1989). A case in point, the level of skin conductance rises with the level of arousal. First, the GSR occurs in response to a stimulus. It may have a fairly long latency, about a second or more, which may be shortened when the subject is required to make discrimination. Second, GSR also occurs in resting subjects, and their frequency can be used to distinguish different types of individuals.

According to Prokasy & Raskin (1973), GSR is also a measure of attention. In addition, correlations between GSR and attitude, empathy and social interactions, have been shown in many studies (Shapiro, 1973).
Although the galvanic skin response has been used as an index for those who need measurable parameters of a person’s internal state, and therefore a relatively reliable and measurable tool, there is not a clear understanding of what the measures reflect. Physiologically, the GSR reflects sweat gland activity and changes in the sympathetic nervous system and measurement variables. Furthermore, the activity of the sweat glands in response to sympathetic nervous stimulation resulting in increased sympathetic activation, explains an increase in the level of conductance. Although one cannot identify the specific emotion being elicited, such as fear, anger, anxiety, and sexual feelings, there is a correlation between sympathetic activity and emotional arousal.

Accordingly, the purpose of this study was to shed some light on the effect of ginseng on sympathetic nervous system by using the GSR responses.

3. METHODOLOGY

3.1 Participants

Forty healthy males and females students in the American College of Greece volunteered to participate in this randomized experiment related to the experimental psychology course. This study examined the effects of ginseng on the sympathetic nervous system. None of the participant was taking any medication, and each subject was instructed to avoid beverages containing whether caffeine or alcohol. Moreover, the experimenter explained the purpose of the experiment, and effects of ginseng before the conductance of the experiment to all participants. Then, informed consent to participate in this experiment was given to each subject. Forty participants were divided in four groups of ten participants in each group. Moreover, each subject was exposed to a stimulus shock and a galvanic skin response (GSR) measurement thirty minutes after the oral administration of the pill. The first group received a dosage pill of 500 mg ginseng and an electric shock intensity of 30 volts. The second group received a dosage pill of 500mg ginseng and an electric shock intensity of 60 volts. The third group received a dosage pill of 0 mg ginseng (placebo) and an electric shock of 30 volts. The fourth group received a dosage pill of 0 mg ginseng (placebo) and an electric shock intensity of 60 volts.

3.2 Materials

In this study, the following materials were used: The equipment which is a GSR Amplifier (Model: CP 122 AC/DC strain Gage Amplifier), which records the whole procedure (shock, response, time), two recording electrodes, a stimulus generator WPI (Word Precision Instrument) A310 Accupulser, which specifies the parameters as the duration of the shock. A (Grass Stimulator system), which gives the shocks of different intensities, two stimulating electrodes, a (Grass Telefactor Electrolyte), and a (Computer Scope). A stimulus generator and a SD9 stimulator, which is responsible to control the stimulus duration, and finally, a polyview, which represents the analysis of the responses to shock intensities.

3.3 Procedure

The experiment took place in a laboratory environment in a one month period of time during the fall semester in the American College of Greece, Deree College. The participants came to the laboratory at 11:00 a.m., and the study was carried out from 11:00 a.m., until 13:00. In the study, all the participants were carefully selected in order to be free from other stimulants and beverages such as caffeine and alcohol, and none of the subjects was taking any medication. Also, an exclusion of females was made due to the menstrual cycle because of the hormonal changes. Moreover, the experimenter explained the purpose of the experiment, and effects of ginseng before the conductance of the experiment to all participants. Then, informed consent to participate in this experiment was given to each subject. Then, they followed instructions related to their reactions when the shock was presented in the experiment by the experiment administrator. (Remember that the subjects' reactions are the most important concern for the experimenter after delivering the shock). The participants were divided in four (4) groups of ten (10) subjects each; two groups received a 500mg ginseng pill and the other two received a placebo pill. Then, participants were asked to receive the pill. After the administration of the pill, they were waiting in the yard outside the lab for thirty minutes. After thirty minutes of time, participants were entering the lab individually, and they were seating in a comfortable chair. Then the experimenter attached two recording electrodes to the fist subject's fingers of the left hand. The experimenter was just staying behind the subject out of visual contact. The laboratory room was temperature controlled at 24'C and quiet with minimization of arousal stimuli. The lights of the room were switched off and the elimination of every disturbing sound inside the room took place. Then, the Grass Stimulator started to release the shocks while the A310 Accupulser was specifying the parameters such as the duration of the shock. From the twenty (20) subjects who took the 500mg ginseng pill, ten (10) of them received an electric shock of 30v. On the other hand, the other ten (10) received an electric shock of 60v. Similarly, the same procedure was followed concerning the other twenty (20) subjects that used the placebo pill. A case in point, we had four (4) groups in our study: Group 1 ginseng 30v, group 2 ginseng 60v, group 3 placebo 30v, and group 4 placebo 60v. Moreover, the Gage Amplifier was recording the subjects' responses. Then, the results were shown graphically in the polyview. After the whole experimental procedure was over the lights turned on and the electrodes were removed from the subjects' palm hand.

