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Physiological Differentiation and Cognitive Discrimination of an Olfactory Stimulus Produced under Stress

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PHYSIOLOGICAL DIFFERENTIATION AND COGNITIVE DISCRIMINATION OF AN OLFATORY STIMULUS PRODUCED UNDER STRESS

by

Robert Gray Perra

A Dissertation Submitted to the Faculty of The Graduate College in partial fulfillment for the Degree of Doctor of Education Department of Counselor Education and Counseling Psychology

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PHYSIOLOGICAL DIFFERENTIATION AND COGNITIVE DISCRIMINATION OF AN OLFACTORY STIMULUS PRODUCED UNDER STRESS

Robert Gray Perra, Ed.D.
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Humans may have ability to transmit, receive, and react to biological information from other humans through olfactory chemosensory communication. Two studies examined human (1) ability to differentiate physiologically, via olfaction, fresh stress produced sweat and (2) cognitive discrimination, through smell, of "aged" stress produced sweat. Four stress conditions were employed: (1) exercise, (2) relaxation, (3) sexual arousal, and (4) repulsion.

*Experiment I*: A male dyad participated—donor and recipient. Donor was prepared to collect his axillary secretion on gauze; following preparation donor was stressed. After stressing, the gauze which was presumed to contain a fresh non-odoriferous sweat, was removed, sandwiched between two surgical masks, and refrigerated. Within forty-five minutes the sample was placed over recipient's nose and mouth and his physiological responses were recorded on a polygraph. Recipient's polygraph record during sweat introduction was compared with: (a) Donor's record during the stress condition and (b) Recipient's
Results: Recipient's physiological responses altered when Donor's stress produced sweat was presented (e.g., relaxation sample produced muscle tension reduction, heart rate reduction, GSR increase, breathing becoming shallow and regular, and a skin temperature increase; erotic sample produced muscle tension increase, heart rate irregularity and increase, GSR decrease, respiration becoming deeper and slower, and a skin temperature decreasing; etc.) In all cases Recipient's physiological responses yielded a similar pattern as Donor's response pattern from the same stress condition. Conclusions: Findings suggest that humans have an ability to differentiate physiologically stress states via olfactory chemosensory communication in a form of "biological empathy."

Experiment II: A single subject provided the stress related axillary secretions. Each sample was collected on gauze. Following donor stressing, the sample was removed, placed in a container, and refrigerated for circa twelve hours; following "ageing," a group smelled the sample and filled out a forced choice questionnaire asking: (a) whether the container contained a sweat sample, (b) the gender of the donor, and (c) the stress condition for sweat sample production. Results: (a) 81.5% correctly identified sample as sweat; (b) 63.3% accurately identified gender; and (c) Ability to discriminate stress
states was not determined. **Conclusions.** Results are consistent with current literature.
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CHAPTER I

LITERATURE REVIEW

Preface

Until recently, our knowledge concerning human ability to utilize olfactory information as a means of communication has been confined to anecdotal material from folklore and the ethnographic literature. Olfactory communication in animals is well-documented and is necessary to the survival of the group; danger detection, reproductive rate regulation, aspects of sexual receptivity, familial group detection or recognition of non-group individuals, and territoriality are among the areas in which olfaction plays a demonstrated role. These observations, in addition to the anecdotal material, have influenced the orientation of the few studies we do possess regarding human olfaction. The purpose of this literature review is to examine the possibility and potential of communication of emotional states between humans, via chemically mediated stimuli, presumably detected by olfactory structures analogous to those we know are used in sub-human species.
Introduction to the Problem

The importance of olfaction as a means of chemosensory communication (both between individuals, as well as for social regulatory purposes) among non-human mammals is well established in the literature (Doty, 1981). The probability that olfaction plays an important role in the chemosensory communication of humans is strongly suggested in much of the research on humans, and in some of the literature the role of olfaction is taken as axiomatic (e.g., Wilson, 1970). Although human chemosensory communication through olfaction is strongly suggested or assumed, systematic and conclusive research does not exist; as a consequence, the limits of this phenomena are not clearly delineated. The research that does focus on humans lags behind the animal research.

It has been suggested that the "research lag" is due to the subordinate place human olfaction has been given in relation to the other senses, as well as to the continual debate over the relative importance of olfaction in human social interactions (cf. Bloch, 1934; Doty, 1976; Ellis, 1936; Kiell, 1976; Owen, 1980; Stoddart, 1982). Implicit in the debate process concerning the relative importance of olfaction is the inability of the scientific community to come to an agreement on basic concepts such as
olfaction (cf. Amoore, 1963; Geldard, 1972; Gesteland, Lettvin, Pitts & Rojas, 1963; Tanabe, Iino, & Takaga, 1975), emotion (cf. MacLean, 1958; Papez, 1938), stress (cf. Goldberger & Breznitz, 1982; Kutash & Schlesinger, 1980; May, 1977; Selye, 1980; Selye, 1982), and communication (cf. Bastian, 1968; Batteau, 1968; Burghardt, 1970a; Frings & Frings, 1964; Klopfer & Hatch, 1968; Lorenz, 1955; Mehrabian, 1969; Scott, 1968; Sebeck, 1968; Skinner, 1966; Stevens, 1950; Tavolga, 1968). Ziporyn (1982) points to other reasons for the research lag: (a) the anatomy of smell is extremely complicated, and "the ... olfactory rods and sustentacular cells, located in the olfactory cleft at the top of the nasal cavity, were not even localized until the 19th century" (p. 228); (b) "relatively little is known about therapy for these conditions" (disorders of smell), and physicians who hear patients' complaints dismiss them by telling their patients to "live with" their problems (Ziporyn, 1982, p. 227). Ziporyn implies that research is linked to clinical interest, which is frequently associated with specific issues and questions.

There is little question that during the past several decades there has been increased interest in the interrelationship between exocrinology (olfaction) and endocrinology (chemical regulators in the body). These interests
appear to be tied to the clinical needs of specific disciplines rather than to the systematic acquisition of knowledge in the global sense. For example, in medicine, research has focused on the problem and use of smell for diagnostic purposes: physical diagnosis: e.g., diphtheria—"sweetish", diabetic coma—"fruity", scurvy—"putrid", yellow fever—"butcher shop", typhoid fever—"freshly baked brown bread", etc. (cf. Farber, 1978; Hayden, 1980; Liddell, 1976; Moschella, Pillsbury, & Hurley, 1975), and psychiatric diagnosis: e.g., depression, schizophrenia, etc. (cf. Bradley, 1984; Brass, 1970; Liddell, 1976; Parkinson, 1969; Smith & Sines, 1960; Smith & Thompson, 1969); in psychology, the interest in the interrelationship between exocrinology and endocrinology can be seen in research on familial recognition (cf. Altmann & Vinsel, 1977; Hall, 1966; Porter & Moore, 1981; Schleidt, Hold & Attili, 1981), the effects of smell on performance (cf. Cowley, Johnson & Brooksbank, 1977; Doty, Green, Ram & Yankell, 1982; Rotton, 1983), and menstrual synchrony (cf. Graham & McGrew, 1980; McClintock, 1971; Quadagno, Shubeita, Deck & Francoeur, 1981), etc.; while in social anthropology the issue emerges in discussions of the regulation of territorial and social space (cf. Calhoun, 1962a; Calhoun, 1962b; Christian, 1963; Hall, 1966; Lorenz, 1955). Furthermore, the question appears in the
fields of pharmacology, in work on the control of specified affective disorders (cf. Liebowitz et al., 1985; Mellman & Davis, 1985); and in occupational therapy, in studies regarding the stimulation of the nervous system (cf. Fox, 1966; Schwartz, 1979).

Animal studies have clearly and systematically demonstrated that most animals are able to determine information from body odor related to species and subspecies (see Otte & Cade, 1976); kinship (cf. Hennessy, 1977; Kallquist & Mossing, 1982); gender (cf. Connor, 1972; Drewett & Spiteri, 1979), reproductive state (cf. Drewett & Spiteri, 1979; Goddard & Beilharz, 1984); and emotional state (cf. Collerain, 1978; Goddard & Beilharz, 1984; Zunino & Landauer, 1980). Yet, studies on humans have left many of these areas unexplored, so that information is limited (Doty, 1981; Hold & Schleidt, 1977).

Chapter Organization

"Despite the relatively limited amount of information on odor communication in humans,... studies ... suggest that humans, like many mammals, have the potential for communicating basic biological information via the smell medium" (Doty, 1981, p. 373). The study that follows this chapter focuses on the extent of physiological and cognitive discrimination of this "potential." This review
examines the following areas: (a) anecdotal material concerning the use of human secretion and excreta within social interaction; (b) the physiological mechanisms of communicating biological information via the olfactory medium; (c) a review of selected studies which are concerned with discriminating/communicating gender and/or family recognition and/or emotional states; and (d) a commentary on the research presented and its potential pitfalls.

Anecdotal Literature

Folklore and customs are the common sense of a people, the collective folk-belief of a society (Jung, 1934). A review of the anecdotal literature offers a glimpse into the system of thinking shared by a sociocultural group. Such a review offers a historical and cross-cultural context in which to view the scientific literature presented later in this chapter. Studies by social anthropologists reporting on folklore and customs show that many societies maintain that human odors from excreta (i.e., urine, feces, sweat, etc.) have the power to alter the recipient's emotional state (cf. Davenport, 1965; Delaney, Lupton, & Toth, 1977; Himes, 1970). So strong is this belief that when the actual human secretion is not used, organic and mineral preparations are utilized.
to emulate, enhance, or mask the basic human odor(s). The use of human excreta predominates, and these, along with the organic and mineral human-like preparations, are employed when basic human needs, such as protection, healing, and/or basic mating behavior—either in a religious or social context—are at issue.

**Aphrodisiacs and Medicinals**

Aphrodisiacs and medicinals that manifest "human or human-like" properties have long been used (cf. Culpeper, 1826; Stark, 1980; Thomson, 1978). In Europe during the Middle Ages it was the appearance of the plant or other organic and/or inorganic substance (animal, human, or mineral) that was the decisive factor in proving the efficacy of the substance; those plants that in some way resembled the human body (in whole or part) (e.g., mandrake root, belladonna, etc.), were accepted as effective (Illustration 1).

The most noted formulation of this kind of logic was developed by Giambattista della Porta in 1588. Known as the "Doctrine of Signatures" (Thomson, 1978), it drew strong analogies between plants and animals, and suggested that consuming a plant that resembles an animal would produce the qualities of that animal (Illustration 2); in the case of plants that resemble human parts,
Illustration 1. 1498 Woodcut/Mandrake Root: For the Middle Ages, a plant's appearance was decisive. The roots of the mandrake (*Mandragora officinarum*) resemble a human body, and often exaggerated in drawings of the plant, such as this fantastical woodcut from an herb of 1498. (Thomson, 1978, p. 141).

Illustration 2. 1588 Woodcut/Analogies Between Plants and Animals: Giambattista della Porta’s treatise on the Doctrine of Signatures draws analogies between plants and animals, suggesting that consumption of a particular plant would make a person either more energetic or calmer (Thomson, 1978, p. 143).
produced the qualities of that body part.

This Doctrine of Signatures was extended by many to include smells. Thus, substances that contained smells that were classified as "human-like" (e.g., musk, cannabis, crushed fish parts, etc.) were frequently used as medicinals and sexual enhancers.

It is uncertain which variable—the association with the body part or the association with the smell—was more important in the development or reinforcement of this system of logic, but the same comparisons are used today in the "modern" advertising of aphrodisiacs, perfumes, and medicinals (Illustration 3 & Illustration 4).

As an aside, many of the herbs used in the past because of their likeness to animals and/or humans have been studied and found effective to some degree and are used in Homeopathic Medicine and Natural Medicine (cf. Boyd, 1981; Grieve, 1931; Julian, 1979; Pratt, 1980; Stark, 1980).

**Fish Odors to Attract Women**

Davenport (1965) reports that some Southwestern Pacific men use fish preparations that have a smell similar to the odors produced by vaginal secretions interacting with semen as a method to attract women.
Illustration 3. Chloe' perfume: Note the stopper. The left side of the stopper depicts the clitoral hood and the right side of the stopper depicts the penis gland.

The Smell of "Calm Fear"

Several years ago, while in England, a tavern philosopher expounded on local folklore. The resident stated that local mythology maintained that the Hounds of Dartmoor, or the Beasts of the god Wotan, would track their enemy by the smell of their enemy's hate. When the Hounds attacked, they spared the faithful because of the smell of "calm fear" that they exuded. The faithful could ensure the Hound's accuracy by using a preparation of ethanol and lavender. It was propounded that drinking this concoction would produce a sweat that would "calm animals." During the conversation a local veterinarian added the information that this was also a preparation that new veterinarians fearful of a certain animal would use prior to treating that animal.

No published accounts on any mythology that corresponded with the tavern philosopher's tale could be found, yet parts of his story are familiar to the culture of the region. Writers in the area have discussed demonic dogs and beasts (see Doyle, 1953), and Wotan, the Old High German form of the Scandinavian god Odin (Bulfinch, 1979), has one or more Celtic quasi-equivalents (e.g., the god Dagda or the god Lug; see Larousse, 1968). The point of this anecdote lies not in the accuracy of the myth, but rather in the medicinal recipe offered for "calm sweat."
The use of lavender in the treatment of nervousness, neurasthenia, states of exhaustion, and sleeplessness have long been known; recently lavender has been analyzed for its tranquilizing effect and found to have some significant tranquilizing properties (Thomson, 1978). Empirical observation and scientific research strongly suggest that body secretions are altered in smell, taste, content, and viscosity by food and drug intake (cf. Goth, 1978; Guyton, 1986; Hopson, 1979; Sastry, Buck, Janak, Dressler & Preti, 1980; Williams & Warwick, 1980). Alcohol consumption initially will flush the skin and promote a sweat (Liska, 1981). Viewing the ethanol/lavender concoction in light of this limited amount of information suggests that the preparation might have some efficacy.

**European Christian Modesty**

The reason for extreme modesty in European Christian sects was to disrupt the efficacy of human scent and avoid the visual stimulus presented by the naked body. This stance grew out of the need to combat non-christian religious traditions and specifically, the Central European cult of the Goat god. The liturgy of this Goat god cult endorsed nudity and sexual expression (cf. Stark, 1980; Summers, 1974) which the Christian found offensive.
**Sudan Love-Dance**

In Nubia in the Sudan, during the annual love-dance, the young female selects her mate by lifting one of her legs and placing it on the shoulder of her chosen male who is seated; this brings her ungarmented genitals close to the face of the seated male. Since social etiquette forbids the male to look upon the female genitalia, it is supposed that an olfactory signal is being transmitted (Morris, 1985). Most likely a bonding imprint of some formulation is being attempted (see Morris, 1969).

**Arab Evaluation of Acceptability**

In Arab countries, human smell is used to judge the "goodness" or "acceptability" of a potential mate. To ensure a good marriage, an intermediary may request to smell the girl. If she "does not smell good" he may reject her for marriage. This "smelling" also extends to everyday forms of Arab interaction; males are taught to "breathe onto" the person with whom they are interacting, which allows for mutual assessment (Hall, 1966).

**English Seduction Custom**

Morris (1985), commenting on an English folk-custom reports, "If a young man wishes to seduce a girl at a dance he must place a clean handkerchief in his armpit,
beneath his shirt, before starting to dance. Afterwards he takes it out and pretends to fan himself with it in an attempt to cool off. In fact what he is doing is wafting his apocrine scent over the girl, who is promptly seduced by its fragrance" (p. 140). Although this activity could be interpreted in terms of nonverbal communication (see Knapp, 1978, p. 220), such as a "sexual intention movement" (Morris, 1977, p. 246) that may function as an "invitation to sexual intimacy" (Morris, 1971, p. 35), in the above case, Morris connects the activity with odor transmission and odor reception.

Physiology of Biological Communication via Olfaction

**Human Body Secretions and Odor Production**

The sources within the human body that can provide a medium for the communication of biological information are varied and include breath, gastrointestinal gasses, and a number of other excreta (i.e., urine, saliva, milk, sweat, etc.). Studies concerning human to human chemosensory olfactory communication tend to concentrate on skin secretions. Although there are studies that do not focus on skin secretions, they are the exceptions to the trend. This review of human body secretions shall concentrate on studies dealing with skin secretions.
Secretions to the skin surface have three primary sources: (1) eccrine sweat glands; (2) sebaceous glands; and (3) apocrine sweat glands. Each different gland type produces a unique secretion that has a specialized service function. Odors are formed from the bacterial decomposition of skin secretions (Moschella, Pillsbury, & Hurley, 1975; Williams & Warwick, 1980). Although the exact secretions and exact bacteriological agents involved with body odor production are not fully understood, the bacterial interaction with the apocrine gland secretion has been identified as being most likely an important source of body odor (Labows, 1979).

**Eccrine**: The primary service function of the eccrine glands is thermoregulatory. These glands respond to any rise or drop in ambient temperature, or an increase or decrease in skin temperature caused by physiological stressors or psychological stressors (Broek, Bradshaw, & Szabadi, 1984; Sugenoya, Ogawa, Asayama & Miyagawa, 1982). The eccrine glands are distributed over almost the entire body surface, independent of the hair follicles. Their secretion is made up of inorganic salt and amino acids suspended in an aqueous solution. The eccrine gland is frequently referred to as the "sweat gland."

**Sebaceous**: The service function of the sebaceous glands is to keep the skin supple and waterproof. These
glands are distributed over the body and are specialized at all points of entry. The sebaceous glands secrete skin lipids.

Apocrine: The specific service function of the apocrine glands is unclear (Moschella et al., 1975). In many mammals the service function of the apocrine glands appears to be two-fold: (1) thermoregulatory—yet unlike the case in non-human mammals, the apocrine sweat glands in humans do not appear to serve a thermoregulatory function (Doty, 1981); and (2) social regulatory and communicatory—yet in humans this function is only suggested and is currently under investigation (Williams and Warwick, 1980). The apocrine glands seem to excrete maximally during stress conditions (cf. Doty, 1981; Sastry et al., 1980; Sugenooya et al., 1982), and Sastery et al., (1980) report that the apocrine gland in the axillary region sweats freely in response to emotional stimuli. It is postulated that the sweating mechanism of the apocrine is under the control of the hypothalamus and the autonomic nervous system and is either triggered by adrenergic nerves or adrenaline (Evans, Smith, & Weil-Malherbe, 1956). Recently one clinician has written that, despite the apocrine glands' "close embryological relation to sweat [eccrine] glands, [they] are controlled by
are controlled by the sympathetic [thoracolumbar] centers of the central nervous system rather than by the para-sympathetic [craniosacral] centers" (Guyton, 1986, p. 691) ( [ ] within quote added for clarification).

The apocrine glands are localized in seven parts of the body--the axillary region, the external auditory canal, the eyelids, the anal area, the areola and nipple, and in the female, the labia minora, and in the male, the prepuce and scrotum. Their secretions vary according to their anatomical positions (Williams & Warwick, 1980). "The quantity of apocrine secretion is quite small, even in the axilla where the apocrine glands are most numerous" (Moschella et al., 1975, p. 50). "In the axilla, the glands become distended with a proteinaceous milky fluid containing various organic compounds including steroids" (Williams & Warwick, 1980, p. 1226). The apocrine glands develop in close association with hairs and hair duct-work systems. "Apocrine glands are tubular in form, having an extensive coiled secretory portion which may be up to two millimeters across in in larger examples, leading into a narrower straight secretory duct which runs parallel to neighboring hair follicles" (Williams & Warwick, 1980, p. 1226).

The apocrine glands differ from eccrine and sebaceous glands in that the apocrine are localized, appear after
puberty, are larger in the male than in the female, and show involutional changes related to each menstrual cycle in the female. Unlike the eccrine and sebaceous glands, which tend to be the same among members of different races, apocrine glands are more numerous in Negros than in Caucasians (Homma, 1926) and are larger in Blacks than in Whites (Doty, 1981; Hurley & Shelley, 1960; Moschella et al., 1975; Thomas, 1975). Orientals, on the other hand, lack apocrine glands in the axillary region almost entirely (Morris, 1985).

Odor intensity from the bacteriological reaction with the secretion from the apocrine gland is directly related to gland size (Doty, 1981). The transmission quality is affected by the quantity of surface area. Hair functions as a trap for apocrine secretions and thus provides a way of expanding the surface area for odor transmission (Doty, 1981; Morris, 1985).

Different opinions exist as to the odoriferous quality of apocrine sweat as it appears on the skin. Moschella et al. (1975) clinically report, "Within the duct, apocrine secretion is sterile and odorless" (p. 50). Leyden, McGinley, Holzle, Labows, and Kligman (1981) report that when the sweat appears on the surface of the skin it is both sterile and odorless. Williams and Warwick (1980) maintain that there is a "naturally occurring odour" (p. 1226). And Guyton (1986) writes, "The apocrine glands
secrete a thick, odoriferous secretion" (p. 691). All sources appear to agree that the cause of the odor is bacterial interaction with the apocrine sweat, but they seem to differ as to when the contamination begins. No information is offered on the speed of the bacteriological decomposition and odor development. In an informal, subjective, unpublished examination of this author's own axillary secretion, no odor was observed in fresh axillary secretion. Two samples produced under physical exertion (jogging in place) were collected from the axillary region on sterile 4 x 4 gauze pads. Each sample was placed in an airtight non-odoriferous container. One sample was left to sit at room temperature and the other was refrigerated. A recording sheet that had a scale from one (1) to fifteen (15) was used, with one (1) meaning no odor and 15 meaning repulsive. Each sample was examined every five (5) minutes for the first hour, every thirty (30) minutes for the next six (6) hours, and then every hour for an additional seven (7) hours. The sample left at room temperature (76°F) developed a nondescript odor at ten (10) minutes; a characteristic musky and urinous scent was noted at about 25 minutes and became stronger as time went on. After three hours the odor was clearly identifiable as body odor (no longer sweet), while after five hours the sample was subjectively rated as repulsive (rated at 15), and at 14
hours the odor was noted to be even stronger and extremely sour with a decaying smell. Holding a sample at a refrigerated state (about 39°F) slowed down the odor-producing process. At about one hour the nondescript odor noted at ten (10) minutes in the non-refrigerated sample was observed. At nine (9) hours the odor level recorded at 25 minutes was observed, and at 13 hours the odor level recorded for the room temperature sample at about one (1) hour was observed. These data should be viewed with great scepticism, but in the absence of research to the contrary, this information has some limited use and purpose.

The exact microflora that interacts with the milky colored apocrine secretion of protein and carbohydrates that provides the distinctive body odor have not yet been differentially isolated, but research has provided some significant clues. Two odorous steroids (androsterone and androstenol) have been detected and are considered important in contributing to the axillary odor (Bird & Gower, 1980). Leyden et al. (1981) have identified the resident microorganisms that, when allowed to interact with apocrine sweat are believed to aid in creating the distinctive body odor: a mixture of micrococcaceae, aerobic diphtheroids, and propionibacteria. In the Leyden study, the diphtheroids were identified and suggested as the most significant produce in the production of the typical body odor.
Little agreement exists as to the nature, form, and method of chemical communication in olfaction. Opinions range from the view that chemical communication is mediated through the organum vomeronasal (Jacobson's Organ) without the use of smell (a form of pheromone theory), to the idea that chemical communication can occur beyond the range of human smell and is processed through the olfactory mechanisms (odor theory—continuous plane; a form of pheromone theory), to the notion that chemical communication is the transfer of information through odor cues (learning theory). While some studies do not use the terms "odor transfer" in their examinations of olfactory communication (e.g., Graham & McGrew, 1980; McClintock, 1971; Quadagno et al., 1981; and others), others are based on the assumption that odor plays a part in the olfactory chemosensory communication process (e.g., Bloch, 1934; Doty, 1981; Fox, 1966; Hold & Schleidt, 1977; Owen, 1980; Parkinson, 1969; Porter & Moore, 1981; Russell, 1976; and others). The largest share of the current research stems from the premise that odor is or must be involved.

Organum Vomeronasal Chemosensory Reception. The vomeronasal organ has been the object of dispute since its identification in the early nineteenth century. Found in every mammal except the porpoise, it has been considered
by some to be a vestige, and by others to be the sensory receptor for pheromones. Its anatomical placement, just above the vomeronasal cartilage of Jacobson in the Nasal Septum (Ballenger, 1969), puts this organ in a logical site for chemoreception, but hard experimental evidence is not available. What exists is speculation. "Mammals ... which possess both the olfactory and Jacobson's organs together" present a research problem, in that these organs "are difficult to distinguish anatomically and functionally" (Burghardt, 1970b, p. 243). Rudolph (1980) reports on the works of psychologist C. Wysocki stating, The vomeronasal organ is "independent of the main olfactory system, both anatomically and neurologically.... Jacobson's organ ...has intimate nervous connections with the hypothalamus, which is the key regulator of hormonal and reproductive activities.... When ... experimentally interfered with,... behavior in animals is severely affected" (p. 108). V. Negus (biologist) is quoted by Rudolph as saying, "The bilateral organ in question is so beautifully designed that one cannot fail to ascribe a purposive function to it. It seems incredible that a carefully arranged system of specialized epithelium, with its own nerve supply, with numerous glands emptying into it and with a duct communicating to the exterior by a more or less devious route, should not play some important role in the animal economy" (Rudolph, 1980, p. 108).
Odor Reception. The theoretical approaches that deal with odor involvement in chemosensory communication in olfaction have established no common ground, for "there has never been general agreement about basic qualities of smell, though not for lack of effort. Plato had only two qualities in his scheme—'pleasant' and 'unpleasant'—while Aristotle, true to form, opposed his mentor and proposed seven qualities" (Ziporyn, 1982, p. 279).

No general agreement exists concerning the mechanism of smell. Two major viewpoints are reported in the literature: (1) odors are perceived in terms of primary scents, and mixtures of these scents establish the quality of the smell, and (2) odors are on a continuous plane (their exact variables still remaining to be identified) (cf. Amoore, 1963; Geldard, 1972; Gesteland, Lettvin, Pitts, & Rojas, 1963; Kalat, 1980; Schiffman, 1974; Tanabe, Iino, & Takaga, 1975; Zotterman, 1963).

Research associated with the "primary odor" theory has raised interesting questions concerning the role of olfaction in chemosensory communication. Amoore (1963) has been examining anosmic conditions, and has found there are certain individuals (about 2-3% of the population) who are unable to smell specific odors. This inability does not seem to effect the ability to smell other odors—a finding that tends to lend support to the primary odor theory.
Amoore has established that there are six odors which are fairly common for specific anosmia: musky, fishy, sweaty, urinous, spermous, and malty (cf. Amoore, 1967; Amoore, 1977). The odors that are identified are frequently associated with the reproductive process in mammals, which opens up an interesting line of inquiry. Amoore associates the "ability to smell" with the subject's ability to identify a specific odor. However, the extent to which chemosensory communication depends on cognitive smell recognition has not been established, and the need for an anosmic to "smell" an odor in order to "react" or gain biological information has also not been assessed.