4. RESULTS

The investigation of the effects of ginseng on the sympathetic nervous system measured by the galvanic skin response (GSR) was performed in this research. The experiment was conducted by asking the participants' to follow instructions given from the experimenter concerning their reactions related to the shock when presented in the experiment. Then participants were asked to receive the pill and after thirty minutes of time, subjects were entering the lab individually, and two recording electrodes were attached to the fist subject's fingers of the left hand. Moreover, the Grass Stimulator started to release the shocks while the A310 Accupulser was specifying the parameters such as the duration of the shock. Afterwards, the equipment which is a GSR Amplifier (Model: CP 122 AC/DC strain Gage Amplifier), which measures the physiological information indicated by electrical resistance of skin variability, and also records the whole procedure, therefore, (shock, response, time), was recording the subjects' responses. The results were shown graphically in the polyview. Furthermore, all of the statistical analysis was performed with the Statistical Package for Social Science (SPSS). A two Factor with Replication ANOVA was carried in this experiment. These results indicate that there is a statistical significance in the second trial of rise time. The results of t-test confirm that particular point of significance. However, there is no significance on the other trials. More specifically, there is no significance between variables on the first trial of duration. The variation of scores between groups and the variation between the group means is less than 0.05. The F ratio should be less than 0.05>p. In the duration of the third trial, we observed that the F ratio is also less than 0.05. So, the first trial, and the second trial of the onset latency come up with the same results. Again, on the rise time of the first trial, the F ratio is also less than 0.05. However, on the rise time of the second trial we observed a significance of two variables. Particularly, we see that the p-value in this specific point is 0.03724< 0.05. In this point, we used a t-test in order to see the interaction in rise time between ginseng and voltage variables. These results indicated that there is no significance in the first and second trial of duration. Similarly, there is no significance in the first and second trial of the onset latency, and also in the first trial of the rise time. However, we found that there is significance on the second trial of the rise time. Therefore, the present data suggest that factors such as noise, amount of ginseng, participants' emotional state, and age, might have influenced our results.

5. CONCLUSIONS

This study is aiming in purposing to investigate the effects of ginseng on the sympathetic nervous system measured by the galvanic skin response (GSR). In other words, we tempted to observe if the effects of ginseng on the sympathetic nervous system would result in more arousal in the organism. While there is not much clinical evidence to support an energy boosting effect, it is stated that ginseng has various effects and studies show its potential value in stimulating immune function, improving memory and symptoms of attention deficit-hyperactivity disorder (ADHD) in children. However, the statistical analysis results indicated that there is no significance between variables on the first trial of duration. Specifically, the variation of scores between groups and the variation between the group means is less than 0.05. Therefore, the F ratio should be less than 0.05>p. In relation to the duration of the third trial, we observed that the F ratio is also less than 0.05. Furthermore, the first trial, and the second trial of the onset latency come up with the same results. Again, on the rise time of the first trial, the F ratio is also less than 0.05. On the other hand, on the rise time of the second trial we observed a significance of two variables. Particularly, we see that the p-value in this specific point is 0.03724< 0.05. In this point, we used a t-test in order to see the interaction in rise time between ginseng and voltage variables. However, the present data suggest that factors such as noise, amount of ginseng, participants' emotional state, and age, might have influenced our results. More specifically, noise may be one of the factors which might have influenced the results. First, the conditions in which the experiment was conducted, and therefore, the experiment's location might be inappropriate for the experiment to take place. A case in point, noise may result as a problem for both the experiment administrator and the participants for the conductance of the study. This study revealed that during the conductance of the experiment, there was some interference when other people entered the door and in some point the procedure was interrupted. Therefore, lack of information concerning the running of the experiment and its consequences in case of interruption might have influenced the results.

Second, insufficient amount of ginseng may be the case since some of the participants received a greater dosage of ginseng than other participants. Therefore, the dosage of ginseng was not equally administered to each of the participant.

In addition, the present data demonstrate that subject's emotional state may play a major role during the conductance of the experiment. After agreeing with the informal consent, participants might have experienced feelings of anxiety, and feelings of fear as well as stress levels. This explains the subjects' lack of information due to the effects of ginseng in the organism as well as feelings of anxiety before the exposure of the shock. Therefore, in some point, it was observed that during the performance of the experiment, especially during the exposure of the shock, participants start getting worried by talking to the experiment administrator. As a result, participants' emotional state might have affected the results which came up to be insignificant.

In relation to the effects of ginseng on the sympathetic nervous system, further research show that age plays an important role. Furthermore, ginseng has been studied by many researchers in its relationship to the process of aging among humans. In fact, aging is a declining process associated with the dysfunction of neuro-endocrine-immuno-system network. Moreover, the atrophy of the thymus places a role in decreased lymphocyte function.

Finally, much more research must be done to see the effects of ginseng on the sympathetic nervous system measured by the galvanic skin response.

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