From a physiological standpoint olfactory information is capable of influencing large areas of the brain, although the actual process is not understood. The structures of the olfactory system have been localized, yet no unanimity of opinion exists concerning the exact relationship of the olfactory system with various parts of the brain (Freeman, 1978). The olfactory rods and sustentacular cells line the mucous membrane located in the olfactory clefts at the top of the nasal cavity. The two olfactory clefts occupy an area of about 2.5 cm² each (Geldard, 1972); axons extend from the olfactory receptors to the olfactory bulb, on the lower surface of the brain. The olfactory bulb (also called the first cranial nerve)
is found in the ventral anterior aspect of the brain just above the cribiform plate through which project the fibers from the olfactory mucosa. These fibers synapse in the tangle of fibers in the bulb, which are termed glomeruli. Receiving the incoming fibers are two main types of cells: (1) mitral cells, which project to the prepyriform cortex along the lateral olfactory tract; and (2) tufted cells whose axons project via the medial olfactory tract to the septum (in humans the subcallosal gyrus) and to the contralateral olfactory bulb. Lying in the prepyriform and pyriform area and in the subcallosal gyrus is the olfactory cortex. The pyriform cortex communicates directly with the amygdala which lies beneath it. The subcallosal gyrus communicates with the cingulate cortex and, via the cingulum, with the hippocampus. Located in the septal area is the anterior terminus of the medial forebrain bundle, which runs through the hypothalamus and terminates in the limbic midbrain area. Throughout the length of the forebrain bundle interconnections and two-way communications are found (Illustration 5 & Illustration 6) (cf. Changeux, 1985; Gault, 1986; Geldard, 1972; Kalat, 1980; Lorenzo, 1963; MacLeod, 1971; Truex & Carpenter, 1969; Winson, 1985).
Illustration 5. Rhinecephalon ("Viscerl" Brain) and the Gyrus Cinguli:

FRONTAL

GYRUS CINGULI

PARIETAL

SEPTAL AREA

SUBCALLOSAL Gyrus (parolfactory body)

PAROLFAC'TORY AREA

OLFACTORY BULB

OLFACTORY TRACT

ANT. PERFORATED SUBSTANCE

LIMEN INSULAE

TEMPORAL

OCCIPITAL

A.

ARCHI- & PALEOCORTEX

MESOCORTEX (transitional)

NEOCORTEX

B.

OLFACTORY BULB

rostrum of corpus callosum

OLFACTORY TRACT

ANT. PERFORATED SUBSTANCE

LATERAL STRIA

MEDIAL STRIA

TRIGONE

INTERMEDIATE Olfactory STRIA

olfactory bulb

craniopharyngeal plate

olfactory membrane

olfactory cell & nerve

C.

amygdalae

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Panel A: Depicts the cortical types found in the limbic system. Note the distinction between Archicortex and Mesocortex. Archicortex has three layers, while Mesocortex has four or five, and Neocortex has six layers. The fewer layered cortices are considered more primitive in that they are found in animals who lack a Neocortex (e.g., amphibians).

Panel B: A ventral view of the brain showing the relationships of the various components of the olfactory system. The diagonal band forms a two way path between the septal area and amygdala.

Panel C: A lateral view of the lateral and medial olfactory systems.

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LATERAL OLFATORY STRIA

OLFACTORY BULB with mitral cells & glomeruli CERIBIFORM PLATE

OLFACTORY NUCOSA

CORPUS CALLOSUM

to hypothalamic nuclei

LIMEN INSULAE

AMYGDALOID NUCLEUS

PYRIFORM AREA

STRIA TERMINALIS

to preoptic nuclei

THALAMOCINGULAR FIBERS

ANT. COMMISSURA thalamus

HABENULO-PEDUNCULAR FIBER

interpeduncular ganglion

PEDUNCULOTEGMENTAL FIBER

PART of DORSAL LONGITUDINAL FASCICULUS

STRIA MEDULLARIS THALAMI

INTERMEDIATE OLFATORY STRIA

Habenular ganglion

dorsal tegmental nucleus

THALAMUS

MAMMILOTHALAMIC FIBER

uncus hippocampi

dentate gyrus

FERNIX

CINGULO-hippocampal fiber

BODY of RIGHT FORNIX

genu of corpus callosum

COLUMN of LEFT FORNIX

hippocampal commissure

CRUS of RIGHT FORNIX

anterior commissure

lamina terminalis

optic chiasm

hypophysis

left hippocampal gyrus

left hippocampal gyrus

Mary Loree

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Panel A: Presents a diagram of the Lateral Olfactory System. The primary olfactory nerves are located in the olfactory mucosa located in the top of the nasal cavity just below the cribiform plate through which they send fibers into the Olfactory Bulb (OB). The OB is known as the first cranial nerve (N-I) although it is actually a projection of the brain tissue.

In the OB the nerve fibers enter spherical tangles of fibers known as GLOMERULI (singular glomerulus) where they synapse either with Mitral Cells (they resemble a Bishop's Mitre) or tufted cells.

Mitral cell axons pass centrally via the Lateral Olfactory Tract in which they might synapse or pass directly to the pre-pyriform cortex and the centro-medial portion of the Amygdala. The principal outflow of the amygdala is the Stria Terminalis which projects to the hypothalamus.

Panel B: Presents the Medial Olfactory Tract (MOT) which carries the axons of tufted cells to the Septal area and to the Anterior Commissure be which means some fibers pass to the contralateral OB. The Stria Medularis Thalami projects from the septal area to the Habenular nuclei which in turn projects caudally via the Habenulo-interpeduncular tract to the Dorsal Longitudinal Fasciculus (DLF). The DLF also carries a major portion of the descending fibers from the Hypothalamus.

Panel C: Depicts the connections of the hippocampus. The major outflow of the hippocampus is via the Fornix which forms a large sweeping loop which passes downward just behind the Anterior Commissure with some fibers terminating in the Septal Area and some in the Mammillary Bodies (MB). The MB project to the Anterior Thalamus which in turn projects to the hippocampus via the Cingulum (Cingulo-hippocampal).

Panel D: Depicts the relationships of the Fornix. The principle difference between this illustration and Panel C is the inclusion of the hippocampal commissure which interconnects the right and left hippocampus.

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Physiological Response, Stress, and Emotion

The suggestion that the limbic system plays a role in the modulation of motor activity, behavior, and emotional bias is important in relation to questions of the purpose and need for physical response patterns from external stressors and internal emotions. The theoretical construct that states that the "purpose of physical response" arises from the need for "life to be adaptive" has been pondered and discussed since Hippocrates (ca. 370 B.C.), and advanced through the centuries by many (cf. Bernard, 1879; Cannon, 1939; Darwin, 1890; May, 1950; May, 1977; Selye, 1952). Bernard (1879) goes so far as to distinguish life from inanimate objects by its adaptability to change. Fredericq in 1885 clearly links the "adaptation process" to purpose when he writes, "The living being is an agency of such sort that each disturbing influence induces by itself the calling forth of compensatory activity to neutralize or repair the disturbance" (cited in Goldberger & Breznitz, 1982, p. 8). Cannon (1939) advanced this concept of adaptation by coining the term "homeostasis" (from the Greek homoios and and stasis, literally "similar state"), which can be defined as a need to maintain position and balance.
Stress

The interrelationship between stress and physical response has long been studied, yet the scientific concept of stress "has suffered from the mixed blessing of being too well known and too little understood" (Selye, 1980, p. 127). Selye (1956) has defined stress as the "nonspecific response of the body to any demand". He includes both physical stressors, such as heat, cold, muscular exertion, drugs and hormones; and emotional states, such as sorrow and joy (Selye, 1980). He reports that these agents have a common function: "They increase the demand for readjustment, for performance of adaptive functions which re-establish normalcy" (pp. 127-8). Selye (1946) identified a syndrome with which he could explore and examine the entire adaptation process in scientific terms. He called this the General Adaptation Syndrome (G.A.S.), and distinguished three stages within it: (1) Alarm reaction—the response of an organism to a sudden stimulus to which it has not been previously adapted; (2) Stage of Resistance—the adaptation of an organism to a stimulus; and (3) Stage of exhaustion—the breakdown of an organism due to its inability to continue to adapt to a stimulus (see Selye, 1946; Selye, 1952). May (1977) cautions that Selye's G.A.S. is appropriate to physiological behavior, but not
to psychological function. May questions the tendency for psychologists to use stress as a synonym for anxiety. He writes, "I do not believe 'stress' encompasses the rich meaning of anxiety" (p. 110). In reviewing Selye, May's argument does not appear to make any logical sense. Selye's use of terms denoting emotions to designate stress agents, and May's interpretation that emotional states are closer to anxiety states than to "stress" is certainly problematic, since May goes on to say that he is unwilling to define emotion. Three states of "being" related to adaptation have been differentiated in common usage—stress, emotion, and anxiety—and to reject the notion of stress because many psychologists use the term incorrectly, as May suggests, seems too hasty a response to the difficulty.

Emotion

The fact that there is a relationship between the physical and the emotional is self-evident, yet its nature has not been understood. Much of the confusion stems from problems in defining emotion. To date no clear and acceptable definition has been established.

It has been demonstrated that emotional responses play an important role in human physiological response patterns, whether as a result of a psychological
predisposition (Darwin, 1890), or an emotional predisposition affecting the healing process or thermo-regulatory function of the body in the recovery of an injury (Sampson, 1984). In all cases the concern is intra-organistic rather than inter-organistic.

Several theories attempt to deal with the basic question of emotion and physical response. Two theoretical approaches in particular have grown in popularity, a mechanical and a neuro-biological theory. These positions are presented in the forms taken by (1) the theory developed by James (1884), and (2) the theory developed by Papez (1937), and later refined by MacLean (1958).

James-Lange Theory: James (1884) suggested that behavior changes and body function changes cause emotions. That is, there is a directional correlation between the body's physiological presentation and emotions. About one year later, K. Lange independently published a similar position paper (Kalat, 1980). Both men were treating a theme in vogue at that time. It was not surprising that a number of writers dealt with the issue. Eight years earlier Maudsley (1876), presented a similar theory that showed the strong relationship between emotion and behavior, writing, "the emotion is intensified and made definite by the bodily action". Influenced by Maudsley's work, Darwin (1890) supported this thinking, and writes,
"He who gives way to violent gestures will increase his rage....These results follow partly from the intimate relation which exists between almost all the emotions and their outward manifestation" (p. 382).

Cannon (1927) disputed this theory, pointing out that several emotional states obtain the same physical responses (heart rate, body temperature, breathing, blood sugar level, etc.). Cannon defined the physical response pattern for a specific emotion, replicated the pattern artificially and then questioned the subject. Each of his subjects reported only arousal, and no emotion, unless they were in some special setting. Cannon's criticisms were not conclusive, however. Carlson (1981) writes, "More recent evidence shows that Cannon underestimated the sensitivity and complexity of afferent feedback from the visceral organs....It is a common assumption that the expression of emotional behavior is synonymous with feelings of emotion. However, this is not always the case" (p 505); in addition Cannon appeared to underestimate the importance of the physical setting in establishing an emotion, even though he made a direct reference concerning setting.

Papez-MacLean Theory: Papez (1937) postulated that emotions depend on a circuit of structures near the "brain center" (limbic system). "Papez proposed that the limbic system constituted a neuroanatomical substrate for emotional behavior. This speculation was based largely upon
the alterations in emotional behavior subsequent to limbic system damage" (Gault, 1986). Papez suggested that the "brain center" would send impulses to the cerebral cortex and thus add "feeling tones" to the actual cognition. For Papez, emotions were the product of processing three "streams" of input: (1) movement, (2) thought, and (3) feeling. Papez believed that these three "streams" were divided by the thalamus, and were then processed through a circuitry that eventually united in the cerebral cortex.

MacLean (1958), refined Papez's theory to take into account current understanding of the structure of the human brain, distinguished by the interrelationship of three structures: (1) the reptilian brain, in control of reflexive and vegetative behavior; (2) the limbic system, in control of emotional behaviors (note: it is MacLean who has been referenced as referring to the limbic system as being involved in the "Four 'F's of Survival--Feeding, Fleeing, Fighting, and Reproduction" (Gault, 1986)); and (3) the cerebral cortex, in control of intelligent and rational behaviors.

Summary

The suggestion that the limbic system plays a role in chemosensory communication seems to require the adaptation process of at least two specific stimuli, stress and emotion. For our purpose, we can define stress most simply as
an external stimulus making demands on the homeostasis process, and emotion as an internal stimulus making demands on the homeostasis process, with both processes (stress and emotion) most likely being modulated by various parts of the limbic system (Carlson, 1981).

Selected Studies

Animal Studies

The ability of animals to communicate basic biological and social information through olfactory cues is well established. What is communicated includes information pertaining to the subspecies (cf. Epple, 1974; Otte & Cade, 1976) and the individual (cf. Hudson & Distel, 1983; Kallquist & Mossing, 1982), as well as territory (cf. Calhoun, 1962a; Calhoun, 1962b; Christian, 1961; Wynne-Edwards, 1962), social status (cf. Thiessen & Rice, 1976; White, Fishcher, & Meunier, 1984), gender (see Whitten & Bronson, 1970), recognition of environmental status (e.g., safety, general frustration, recent kill, etc.) (cf. Calhoun, 1962b; Feldman & Conforti, 1980; Gabba & Pavan, 1970; Hall, 1966; Hediger, 1955; Hediger, 1950), emotional state (cf. Carr, Roth, & Amore, 1971; Schultz & Tapp, 1973; Sprott, 1969; Valenta & Rigby, 1968), and hormonal conditions, including sexual receptivity in females (Epple, Golob, Cebul, & Smith, 1981; Freeman,
1978) producing a reproductive priming activity on the part of males (Bronson, 1974; Cheal, 1975; Mykytowycz, 1970).

Animal studies reveal limited mechanisms that would enable us to determine whether the biological information transmission is associative learning or a pheromone phenomenon (no prior learning); however, "memory function," which suggests that in some cases associative learning may play an important role, has been observed. Bertrand (1969) reports that in some primates, kin recognition from sixty (60) meters away after a year of absence has been noted; Bertrand in 1971 writes, "Un singe capable de reconnaître un congénère ou un observateur à plus de soixante mètres, et après un an d'absence, s'obstinerà à le flairer dès qu'il sera en contact avec lui" (p. 29).

The media for information transmission appear to fall into three categories: (1) urine marks—a complex scent mark consisting mainly of the secretion of special circumgenital skin glands and some urine (cf. Doty & Dunbar, 1974; Epple et al., 1981; Kessler, Harmatz, & Gerling, 1975); (2) skin secretions—odors produced by sweat (most likely apocrine) glands and deposited on the skin surface and interacting with skin bacteria (cf. Sawyer, 1980; Sprott, 1969; Thiessen & Rice, 1976; Thomas, Riccio, & Myer, 1977; Valenta & Rigby, 1968); and (3) bloodmarking—
alterations in the blood chemistry that, when spread through a kill, leave an odorous message (see Feldman & Conforti, 1980).

Thomas, Riccio and Myer (1977) have shown that these olfactory cues are "time bound." Their study focused on avoidance response memory (Kamin effect) in rats to a specific fresh stress produced odor cue and an old stress produced odor cue (produced six hours previously). Rats tested in the presence of the aged odor produced a less pronounced avoidance response than did rats tested in the presence of fresh odor.

Animal—Human Studies

Studies have shown that animals are able to utilize their olfactory abilities and receive biological information from other species, including humans. Data on the scope of biological information received by animals from humans is limited, however. Individual scents, emotional states and territory are three areas that have been identified (cf. Kalmus, 1955; Lorenz, 1955; Schmid, 1935; Smith & Sines, 1960; Smith & Thompson, 1969; Wynne-Edwards, 1962).

The works of Schmid in 1935 and Kalmus in 1955 have shown that dogs are able to identify specific humans through scent cues provided by clothing worn by a
particular individual. The use of tracking dogs has long been recognized as an effective method of locating a specific person. Experimental studies (cf. Bradley, 1984; Brass, 1970; Liddel, 1976; Parkinson, 1969; Smith & Sines, 1960; Smith & Thompson, 1969) and empirical observation have suggested that different emotional states in humans are detectable by non-human mammals. Smith and Sines (1960) reported that rats readily distinguish between the smell of schizophrenic and non-schizophrenic patients. Animal capacity to detect the territory of a human has long been noted (cf. Lorenz, 1955; Wynne-Edwards, 1962). In the book Never Cry Wolf, a study on the behavior of wolves, the author (Mowat, 1984) reports that he staked out his territory by marking the perimeter of his campsite with his urine. The wolves respected the markings and remained outside the marked territory.

There are few studies that examine human response to animal biological information transmission. Only one study was found, in which human response patterns were examined when subjects were presented 5-alpha-androst-16-en-3-one (androsterone) produced by Sus Scrofa (Pig) (Filsinger, Braun, Monte, & Linder, 1984).

In the Filsinger et al. study (1984), subjects (98 males and 102 females) were assigned to one of four odor conditions (androsteone, methyl anthranilate, skatole, and
a no-odor control. Photographs of a male were used as the stimulus. Each subject was asked to rate the photographs and rate their mood in the presence of one of the odors. Subjects who were presented 5-alpha-androst-16-en-3-one from Sus Scrofa responded in a significant fashion that was attributed to the compound, and differently to the other substances/odors. "Males in the androsterone condition rated the stimulus male photographs as more passive, and females in the androstone condition rated themselves as less sexy" (Filsinger et al., 1984, p.221).

**Human Studies**

A limited number of studies that examine the relationship of chemosensory communication in humans and physiological response patterns to airborne compounds exist. They appear to fall into four categories: (1) chemosensory transmission of biological information which is not dependent on odor, (2) chemosensory transmission of biological information dependent on smell, (3) clinical studies concerning excited hyper-dopaminergic states, and (4) physiological response patterns to non-biologically produced inhalants (Odorous and non-odorous).

**Studies Not Dependent on Smell**

Studies concerned with response patterns to olfactory stimuli are limited, and their focus is either on mood
alteration and performance effects (cf. Benton, 1982; Cowley, Johnson, & Brooksbank, 1977; Kirk-Smith, Toller, & Dodd, 1983), or menstrual synchrony (cf. Graham & McGrew, 1980; McClintock, 1971; Preti et al., 1984; Quadagno et al., 1981; Russell, Switz & Thompson, 1980). Several studies concerned with behavioral response patterns have used compounds present in human axillary secretions, or the secretion itself. Most attention has been given to 5-alpha-16-en-3-one and its related alcohol (androstenol).

**Mood and Performance Effects**: Cowley, Johnson, and Brooksbank (1977) had subjects conduct a mock job interview while wearing paper surgical masks impregnated with either a mixture of fatty acids (found in the vaginal secretions of primates), or androstenol (5-alpha-16-en-3-one), or with no substance (clean mask). Results suggested that the masks with the impregnated preparations influenced the assessments made by females interviewers, yet did not significantly affect the assessments made by male interviewers. The female interviewers wearing the masks impregnated with the fatty acids gave opposite evaluations of the job candidates than interviewers wearing masks saturated with androstenol. "The androstenol is associated in a direction which is opposite of the fatty acid mixture. A favorable assessment in the presence of the androstenol is accompanied by a less favorable assessment in the presence
of the fatty acid mixture" (Cowley, Johnson, & Brooksbank, 1977, p. 170).

Benton (1982) reported that 18 female subjects rated their mood daily for a month. Each morning subjects placed either 5-alpha-16-en-3-alpha-ol (androstenol) or a placebo on the upper lip; each evening the subjects would rate themselves on five scales: (1) submissive/aggressive, (2) happy/depressed, (3) lethargic/lively, (4) sexy/unsexy, (5) irritable/good-tempered. The results of the records for four of the five scales were not significant. The scale that did show significance was the submissive/aggressive scale; subjects exposed to androstenol tended to rate their moods as more submissive than aggressive.

A specific study to note under the sub-section of Mood and Performance Effects does not deal with androstenone, rather it is a study that deals with ease of aversion conditioning through pairing a neutral airborne medium with a mildly stressful task. Kirk-Smith, Toller, and Dodd (1983) found that aversion conditioning by pairing a low intensity neutral odor (trimethylundecylenic aldehyde (TUA)) with a mild stress condition was easily obtainable. Two groups, of twelve females each, were given "a stressful task involving the completion of 11 WAIS Block Patterns" (abstract) under a time limitation (*Note: the Wechsler Adult Intelligence Scale (WAIS) Block Design
subtest contains only ten design pictures, it is uncertain if the authors created an eleventh design or if the report was in error). One group engaged in the stressful task in the presence of low level TUA, the other group engaged in the same stressful task in the absence of TUA. Several days later both groups were asked to complete a mood rating scale and then enter a room where a low level of TUA was present. Once in the room the subjects were asked to evaluate a series of photographs and then complete a second mood rating scale. Subjects that had experienced the stressful condition in the presence of TUA reported a greater anxiety level on the mood rating scale following the photograph judging. It was reported that the subjects did not perceive any odors during the experiment. Findings "demonstrate how odors might acquire values through pairing with emotionally significant events" (abstract).

Menstrual Synchrony. That physiological response patterns can be altered through the presence of an olfactory medium has been shown in studies concerned with menstrual synchrony. McClintock (1971) was the first to report that a dominant female will affect the menstrual cycle of other women living with her.

Russell, Switz, and Thompson (1980) reported that they were able to shift the menstrual cycle of a group of women subjects by using the axillary secretion of a single
donor over time. Two groups were employed, a treatment group and a control group. The treatment group rubbed alcohol and axillary secretion (from a single donor) on their upper lip. The menstrual cycles of the women in the treatment group began to modify in conformity to cycle of the donor subject. Although Russell, Switz, and Thompson concluded that odors produced from the axillary secretion of one woman may influence the menstruation of another, they also acknowledge that it may have been the non-odorous properties of the stimuli that induced menstrual synchrony.

**Studies Dependent on Odor**

Studies on gender recognition, family recognition, and emotional and physiological response patterns are considered below. In addition to work focusing on olfactory cues produced by skin secretions (e.g., Hold & Schleidt, 1977; Porter & Moore, 1981; Russell, 1976; Schleidt, Hold & Attili, 1981), researchers have examined responses to breath odor (Doty et al., 1982) and breast milk (Russell, 1976); the Doty study and Russell study will be examined below.

**Gender Recognition:** Several experiments have attempted to determine to what extent humans are able to identify gender via olfactory cues (cf. Doty et al., 1982; Hold &
Russell (1976) had 29 subjects (16 males, 13 females) not use body deodorant for twenty-four hours prior to the study, and then wear white undershirts for a twenty-four hour period. Following the time period, each subject was given a three-choice discrimination test where he/she was asked to examine three undershirts and indicate which shirt was his/her own, which was a strange female, and which was a strange male. Russell reports that 13 of the 16 males and 9 of the 13 females answered correctly.

Hold and Schleidt (1977) conducted a similar experiment with twenty-four married couples, which produced less convincing results than those of the Russell (1976) study. The subjects wore cotton undershirts for seven consecutive nights. During the test period each subject was allowed to smell each of the groups' shirts (10 shirts) on three occasions. Only one third of the subjects were able to identify their odor or the odor of their partner correctly and only about one third were able to identify the correct gender of the donor. The Hold and Schleidt study reported that both sexes involved more often rated odors that were subjectively considered pleasant "female" and odors that were subjectively considered unpleasant "male," regardless of the actual gender of the donor.

Doty et al. (1982), studying the communication of
gender from human breath odors, recorded observations similar to those of Hold and Schleidt in regard to subjective responses of pleasant versus non-pleasant. Their findings suggest that subjects assign weaker and less unpleasant odors to the female category and stronger and less pleasant odors to the male category. Nonetheless, the assignment of correct gender by the subjects was at a frequency greater than chance (females seemed to be more accurate in regard to the gender assignment). During five consecutive days five men and five women sampled breath odors from 14 males and 19 females (the donors were on a "no oral hygiene" regimen). The donors sat behind a plywood barrier in a well-ventilated room. The evaluation took place between 07:00 and 09:00. The subjects were asked to assess the gender of the donor and the relative (subjective) intensity and pleasantness. The authors suggest that differences exist between the breath of males and females, and that humans are able to assess gender from oral odors.

A cross-cultural study by Schleidt, Hold, and Attili (1981) showed that gender identification varied according to culture and race, or at least the concept of "pleasant" and "unpleasant" differs. Italians, Germans, and Japanese were studied. The ability of each group to identify gender successfully was as follows: Italian subjects--20%; German
subjects—30%; and Japanese subjects—60%. Across culture, 80% of the subjects were able to identify their partner's odor. Cultural differences were also noted in the rating of odors as pleasant and unpleasant. Italian, German, and Japanese men rated their partner's odor as being pleasant. Italian and Japanese women, on the contrary, rated their partner's odor as unpleasant, while German women rated their partner's odor as pleasant.


Russell (1976) reported that 60% of the infants that he studied were able to distinguish their mother's milk from that of another donor or raw cow's milk by the age of six weeks. In Russell's simple study, ten full-term breast-feeding neonates and their mothers were employed. The infants were exposed either to a clean breast pad, their own mother's breast pad, a strange mother's breast pad, or a pad with raw cow's milk. The neonate's pattern of orienting and sucking was examined and recorded. At two days old, the infants showed general arousal when exposed to milk; at six weeks, six (6) of ten (10) could discriminate their mother's milk through odor.

In a cross-cultural study reviewed under "Gender
Recognition" above, Schleidt, Hold, and Attili (1981) reported that 80% of the subjects were able to identify their partner's odor.

Porter and Moore (1981) report that family members are able to identify correctly other family members through olfactory cues, and that mothers are able to distinguish between children through the same olfactory cues. In this unique study the researchers examined familial recognition using children from a family unit. The study consisted of each child wearing an undershirt; then the undershirts were examined by siblings and mothers. The author's abstract reported, "T-shirts worn by individual children were correctly identified by the siblings and mothers of those children through olfactory cues alone. Parents correctly distinguished between the odors of otherwise identical shirts worn by 2 of their own children".

**Emotional Response Patterns.** Studies concerned with emotional response patterns to human olfactory stimuli are uncommon. In fact, only one study could be found: a doctoral dissertation by Owen (1980), reported later by Owen and Lawlis (1981).

Owen (1980) assessed the imagery of subjects who smelled axillary secretions produced under different emotional states (relaxation, anxiety, sexual arousal). Her study produced mixed results in the subjects' ability to
identify, through imagery and through the judge's perception of pleasantness, the different emotional state-related secretion. Owen stated that her judges were able to detect the anxiety-producing odorant of her Black donors differentially on an unpleasantness scale; and were able to detect anxiety and relaxation on a "free imagery" task. Four donor subjects, two Black and two White females, were employed. Each subject was prepared for axillary secretion collection by washing her underarm with Ivory Soap (contents: tallow (lard), coconut oil, perfume, preservatives). Following the washing a four inch square gauze pad was taped to the underarm area of the left arm. A pad was worn throughout each image induction that was reported to produce the intended emotional affect. Following the image induction the gauze pad was removed and placed into a clean 30 ml test tube and covered with two (2) clean gauze pads; four (4) drops of ethenol were placed on the pads in the test tube to slow down bacteriological decomposition, and then the test tube was corked, wrapped in aluminum foil and frozen on dry ice. This procedure was repeated for each donor and under each image induction task. Sixteen white male subjects were asked to evaluate the twelve samples. Four judges were assigned to each donor subject's axillary samples. The judges were given instructions to relax and to report any immediate images, feelings, and sensations they might ex-
experience following smelling each odor sample; this free imagry task lasted for two minutes per sample. Following the free imagry task a second phase "required the 16 judges to make magnitude estimates of the hedonic quality of each odor sample. Judges were asked to rate how unpleasant each test tube odor smelled" (p. 39).

**Hyper-Domaminergic States**

Hyperosmia has been noted in clinical literature. The intensification of the sense of smell has been associated with excited hyper-domaminergic states, as with some post-encephalitic patients on L-Dopa, and some Tourette Syndrome patients. It has been debated whether these "hyperosmic states" are an intense olfactory hallucination or delusion, or a true generalized intensification of smell. The following is a case study that supports a belief of true hyperosmia.

The physician of record is a neurologist, O. Sacks; Sacks (1985) reports of a 22 year old male medical student who sustained a temporary state of hyperosmia. Hyperosmia was a result of the use several different drugs (cocaine, phencyclidine & amphetamines); the intensification of smell lasted for about three weeks. Sacks (1985) reports that the subject could distinguish his friends and the patients he (the subject) attended by smell alone; this
neurologist goes on to state that his patient informed him, "I went into the clinic, I sniffed like a dog, and in that sniff recognized, before seeing them, the twenty patients who were there. Each had his own olfactory physiognomy, a smell face" (p. 150). As commentary Sacks writes, "He (the patient) could smell their (friends and patients) emotions--fear, contentment, sexuality--like a dog. He could recognise every street, every shop, by smell--he could find his way around New York, infallibly, by smell" (p. 150).

**Inhalants and Physiological Response**

The literature is scanty concerning the differential responsiveness of physiological activity from different non-human odorous compounds. Yet, limited as they are, studies have shown that muscle activity, body movement, respiration, and heart rate can be differentially affected by exposure to different odorous compounds (cf. Anderson, 1954; Engen, Lipsitt, & Kaye, 1963; Komisaruk, 1974; MacLeod, 1971; Schwartz, 1979; Self, Horowitz, & Paden, 1972; Steiner, 1974) and empirical literature suggests that different odorous compounds can elicit strong memories (Fenchiel, 1945; Freud, 1930; Jung, 1934).

Engen, Lipsitt, and Kaye (1963), Steiner (1974), and Self, Horowitz, and Paden (1972) in studying newborn
humans have shown that different patterns of response are elicited by different odorous substances introduced to the neonate. The scope of reaction seems to be on the continuum of "pleasant" to "unpleasant." Bananas and vanilla evoked positive responses, while odors of shrimp and rotten eggs elicited adverse responses from the neonates (Steiner, 1974). Habituation to novel odorous stimulus has been explored, and habituation seems to occur with some odors, but not with others (cf. Engen, Lipsitt, & Kaye, 1963). These types of olfactory communication studies seem to suggest some type of rapid neuro-recognition association process, with the proposed limbic system involvement affecting the endocrine system (Freeman, 1978).

Physiological changes directly concerned with non-odorous inhalants have also been examined in the literature, but these studies have been confined to circulatory system involvement. Carbon monoxide, for instance, is known for its toxic effect on the human system, but the toxic effect is predicated on the percentage of carboxy-hemoglobin in the blood (Berkow, 1977); it is not suggested that olfaction and limbic system involvement are associated with the physiological reaction, per se, but rather the nasal cavity acts only as point of entry for the toxin. It is totally unclear what, if any, immediate olfactory system-to-limbic system involvement there may be.
Commentary on the Research and its Potential Pitfalls

Some of the work reviewed above must be accepted with reservations because of methodological limitations (e.g., questionable sample collection in Hold & Schleidt, 1977 and Owen, 1980; lack of a single or double blind in Russell, 1976; failure to use "neutral" control odor in Cowley, Johnson & Brooksbank, 1977). Moreover, studies that use smell as a mechanism for gender and kin identification must be accepted with caution, since human odors are altered by food intake, and one would suppose that families would eat similar food products. The conclusions of these studies could be seen as an artifact of familial and/or culturally biased eating styles.

In reviewing the literature, two key problems seem inherent in the nature of research into chemosensory communication via olfaction among humans: (1) the effects of external factors on human excreta and (2) the definition of the concept of chemical communication. Both areas are examined below:

Effects of Specific Factors on Human Excreta

"Literally thousands of volatiles, many with odors, are excreted or secreted from the human body. These chemicals reflect, in varying degrees, (a) environmental factors (e.g., chemicals in the air, drinking water, diet,
drugs, and personal hygiene products) and (b) organismal factors (e.g., the individual's gender, reproductive state, race, age, health, exercise schedule, hygiene and emotional state" (Doty, 1981, p. 359). Almost every normal life activity affects them. These volatiles are excreted or secreted from many bodily sources, and include sweat (see Sastry et al., 1980).

Individual physiology and emotional states are suspected to have significant impact on odor differences (Doty, 1981; Owen, 1980; Owen & Lawlis, 1981; Sastry et al., 1980). Kuno (1956) reports on anecdotal and empirical evidence indicating that humans give off species-specific odors, and that the quality and quantity of odor production varies among individuals. Montagna (1962) states that the quality and quantity of odor production has recognizable racial differences, and physiological differences are noted in the apocrine gland of the different races (Doty, 1981; Morris, 1985; Thompson, 1973). As for differences that can be attributed to emotional states, research done by physicians studying patients institutionalized in mental hospitals (Bradley, 1984; Brass, 1970; Liddell, 1976; Smith & Sines, 1960; Smith & Thompson, 1969) suggests the odor of psychiatric patients differs in quality and quantity from that of the "normal" population.

The role of external factors must be taken into consideration in evaluating the results of the studies dis-
cussed in the preceding section of this chapter; both ex-
ternal factors that constrain the subject, as well as ex-
ternal factors placed on the experiment by the researcher
must be taken into account (investigator experimenter ef-
facts; Barber, 1976). Russell's experiment on neonate re-
sponses to mother's milk (1976) did not include monitoring
the mothers' food intake; thus there is no way to deter-
mine the effect of dietary habits on milk recognition.
Similarly, in Doty's 1982 study on gender recognition from
breath, the donors' food and drug intake was not reported;
thus the precise effects of these factors cannot be ascer-
tained. Hold and Schleidt (1977) collected their sample
over a fifty-six hour period, in eight hour intervals,
with sixteen hour breaks between the eight hour collection
periods; a question of when a sample becomes rancid due to
bacteriological decomposition was never addressed, thus
confounding the results. Owen's study (1980) presents such
a wide variety of potential problems that her study must
be reviewed with great skepticism; first, Owen arbitrarily
collected her samples from only the left axilla—no
studies are available to allow researchers to accept as
axiomatic that humans sweat differentially, based on neur-
ological dominance or any other factors; second, Owen had
her subjects wash their axillary area with a soap made up
of tallow (lard), coconut oil, perfume, and preservatives,
substances known to leave a heavy scum—sample contamina-
tion; third, Owen used ethenol directly on what she stated was apocrine gland secretion to slow bacteriological decomposition—ethenol has its own smell and is known to break down carbohydrates, a structure known to be present in apocrine gland secretion; and fourth, Owen froze her sample on dry ice for later use—freezing will denature (shatter) protein molecules, a structure known to be present in apocrine gland secretion.

Definitional Problems

The terms "chemical communication," "chemosensory communication," "animal communication," "pheromonic communication," etc. have become popular in discussions of research concepts, yet in their presentations researchers often act on the assumption that everyone "intuitively knows what communication is." This vagueness renders their conclusions almost meaningless. While attempting to develop an understanding of these terms, Burghardt (1970a) soon discovered that he was confused, and that many other researchers faced the same difficulty. He writes, "I rapidly approached the point where 'animal communication' seemed merely one of the latest 'in' or 'vogue' fields labeled with a phrase which very well might turn out to be meaningless in the sense of being a scientifically valid or useful concept" (p. 6). There have been several efforts
to resolve this problem of definition; some of the more significant attempts are offered below:

**Discrimination.** The proposal that communication "is the discriminatory response of an organism to a stimulus" (Stevens, 1950) is probably the most elementary definition we have. This view presupposes that the recipient is able to discriminate on some level, and therefore, according to Burghardt (1970a), communication is the same as "stimulus control".

**Information Transfer.** Communication is defined as the "transfer of information from one carrier to another" (Batteau, 1968). This idea focuses on the recipient's ability to perceive stimuli from the environment and react and/or respond to it. A basic problem emerges, however, for in the terms of this definition, seeing a tree and walking around it would constitute "communication." Others have attempted to refine this basic concept by establishing restrictions. For example, the Organism Restriction states that two organisms must be involved in either the stimulus control or information transfer (see Scott, 1968). Animal Restriction extends the restriction to include a stimulus arising from one animal and eliciting a response in another (see Scott, 1968). Further restrictions have also been made on the extension, in the suggestion that the information transfer must occur between species members (see Frings & Frings, 1964; Sebeok, 1968).
Yet despite these alterations to the basic theory, the same concern as to the scientific meaning of the term "communication."

Levels of Communication. Tavolga (1968) attempted to resolve the problems arising from the Information Transfer theory by defining communication, implying that since the complexities of different organisms suggest different needs, caution should be taken in attempting to offer a single definition. Instead he proposes a hierarchical definition comprising the following levels of interorganismic interaction: vegetative, tonic, phasic, signal, symbolic and language; of the six levels of interorganismic interaction, only the last three are said to be communication. Within the last three levels presented an interaction between two organisms are implied with the emitter possessing a specialized stimulus producing mechanism, the stimulus occupying a narrow portion of the connecting pathway or spectrum, and the receiver possessing a specialized receptor so as to respond in a specialized fashion.

The problem of definition is further compounded by the tendency, seen in the Information Transfer model and Levels of Communication View, to refer to or presuppose the construct of "chemical communication."

Pheromonic Concept. The term "pheromone" implies the concept of chemical communication. Pheromones are sub-
stances used by an organism to relay biological information among members of the same species. Learning and/or prior experience with the odoriferous substance seem to play no part in the efficacy and potency of the compound. Implied in this concept of chemical communication is that the transfer of information does not rely on the sender nor the receiver, but rather maintains some adaptive value (Freeman, 1978).

**Multi-criterion Approach.** Lorenz (1965), Skinner (1966), and Klopfer and Hatch (1968) stipulate that no one definitional criterion is sufficient to describe chemical communication, since communication of this type is a product of natural selection. Klopfer and Hatch (1968) suggest behavior must be evolutionarily adaptive, and that for chemical communication to take place, it must be used by an organism to relay biological information in such a way that the survival value and reproductive success of the organism must be enhanced. The major distinction between Lorenz (1965) and Skinner (1966) is whether the process of chemical communication is "innate" or "learned."

**Summary.** The underlying assumptions regarding the nature of "communication" found in the theories presented under the heading of Definitions vary, except to the extent that it can be said that communication relies on the "intent" of an organism to impart information. Efforts to
clarify the terminological muddle have resulted in further specifications (e.g., the intent must be evolutionarily adaptive and does not necessarily have to be conscious/intentionally aware). Certainly, studies of non-verbal behavior have clearly demonstrated that species transmit information unconsciously/unintentionally aware (cf. Knapp, 1978; Mehrabian, 1969; Morris, 1977; Scheflen, 1973). To attempt to resolve the definitional problems related to the concept of chemical communication is beyond the scope of this review. The purpose here is to present the confusion as it currently exists and present a temporary definition that will suit the needs of the research study which will be presented in the chapter to follow. For the purpose of the study to follow, chemical communication will be defined simply as the act of discrimination, be that discrimination cognitive or physiological.

Summary

The importance of olfaction as a method of chemosensory communication is well established for animals and has been strongly suggested for humans. It has been clearly and systematically demonstrated that most animals can determine a variety of information from body odor. However, the research on humans has yet to explore many of
these areas. Despite the limited extent of the research on odor communication in humans, the work that has been done suggests that humans may have the potential for communicating basic biological information via olfaction, such as family recognition, gender recognition, and emotional state recognition. Folk beliefs in modern England and ethnographic reports from a variety of cultures indicate that many societies believe that human odors from excreta reveal information about others and have the power to alter the emotional state of another individual. Such anecdotal material is useful in scientific study, as it offers limits to this as yet largely unstudied communicatory potential.

Transmission of these olfactory cues in both animals and humans appears to occur via a number of forms, such as breath, urine marks, blood marking, and skin secretions. These cues are "time bound," and may change in potency, efficacy, and purpose over time.

Among humans, research suggests that skin secretions are the primary source for information transmission via olfaction. They have three main origins: (1) eccrine sweat glands; (2) sebaceous glands; and (3) apocrine sweat glands. Each gland produces a different secretion, with the apocrine gland secretion identified as a likely source of body odor. The function of the apocrine glands is unclear; unlike the case for many mammals, the apocrine
gland in humans does not appear to serve a thermoregulatory function and seems to excrete maximally during stress conditions.

No general agreement exists about the precise nature of smell. Two major viewpoints are reported in the literature: (1) odors are perceived in terms of primary scents, and mixtures of these scents establish the quality of the smell; and (2) odors are on a continuous plane (the exact variables as yet unidentified). Despite confusion as to the actual nature and mechanism of information transmission, the structures of the olfactory system have been localized. But no unanimity of opinion exists concerning the relationship of the olfactory system and various parts of the brain. The suggested thalamic connection to the neocortex raises the possibility of greater complexity and association with other stimulus events than older anatomical evidence would have implied.

Further problems in the field are due to a lack of agreement among researchers on such fundamental concepts as stress, emotion, and chemical communication. Selye (1946) has defined stress in relation to the adaptation process (General Adaptation Syndrome); his work has been contested by May. Two theoretical approaches in particular treat the question of emotion: a mechanical theory, developed by James (1884), and a neuro-biological theory, developed by Papez (1937) and later refined by MacLean.
(1958), both of whom are interested in behavior and its relationship to brain function. Here, the basic difference noted between stress and emotion is the locus of origin; stress is a product of external stimuli and emotions are a product of internal stimuli. It must be emphasized that to be able to explore the potential of chemosensory communication via olfaction requires an awareness of the precise applications of the above-mentioned terms.

Although they posit varying notions of what constitutes communication, most theories of chemical communication rely on the concept of intent as a fundamental attribute of the organism. Pheromone research (on olfactory communication) implies that neither learning nor prior experience play an essential role in the process. It is also suggested that human pheromones are productions of the apocrine glands, which produce odorless sweat. This possibility opens up the field to a line of inquiry aimed at determining whether physiological response patterns can be elicited through the olfactory-limbic system by means of exposure to an "odorless scent." For the purpose of this study "chemical communication" will be defined strictly by the act of discrimination—physiological differentiation and/or cognitive discrimination—of a human axillary secretion produced under different stress/external conditions.
CHAPTER II

METHOD

Chapter Organization

Chapter two is divided into six major sections covering the pertinent aspects of the study: (1) Purpose; (2) Hypotheses; (3) Subjects, including solicitation, screening, selection and description of same; (4) Technical Considerations, including subject briefing and preparation, axillary sample production, axillary sample collection and treatment; (5) Data Collection and Instrumentation; and (6) Procedure with schematic (see p. 92).

Purpose

The purpose of this study is to examine the extent of human ability to differentiate and discriminate emotional states from body excreta through olfactory chemosensory communication. It will consider both physiological differentiation and cognitive discrimination of the olfactory stimuli presented. To this end eight hypotheses were developed for examination--five for the examination of physiological differentiation and three for the examination of cognitive discrimination.
This project has been designed in the hope of acquiring information that is both global (pertinent to more than a single discipline), as well as clinically useful within the field of Counseling Psychology. Two experiments are presented: a primary study concerned with the ability of a subject to differentiate physiologically among four samples of fresh axillary secretion, each of which was produced under a different stress condition; and a secondary study concerned with the ability of a subject group to discriminate cognitively among four samples of body odor/aged axillary secretion, again with each sample being produced under a different stress condition.

Hypotheses

**Primary Study (Physiological Differentiation)**

**Null Hypothesis Number 1:** There is no empirical difference for Subject B in the physiological baseline record and the physiological record taken during the introduction of the axillary secretion collected from Subject A, during the condition labeled "Exercise."

**Null Hypothesis Number 2:** There is no empirical difference for Subject B in the physiological baseline record and the physiological record taken during the introduction of the axillary secretion collected from Subject A, during the condition labeled "Relaxation."
Null Hypothesis Number 3: There is no empirical difference for Subject B in the physiological baseline record and the physiological record taken during the introduction of the axillary secretion collected from Subject A, during the condition labeled "Erotic."

Null Hypothesis Number 4: There is no empirical difference for Subject B in the physiological baseline record and the physiological record taken during the introduction of the axillary secretion collected from Subject A, during the condition labeled "Repulsive."

Null Hypothesis Number 5: There are no empirical differences among any of Subject B's physiological records, taken during the introduction of any of Subject A's axillary secretions.

Secondary Study (Cognitive Discrimination)

Null Hypothesis Number 6: There is no descriptively significant aptitude noted in the group subjects' ability to correctly identify a sample as containing human axillary secretion.

Null Hypothesis Number 7: There is no descriptively significant aptitude noted in the group subjects' ability to accurately identify the gender of the sample donor.

Null Hypothesis Number 8: There are no descriptively
significant differences noted in the group subjects' ability to identify the actual condition the donor subject experienced in producing each of the samples.

Subjects

Primary Study (Physiological Differentiation)

Solicitation

The subjects were selected from a group of thirty-two volunteers solicited from an advertisement in an university student newspaper. As an incentive to attract participants, subjects were given a small stipend for taking part in the study. The amount of the stipend was related to the amount of time each volunteer would need to expend.

Screening, Screening Criteria, and Selection

The screening and selection process consisted of four phases: (1) an application to participate/fact sheet, consent form, and questionnaire; (2) administration of the Minnesota Multiphasic Personality Inventory (M.M.P.I.); (3) a clinical interview and modified neuro-psychological evaluation; and (4) a urine screening for drug use, and a smell threshold sensitivity evaluation.
Application to Participate/Study Fact Sheet, Consent Form, and Questionnaire (Appendix A). This phase consisted of (a) a general description of the demands the study would make on the subject, (b) a descriptive outline of the screening process, followed by an explanation of the experimental design, (c) a subject research consent form, and (d) a questionnaire on general background of the potential participant. Selection Criteria: The participants selected to continue on to phase two of the study were all required to be Caucasian males over the age of eighteen, who stated that they met the following criteria: they did not smoke; they had not taken any drugs or medicines for 14 days prior to filling out the questionnaire; they had no medical problems (i.e., allergies, skin conditions, heart conditions, smell and/or taste dysfunction); they were able to be sexually aroused by the opposite sex; they had no emotional and/or mental disorders; and did not use deodorants, body oils, after shaves, and colognes during their normal hygiene routine.)

Twelve (12) of the original thirty-two (32) subjects were permitted to continue to the next phase, eight (8) elected to continue.

Administration of the M.M.P.I. Subject answers to specific questions on the M.M.P.I. were used to judge which subjects would be continued to phase three. Selection Criteria: Subjects giving the following answers were
dismissed: TRUE to question # 34 ("I have a cough most of the time"); FALSE to question # 51 ("I am in just as good physical health as my friends"); TRUE to question # 69 ("I am very strongly attracted to members of my own sex"); TRUE to question # 108 ("There seems to be a fullness in my head or nose most of the time"); FALSE to question # 131 ("I do not worry about catching diseases"); TRUE to question # 210 ("Everything tastes the same"); TRUE to question # 334 ("Peculiar odors come to me at times"); FALSE to question # 430 ("I am attracted by members of the opposite sex"); FALSE to question # 508 ("I believe my sense of smell is as good as other people's"); and/or TRUE to question # 535 ("My mouth feels dry almost all the time").

Five (5) of the eight (8) subjects were allowed to continue to phase three, four (4) subjects elected to continue.

Clinical Interview and Modified Neuro-psychological Evaluation (Appendix B). The M.M.P.I. was scored for each of the subjects who continued to phase four and the profiles were used as part of the clinical interview. Each interview took two (2) hours—a mental status examination was conducted, a Bender Visual Motor Gestalt Test was administered, and a modified neuro-psychological evaluation including an examination of lateral dominance and an examination of Cranial Nerves I, IX, X, and XII was
conducted (Bigler, 1984). To ensure that no subject would be morally offended by the use of sexually explicit materials in the experiment proper, each subject was asked at this time if he was morally offended or physically repulsed by visual sexually explicit material. **Selection Criteria:** Subjects whose evaluations suggested acute psychopathology and/or organic brain dysfunctions (evaluated through the use of the M.M.P.I., the Visual Motor Bender Gestalt Test, and the clinical interview), and/or mixed lateral dominance, and/or who had remarkable findings on the mental status examination and/or cranial nerve evaluations would be excused.

All four (4) subjects were found suitable to continue; three (3) subjects elected to continue.

**Urine Screen/Smell Evaluation.** Phase four was made up of two parts: (1) a urine screen for drug usage and (2) the establishment of a smell sensitivity threshold for each subject.

(1) **Urine Screen:** A qualitative urine drug screen was conducted. The following compounds were sought: **Barbiturates:** Allobarbital, Amobarbital, Aprobarbital, Barbital, Butabarbital, Mephobarbital, Pentobarbital, Primidone, Phenobarbital, Secobarbital. **Antidepressants:** Amitriptyline, Doxepin, Imipramine. **Sedatives:** Carbamazepine, Ethchlorvynol, Meprobamate, Methyprylon, Methaqualone, Pyrilamine. **Sympathomimetics:**
Chlorphendrine, Diphenhydramine, d,l-Ephedrine. **Analgesics:** Acetaminophen, Acetylsalicylate, Ibuprofen, Meperidine, Methadone, Opiates (by class), Phenylbutazone, Propoxyphene, Salicylate. **Stimulants:** Amphetamine, Chloramphetamine, Cocaine, Methamphetamine, Nicotine, Phenylpropanolamine, Strychnine, Theobromine, Theophylline. **Minor Tranquilizers:** Diazepam, Chlorodiazepoxide, Flurazepam, Oxazepam. **Major Tranquilizers:** Chlorpromazine, Prochlorperazine, Thioridazine. **Other:** Tetrahydrocannabinol. The evaluation of the urine was conducted by Medical Laboratory Network in California. The methods employed in the drug screen were Thin-Layer-Chromatography (TLC), Gas-Chromatography (GC), and Enzyme-Multiplied-Immuno Technique (EMIT). 

**Selection Criteria:** Any subject whose urine sample was found to have a remarkable lab result would be excused. **Results:** No remarkable findings were obtained from the laboratory.

(2) **Smell Evaluation:** Each of the three subjects underwent an odor sensitivity procedure by smelling ten samples containing different concentrations of butyl alcohol; after smelling each sample the subjects were required to indicate which sample had an odor. This procedure was repeated three times. **Selection Criteria and Subject Assignment:** The subject who displayed the lowest threshold of sensitivity by most frequently selecting the sample with the lowest concentration of butyl alcohol was
designated the recipient subject (Subject B) in the primary study. The subject who had the second lowest threshold sensitivity was designated the donor subject (subject A); and the third subject was retained as an alternate.

**Description of Subjects**

**Subject A (Donor Subject).** Subject A was a twenty-one (21) year old (D.O.B. 26 July 1964), single, Caucasian male, five feet five inches in height, weighed 120 lbs., indicated that he grew up in a rural area, and was judged as athletic and well-built by the interviewer. No remarkable findings concerning this subject were noted from the clinical interview, mental status examination, and modified neuro-psychological evaluation. Subject A was noted to maintain a right hand, right eye, and right foot dominance. The results from the M.M.P.I. did not appear remarkable: anxiety index \((1.33D+Pt)-(.66Hs+.66Hy) = 55\); internalization ratio \((Hs+D+Pt)/(Hy+Pd+Ma) = 1.005714\); expressive-repressive index \((L+K+Hy)-(Pd+Ma) = 34\); frustration tolerance index \((Ma+Pd)/(Hy+D) = 1.081081\); passive-aggressive index \((Hy+100)-(Pd+2Pa) = -24\); mean neurotic triad \((Hs+D+Hy)/3 = 57\); mean psychotic triad \((Pa+Pt+Sc)/3 = 61\); and triad elevation index \((Hs+D+Hy)/3- (Pa+Pt+Sc)/3 = -4\). Subject A reported that his health was excellent and that his last physical examination was in the fall of 1984.
Subject B (Recipient Subject). Subject B was a twenty-seven (27) year old (D.O.B. 12 September 1957), single, Caucasian male; subject was 6' 2" in height, weighed 195 lbs., and was judged by the interviewer as being normally built with no outstanding features. No remarkable findings concerning Subject B were noted from the clinical interview, mental status examination, or from the modified neuro-psychological evaluation. Subject B was noted to maintain a right hand, right eye, and right foot dominance. The results from the M.M.P.I. did not appear remarkable: anxiety index $(1.33D+Pt)-(0.66Hs+.66Hy) = 67$; internalization ratio $(Hs+D+Pt)/(Hy+Pd+Ma) = .8619048$; expressive-repressive index $(L+K+Hy)-(PdMa) = 44$; frustration tolerance index $(Ma+Pd)/(Hy+D) = 1.068182$; passive-aggressive index $(Hy+100)-(Pd+2Pa) = -83$; mean neurotic triad $(Hs+D+Hy)/3 = 62$; mean psychotic triad $(Pa+Pt+Sc)/3 = 71$; and triad elevation index $(Hs+D+Hy)/3-(Pa+Pt+Sc)/3 = -9$. Subject B reported his health as excellent with his last physical examination "being sometime in the summer of 1984," and conducted by the U.S. Air Force medical staff; Subject B indicated that his adenoids and tonsils were intact.
Secondary Study (Cognitive Discrimination)

Solicitation

Donor Subject. Refer to the solicitation process outlined above under Primary Study, page 67.

Group Subjects. Subjects were solicited from a five hundred-level undergraduate/graduate psychology course in Human Sexuality at Western Michigan University. The students were a mixture of upper level undergraduate students and graduate students.

Screening, Screening Criteria, and Selection

Donor Subject. Refer to the screening process, screening criteria, and selection process outlined above under Primary Study, page 67.

Group Subjects. A survey (Appendix C) was administered to any interested party. The survey contained (a) an explanation of the study, (b) consent form, (c) participant background sheet, and (d) survey recording form. Any individual over the age of eighteen and interested in participating in the project was accepted as a subject.

Description of Subjects

Donor Subject. Refer to the description of Subject B (Recipient subject) outlined above under Primary Study,
Group Subjects. The pool of subjects totalled thirty-eight (38) individuals: thirty-two (32) females, ranging in age from 18 to 52 years, with an average age of 29.8 years; and six (6) males, with an age range of 20 years to 49 years, and an average age of 29.3 years. Of the 38 subjects in the pool 68.4% were non-smokers; 86.8% reported their health as very good or excellent, with 7.9% rating their health as good and the remaining 5.3% leaving the question blank; 76.4% reported their race as White, 10.5% reported their race as Black, 13.1% reported their race as "other"; twenty-six (68.4%) of the 38 subjects indicated that they did not have sinus condition and 27 of the subjects (71.1%) stated they did not have any allergies; and 86.8% reported no use of any types of medication on the dates of the study, with 92.1% (35 subjects) reporting no use of nasal type medications for two weeks prior to the study. When asked where the subjects were reared, 26.3% reported an urban area, 44.7% reported a suburban area, and 29.0% reported a rural area. From the core pool of participants four groups were assembled, one group for each of the samples of axillary secretion produced under different stress conditions—
Group 1: 12 August 1985/axillary sample from condition Exercise, N=33; female subjects = 28, male subjects = 5; 
Group 2: 14 August 1985/axillary sample from condition Relaxation, N=25; female subjects 24, male subject = 1; 
Group 3: 19 August 1985/axillary sample from condition Erotic, N=32; female subjects = 27, male subjects = 5; 
Group 4: 21 August 1985/axillary sample from condition Repulsive, N=34; female subjects 29, male subjects = 5.

Technical Considerations

Subject Briefing/Preparation

Primary Study (Physiological Differentiation)

Three weeks prior to the collection of data, the subjects were gathered together three times to desensitize them to the overall experimental design. This process included desensitization to the method of sample collection, the area where the study was conducted, and the equipment, electrodes, and wires attached to the body. During the first gathering the following instructions concerning hygiene, diet, and use of medication were given.

Hygiene. The subjects were asked only to shower and were restricted from using any soap; as a soap substitute each subject was given a non-medicated "Buff Puff" (a rough sponge of man-made material) to clean the skin. To
protect the axillary region, hair washing was to be conducted in the sink. No deodorants, antiperspirants, colognes, oils, and/or body powders were permitted. Shaving of the face was permitted for the three weeks prior to data gathering (a non-medicated, non-mentholated shaving foam was supplied) but no shaving was permitted for twenty-four hours prior to data collection.

**Diet.** For three weeks prior to the data collection subjects were asked to avoid spicy foods (e.g. Mexican, Italian, etc.). In addition to the general "spicy food" restriction, the following foods were not allowed: garlic, asparagus, artichokes, radishes and raw onions. Each subject was asked to keep a log of his food intake.

**Medication.** Subjects were informed that the use of over-the-counter medications was not permitted. This restriction also included any vitamin and/or mineral supplements. If a subject's physician ordered any medication during the study, this fact was to be reported to the researcher.

**Secondary Study (Cognitive Discrimination)**

No subject briefing/preparation necessary.
Axillary Sample Production

Research Environment

A 5 x 9 foot shielded enclosure was employed to minimize influence from electric, magnetic, or radio frequency, or interference from the 60 cycle AC lines, and electric devices. The polygraph, located outside the shielded room, was appropriately grounded. Within the shielded enclosure was placed a comfortable padded chair, an exercise cycle, and a movie screen at one end. The room was arranged so that the researcher was able to project visual material on the screen from a projection station outside of the room (Photograph Collection 1).

Stress Conditions

Four stress conditions were employed throughout this research project: (1) Exercise, (2) Relaxation, (3) Sexual arousal, and (4) Repulsion. Once the subject was prepared as described in Axillary Sample Collection (see page 87), he was seated and a baseline was established. The following stressing method were employed:

Exercise. After his baseline was recorded, the subject was placed on a "National Cyc-O-Line 1200" exercise cycle. Once he was in place a second baseline was established; then the subject was told to ride the cycle for a
Photograph Collection 1: Shielded room and polygraph.
period of five minutes on a tension level of three, maintaining a speed of between 15 to 30 Km/h.

**Relaxation.** After his baseline was taken, the subject was asked to sit in as comfortable position as possible and listen to an audio tape. The subject was informed that an audio recording that has been known to help people relax was going to be played. He was given to understand that no response was required of him except to listen. An audio tape (Miller, 1980) using mental imagery to produce a relaxation response was played for the ten-minute period.

**Sexual Arousal.** After his baseline was recorded, the subject was informed that no specific response was required of him except to watch a twelve-minute color film. He was informed that the visual material presented has been known to elicit sexual arousal responses from male viewers. The subject was left to sit in the darkened room for three minutes before the projector was engaged; once the projector started, the film continued for the full twelve minutes. The visual stimulus employed was a combination of two standardly available pornographic films: *Valerie* and *Love At First Stroke*, which presented scenes of a single male and one female followed by scenes with one male and two females engaged in different sexual activities including, but not limited to, copulation,
masturbation, fellatio, and cunnilingus. The material presented would be classified as normal sexual behavior and contained no material which would be classified as sexual perversions. The films were spliced together with only one modification. The ejaculatory phase presented in the first film, Valerie, was removed and spliced into the end of the second film, Love At First Stroke to avoid any potential break in the arousal phase. To review the relative attractiveness of the individuals who participated in the film note Photograph Collection Number 2.

Repulsive. After his baseline was taken, the subject was informed that no specific response was required of him except to sit and watch a slide show. He was informed that the slides that he was to see were known to make people uncomfortable, and that he should not turn away but make every attempt to view each slide for its full five-second presentation. After the instructions were given the motor governing the automatic presentation of the slides was engaged. Thirty-two color slides taken from a surgical atlas (Walker, 1976) served as the stimulus. The slides were presented every ten seconds for a five-minute period; the screen was left dark for five seconds between each slide presentation. For an examination of the order and subject matter of the material presented, refer to Photograph Collection Number 3.
Photograph Collection. Sexual Stimulus.
Photograph Collection 3. Repulsive Stimulus.
Photograph Collection 3--Continued.

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Photograph Collection 3—Continued.
Photograph Collection 3—Continued.
Axillary Sample Collection and Treatment

Axillary Sample Collection

Upon arrival at the lab, each subject rinsed the underarm area with distilled water. After the subject was properly connected to the polygraph, the axillary regions were wiped with distilled water for a second time by the researcher. Then each of the subject's axillary regions were covered with a 4 X 4 sterile gauze pad, taped in place and covered with a 6 X 6 piece of plastic film. The plastic film was secured with hypoallergenic plastic tape.

Axillary Sample Treatment

Primary Study (Physiological Differentiation). Once the axillary sample was produced under each stated condition by subject A, the 4 X 4 cotton gauze pads were removed from subject A's axillary area and sandwiched between two paper surgical masks, wrapped in plastic film, and placed in the refrigerator for later use.

Secondary Study (Cognitive Discrimination). Once subject B has produced the axillary sample under each stated conditions, the 4 X 4 gauze pad was removed and placed into a non-odorous, sealable, hard plastic container that had been rinsed with distilled water. After the sample was placed in the moist container and sealed, it was refrigerated for later use.
Data Collection and Instrumentation

**Primary Study (Physiological Differentiation)**

**Physiological Data.** Heart rate, respiration rate and quality, skin resistance (GSR), and muscle activity (EMG) were recorded on a Grass Model Seven polygraph (Quincy, MA) with modular unit pre-amplifiers. The polygraph used a pen and ink system for a direct write-out on continuous paper and produced a direct record for each of the biological functions monitored. Skin temperature was recorded with a Norelco digital thermometer (serial No. HT 986).

**Electrodes:** When appropriate, silver-chloride disposable electrodes pre-prepared with a hypoallergenic medium were used. **Skin preparation:** The areas selected for electrode placement were first rinsed with distilled water, dried, lightly sanded with an extra fine piece of sandpaper and wiped clean with a 4 X 4 gauze pad that had been rinsed in distilled water--alcohol was not used due to its strong smell. **Electrode/instrument Placement:** Heart rate--arm to arm (Lead I) and chest lead (Lead V-2); Respiration rate and quality--a thermistor was taped in place below the left nasal opening in such a fashion as to allow the subject's breath to flow freely over the thermistor; GSR--first and third fingers left hand; EMG--frontalis; skin temperature--probe tip was placed on the skin surface at the head of the fibula.
**Psychological Data.** Empirical observations were recorded by the researcher from the time each subject arrived at the lab until his debriefing and dismissal. In addition to the empirical observations, an adjective checklist (Appendix D) with "feeling terms" was employed throughout the study.

**Secondary Study (Cognitive Discrimination)**

Data were collected on a paper and pencil survey form (Appendix C). Subjects were given the following verbal directions: "On the table you will see a 'smelling box.' You are asked to smell the sample and indicate whether the smelling box is 'empty/no perceivable odor' (contains no 'real' sample), or 'loaded' (contains a 'real' sample); if you believe that the smelling box is loaded, you are asked to identify the smell as Rest Smells, Sexual Smells, Work Smells, Fear Smells; then label the loaded sample as pleasant, neutral, or unpleasant, and indicate if the donor was male or female."

**Procedure**

Both the primary study and the secondary study concerned physiological reactions or cognitive responses by subject(s) to a sample of axillary secretion produced under four different stress conditions (exercise, relaxation, sexual arousal, and repulsion).
Primary Study (Physiological Differentiation)

The primary study focused on physiological differentiation. The donor subject (Subject A) was prepared so that his axillary secretion could be collected on cotton gauze pads. Then he was attached to several physiological monitoring devices connected to a Grass Model Seven Polygraph, and put in a shielded chamber. Following the establishment of a baseline subject A filled out an adjective check list (Appendix D) and then experienced one of the four stress conditions. After the stress condition his axillary sample was collected and placed between two paper surgical masks, wrapped in plastic film and placed in a refrigerator for later use. Once the axillary sample was collected, Subject A was given the adjective check list for a second time, was disconnected from the monitoring devices, debriefed, and dismissed. The chamber was aired out and the recipient subject (Subject B) was prepared in the same manner as Subject A (placement of axillary area pads and connection to the polygraph). Once seated in the chamber, two clean surgical masks with a clean cotton gauze pad sandwiched between them were placed on Subject B and a baseline was then recorded. Once a baseline was taken, subject B was asked to fill out an adjective check list while the prepared mask was taken from the refrigerator. The clean mask was removed and replaced with the
prepared mask. Subject B was asked to relax and breathe normally through his nose. Subject B's physiological responses (heart rate, skin temperature, respiration rate, and respiration quality, skin resistance (GSR), and muscle activity (EMG)) were recorded. The mask was removed and discarded, and Subject B was given the adjective check list for a second time. Subject B then experienced the same stress condition as Subject A. Subject B then filled out the adjective checklist for the third time. The cotton pads were removed from Subject B's underarms, placed into a sealable non-odorous plastic container that had been rinsed with distilled water, sealed, and placed in the refrigerator for later use. Subject B was then disconnected from the monitoring devices, debriefed, and dismissed (see Illustration 7). This procedure was repeated for each stress condition.

Secondary Study (Cognitive Discrimination)

The secondary study focused on cognitive discrimination. The sample produced by Subject B during the primary study was employed later during the same day of collection (within twelve hours). Four groups were assembled from a core group of thirty-eight (38) volunteer subjects recruited from a class on Human Sexuality. All subjects were asked to fill out a background sheet on themselves, smell
Illustration 7. Procedure Outline.
the sample, and fill out a questionnaire. Each subject was given as much time as he/she wished to smell the sample, but on the average each subject took less than ten (10) seconds. Each subject was asked if the sample they smelled was "empty/no perceivable smell" or "loaded (contains a 'real' sample)." If the subject response given was "loaded," the subject was asked to describe the sample as "Rest Smells," "Sexual Smells," "Work Smells," or "Pear Smells" and rate the smell as pleasant, neutral, unpleasant, and then was asked to indicate the gender of the subject.
CHAPTER III

RESULTS

Chapter Organization

This chapter is divided into four sections: (1) Introduction; (2) Method of Data Analysis; (3) Experimental Outcome/Results; and (4) Summary.

Introduction

In attempting to determine the range of the human capacity to recognize and distinguish various emotional states from body sweat through olfactory chemosensory communication, both physiological differentiation and cognitive discrimination of olfactory stimuli have been examined. To direct this study the eight hypotheses presented in Chapter II were formulated. In this chapter the outcome of the experiment is outlined as it relates to each hypothesis. The chapter will conclude with a summary in which the limits of some aspects of human ability to utilize olfactory chemosensory communication will be addressed.
Method of Data Analysis

**Primary Study (Physiological Differentiation)**

The data from the Primary Study consist of physiological records produced under different stress conditions. To analyze these data an empirical/observational comparison of the physiological record focusing on the physiological record of Subject B chronicled during two phases of the study was used: the baseline phase and the phase following the introduction of the axillary secretion produced by subject A under a stated stress condition. After an intra-record examination of each record produced under different stress conditions was made, an inter-record examination was conducted.

**Secondary Study (Cognitive Discrimination)**

The data from the Secondary Study consist of reports of cognitive discrimination of an olfactory sample recorded on a "forced choice" questionnaire/survey form. In the secondary study the responses given by the group were examined with three factors in mind: the accuracy of the group responses in cases where an actual sample was used; the gender of the subject; and the relationship of the responses to the actual stress conditions that produced the axillary sample, with particular attention paid to the
background information given by each respondent. The mean was employed as the descriptive statistic.

Results

In this section first the hypothesis examined is listed, followed by the related data, the data abridgment and analysis, and then the findings and interpretations.

Null Hypothesis Number 1

"There is no empirical difference for Subject B in the physiological baseline record and the physiological record taken during the introduction of the axillary secretion collected from Subject A, during the condition labeled Exercise."

The procedure to examine Null Hypothesis Number 1 took place on 12 August 1985, from 09:40 to 11:50. No problems were noted during the execution of the procedure.

Data

Psychological Report, Subject A (Donor Subject):

(a) Arrival: Subject A arrived at 09:10. Having come by bicycle. He entered the lab with the bicycle seat in his hand. He was evaluated upon arrival. No remarkable information was noted; the subject appeared to be in good humor and freely willing to enter conversation. It was noted that the subject was oriented and most alert. The
subject was asked if he had showered/rinsed prior to arrival. He indicated that he had. Since he had arrived on a bicycle he was asked to re­rinse in the bathroom with distilled water and change into a set of gym clothes (shorts and tank top).

(b) Following Baseline Record on the Exercise Cycle: The subject reviewed the adjective check list and chose the following terms to describe his mood: excited, happy, tired, and apathetic.

(c) During Procedure: The subject did not appear taxed by the exercise. It was most apparent that he was an avid cyclist and once he began to exercise he quickly established a rhythm.

(d) Following Procedure: The subject selected the following terms on the adjective check list: excited, happy, tired, and apathetic.

(e) Debriefing: Subject reported no unusual feelings or thoughts following the exercise. However, when asked about his response "tired" on the adjective check list, he defined "tired" as sleepy, rather than fatigued.

Psychological Report, Subject B (Recipient Subject).

(a) Arrival: The subject arrived at 10:30, alert and somewhat talkative. He was in good humor and stated that he was enthusiastic about being a subject. Subject B was asked if he had showered/rinsed prior to arrival. He indicated that he had, his underarm areas were wiped clean
with distilled water, and then he was instructed to change into the gym clothes provided.

(b) **Following Baseline Record on Exercise Cycle, Prior to Sample Introduction:** The subject reported on his mood by selecting the following descriptors on the adjective check list: calm, hopeful, comfortable, apathetic, anxious, relaxed, and indifferent.

(c) **During Sample Introduction:** No remarkable observations were noted.

(d) **Following Sample Introduction, Prior to Exercise:** The subject picked the following descriptors on the adjective check list to reflect his mood: excited, restful, calm, hopeful, comfortable, and anxious.

(e) **During Exercise:** The subject appeared physically "out-of-shape" and appeared to find the exercise most taxing, he appeared to maintain good humor.

(f) **Following Exercise:** The subject indicated that he was tired, fatigued, and anxious from the exercise; he also reported his mood as hopeful on the adjective check list.

(g) **Debriefing:** During the debriefing session, the subject reported no unusual thoughts or feelings following the experimental procedure. When questioned if he knew which stress condition would be employed, he indicated that he did not.

**Physiological Record/Data.** Five one-minute segments.
from the physiological records produced by both Subject A and Subject B were selected for comparison. Two one-minute segments from the physiological record were selected for Subject A, and three one-minute segments were selected for Subject B. The segments selected from the full physiological record reflecting the different phases of the study were: (a) Subject A during baseline, (b) Subject A during the exercise condition exercise, (c) Subject B during baseline, (d) Subject B during the introduction of the axillary secretion, and (e) Subject B during the exercise condition (Physiological Record 1). The entire record can be studied in Appendix E; the one-minute segments were selected as representative of the record produced during each phase of within whole record.

Data Abridgment and Analysis

From a comparison of the record produced by Subject B during the baseline phase and the record produced during the introduction of the axillary secretion phase for the same subject the following observations are noted:

Psychological Report. No marked alterations and/or changes in behavior during the procedure were noted.

EMG. A minimal increase in muscle tension is noted.

Heart. The chest lead (Lead I) record showed an increase in response patterns; the arm-to-arm (V-2) record
12 August 1985

Physiological Record 1. Exercise.
CONDITION: EXERCISE
12 August 1935

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<td>HEART Chest Lead</td>
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<td>= 500 μv/cm</td>
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<tr>
<td>HEART Arm to Arm</td>
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<tr>
<td>RESPIRATION</td>
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<td>TEMPERATURE</td>
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| 10:20 | 10:21 |

Skin 98.6°F Room 74.0°F
CONDITION: EXERCISE
12 August 1985

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<td>Arm to Arm</td>
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<td>[Graph of heart activity]</td>
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<td>RESPIRATION</td>
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**CONDITION: EXERCISE**  
12 August 1985

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<tr>
<td>Chest Lead</td>
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<td>$I = 500 \mu V/cm$</td>
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<tr>
<td><strong>HEART</strong></td>
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<tr>
<td>Arm to Arm</td>
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<tr>
<td><strong>RESPIRATION</strong></td>
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</table>

INTRODUCTION OF Axillary Secretion collected from Subject A

Skin 93.0°F Room 76.0°F
**CONDITION: EXERCISE**

12 August 1985

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<td>HEART Arm to Arm</td>
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<tr>
<td>TEMPERATURE</td>
<td>Skin 93.8°F Room 78.0°F</td>
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</table>

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showed an increase in response. The changes noted in the
records are clearly observable.

**Respiration**: Obvious changes in the quality and
quantity of respiration are noted. The difference is
judged to be empirically significant.

**Body Temperature**: In comparing Subject B's record
during the introduction of the axillary secretion with his
record during the stress/exercise phase an increase in
skin temperature of $0.8^\circ F$ is noted. Although the increase
is consistent between baseline and introduction of sweat,
and between sweat introduction and exercise, this rise in
temperature is to small to suggest that it was a result of
the experimental treatment.

**Findings and Interpretations**

A comparison of the baseline record and the record
during the introduction of the axillary secretion suggests
that Null Hypothesis Number 1 should be rejected. Observ­
able differences in the records are clearly noted, most
predominantly in the evaluation of the cardiac record and
the respiration record; although the temperature record
was not judged to be great enough to stand as "different"
on its own merit, temperature increase supports the other
findings.
Null Hypothesis Number 2

"There is no empirical difference for Subject B in the physiological baseline record and the physiological record taken during the introduction of the axillary secretion collected from Subject A, during the condition labeled Relaxation."

The procedure to examine Null Hypothesis Number 2 took place on 14 August 1985, from 08:30 to 11:00. No unusual occurrences were noted during the execution of the procedure.

Data

Psychological Report, Subject A (Donor Subject).

(a) Arrival: Subject A arrived at 08:00. Upon arrival he was evaluated; no marked abnormalities were noted. The subject appeared sleepy, yet entered easily into conversation. The subject was oriented. The subject was asked if he had showered/rinsed prior to arrival. He indicated that he had, his axillary regions were wiped clean with distilled water and then he changed into a set of gym clothes.

(b) Following Baseline Record: The subject reviewed the adjective check list and chose the following terms to describe his mood: restful, tranquil, happy, tired, calm, comfortable, and relaxed.
(c) **During Procedure:** The subject appeared to become more relaxed when listening to the relaxation tape, than he had been at the start of the stress condition.

(d) **Following Procedure:** The subject selected the following terms on the adjective check list: restful, tranquil, happy, calm, comfortable, (very) relaxed, and indifferent.

(f) **Debriefing:** The subject reported no unusual feelings or thoughts following the relaxation condition; when asked if he found the audio tape relaxing, he responded that he was relaxed by the tape.

*Psychological Report, Subject B (Recipient Subject).*

(a) **Arrival:** The subject arrived at 09:30, was alert extremely talkative and friendly. He reported that he had showered/rinsed prior to arrival, his underarms were wiped clean with distilled water and he changed into gym clothes.

(b) **Following Baseline Record, Prior to Sample Introduction:** The subject described his mood with the following descriptors on the adjective check list: excited, restful, tranquil, calm, hopeful, comfortable, anxious, and relaxed.

(c) **During Sample Introduction:** No remarkable occurrences were noted.

(d) **Following Sample Introduction, Prior to Relaxation Condition:** The subject chose the following terms on
the adjective check list to reflect his mood: confused, restful, tranquil, happy, calm, hopeful, comfortable, anxious, and relaxed.

(e) **During Relaxation Condition**: No remarkable comments were recorded.

(f) **Following Relaxation Condition**: The subject indicated the following terms on the check list: restful, calm, hopeful, comfortable, anxious, and relaxed.

(g) **Debriefing**: During the debriefing session, the subject reported no unusual thoughts or feelings following the experimental procedure. It is worth noting that the subject reported that the audio tape was a distraction while he was attempting to relax. When questioned if he was aware of the stress condition to be employed prior to arrival, he indicated that he did not.

**Physiological Record/Data.** Five one-minute segments from the physiological records produced by both Subject A and Subject B were selected for comparison. Two one-minute segments from the physiological record were selected for Subject A and three one-minute segments were selected for Subject B. The segments selected from the full physiological record reflecting the different phases of the study were: (a) Subject A during Baseline, (b) Subject A during the stress condition relaxation, (c) Subject B during Baseline, (d) Subject B during the introduction of the axillary secretion, and (e) Subject B during the
stress condition relaxation (Physiological Record 2). The complete record can be found in Appendix E; the one-minute segments were selected as representative of the record produced during each phase of the entire record.

Data Abridgment and Analysis

A comparison of the record produced by subject B during the baseline phase and the introduction of the axillary secretion phase generates the following observations:

Psychological Report. No alterations and/or changes in the subject's behavior were noted during the relaxation condition. During the debriefing session Subject B indicated that he found the audio tape/relaxation condition distracting rather than relaxing.

EMG. A marked reduction in muscle tension is noted between the record of Subject B's baseline and his sweat introduction record. The decrease is clearly and observably different.

Heart. Little or no observable differences are noted in the cardiac record taken from the chest lead (Lead I) during the baseline and introduction of the axillary secretion were noted. The cardiac record taken from the arm-to-arm lead (V-2) shows a small reduction in "intensity" without any apparent movement on the part of
Physiological Record 2. Relaxation.
**CONDITION: RELAXATION**  
14 August 1985

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<tr>
<td><strong>HEART Arm to Arm</strong></td>
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<tr>
<td><strong>GSR</strong></td>
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CONDITION: RELAXATION
14 August 1985

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<tr>
<td>HEART Chest Lead</td>
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<tr>
<td>HEART Arm to Arm</td>
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<td>GSR</td>
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CONDITION: RELAXATION
14 August 1985

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<tr>
<td>EMG</td>
</tr>
<tr>
<td>TIME LINE/Sec.</td>
</tr>
<tr>
<td>10:27</td>
</tr>
<tr>
<td>HEART Chest Lead</td>
</tr>
<tr>
<td>1 = 500 µV/cm</td>
</tr>
<tr>
<td>HEART Arm to Arm</td>
</tr>
<tr>
<td>GSR</td>
</tr>
<tr>
<td>9.30</td>
</tr>
<tr>
<td>RESPIRATION</td>
</tr>
<tr>
<td>TEMPERATURE</td>
</tr>
<tr>
<td>Skin 91.2°F Room 80.0°F</td>
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</tbody>
</table>

INTRODUCTION OF Axillary Secretion collected from Subject A
CONDITION: RELAXATION
14 August 1985

<table>
<thead>
<tr>
<th>TIME LINE/Sec.</th>
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<tr>
<td>Chest Lead</td>
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<tr>
<td>Arm to Arm</td>
<td></td>
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</tr>
<tr>
<td>GSR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RESPIRATION</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TEMPERATURE</td>
<td>Skin 90.4°F Room 82.0°F</td>
<td></td>
</tr>
</tbody>
</table>

RELAXATION

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the subject. The most noteworthy difference in Subject B's cardiac record is the change in the regularity of heart rhythm during the introduction of the sweat produced by Subject A, when compared to Subject B's baseline. The changes noted in the cardiac record of Subject B when compared to baseline record are observably different.

GSR. A change is noted in galvanic skin response, as recorded during the sweat introduction from 7.15 on the baseline record to 9.30 on the sweat introduction record. Of interest is the slight drop in the GSR that is noted when comparing 9.30 during the sweat introduction record to 8.20 during the relaxation condition. This decrease corresponds with subject B's verbal report of finding the audio tape distracting when attempting to relax. The increase in GSR noted in comparing Subject B's baseline with Subject B's response to sweat introduction shows an observable difference between the two records.

Respiration. The differences are clear between the baseline record and the record of the introduction of sweat. During the introduction of the sweat the subject's breathing became more regular and more shallow, a clear difference.

Body Temperature. An increase in skin temperature is noted, from 90.6°F during the baseline record, to 91.2°F during the introduction of sweat record. Of import, is the drop in temperature from 91.2°F to 90.4°F during the
record taken while subject B was listened to the relaxation tape, even though there was an increase in room temperature from 80.0°F to 82.0°F; this decrease corresponds with the psychological report. The overall temperature increase noted between the sweat introduction record and the baseline record clearly shows a change from one record to the other.

**Findings and Interpretations**

A comparison of the baseline record and the record produced during the introduction of the axillary secretion suggests that Null Hypothesis Number 2 should be rejected. Observable differences are clearly noted throughout the entire record. Changes are found in the GSR record, respiration record, and temperature record. It should be noted that Subject 3 appeared to find the axillary secretion from Subject A more "relaxation producing" than the audio tape.

**Null Hypothesis Number 3**

"There is no empirical difference for Subject B in the physiological baseline record and the physiological record taken during the introduction of the axillary secretion collected from Subject A, during the condition labeled Erotic/Sexual Arousal."
The procedure to test Null Hypothesis Number 3 took place on 19 August 1985, from 11:00 to 13:00. No unusual occurrences were noted during the execution of the procedure.

Data

Psychological Report, Subject A (Donor Subject).

(a) Arrival: Subject A arrived at 09:00 and was asked to return at 10:30 due to technical difficulties. When he returned at 10:30 he was evaluated psychologically and appeared in good humor, but was somewhat quiet. It was noted that the subject was oriented and most alert. The subject was asked if he had showered/rinsed prior to arrival. He indicated that he had, the axillary areas were wiped clean with distilled water and he changed into a set of gym clothes.

(b) Following Baseline Record: The subject reviewed the adjective check list and chose the following terms to describe his mood: restful, tranquil, tired, calm, comfortable, apathetic, relaxed, and indifferent.

(c) During Procedure: The subject appeared somewhat uncomfortable during the erotic condition/film, but he did not verbalize this.

(d) Following Procedure: The subject chose the following terms on the adjective check list: excited, repulsed, apathetic, anxious, and indifferent.
(e) **Debriefing:** The subject reported that during the viewing of the film he went through several different sets of emotions and feelings. During the first part of the film (about the first nine minutes) he reported that he felt sexually aroused and sustained a flaccid erection, but during the last three minutes of the film (the ejaculatory segment of the film) the subject indicated that he found the film too graphic, and more distressing than arousing.

**Psychological Report, Subject B (Recipient Subject).**

(a) **Arrival:** The subject arrived at 10:30 and was talkative. He reported that he was out the previous evening at a party; he took the time to indicate that he did not drink at the party. He was asked to return at 11:30 due to technical difficulties; he complied. Prior to establishing a baseline, the subject was asked if he had showered/rinsed prior to his arrival. He indicated that he had, the subject's underarms were wiped down with distilled water.

(b) **Following Baseline Record, Prior to Sample Introduction:** The subject described his mood with the following selections on the adjective check list: restful, tranquil, happy, calm, hopeful, comfortable, anxious, and relaxed.

(c) **During Sample Introduction:** No remarkable commentary was recorded.
(d) **Following Sample Introduction, Prior to Erotic Condition**: The subject picked following descriptors on the adjective check list to reflect his mood: restful, tranquil, calm, hopeful, comfortable, anxious, and relaxed.

(e) **During Erotic Condition**: The subject appeared to be enjoying the erotic film.

(f) **Following Stress Condition**: The subject reported his mood as excited, happy, comfortable, anxious, sexy, relaxed, and horny on the adjective check list.

(g) **Debriefing**: During the debriefing session, the subject reported that he was highly sexually aroused by the film, sustaining an erection throughout the film; according to his self-report, the subject found the experimental procedure to be most pleasurable. When questioned if he knew which condition was going to be employed prior to the exposure, he indicated that he did not.

**Physiological Record/Data.** Five one-minute segments from the physiological records produced by both Subject A and Subject B were selected for comparison. Two one-minute segments from the physiological record were selected for Subject A and three one-minute segments were selected for Subject B. The segments selected from the full physiological record reflecting the different phases of the study were: (a) Subject A during baseline, (b) Subject A during the erotic condition, (c) Subject B during base-
line, (d) Subject B during the introduction of the axillary secretion, and (e) Subject B during the erotic condition (Physiological Record 3). For an examination of the entire record, review Appendix E. The one-minute segments were selected as representative of the record produced during each phase of the complete record.

Data Abridgment and Analysis

From a comparison of the record produced by Subject B during the baseline phase and the introduction of the axillary secretion phase the following observations are noted:

Psychological Report. No marked alterations and/or changes in behavior during the procedure were noted.

EMG. There is an observable increase in muscle tension seen when the baseline record is compared with the sweat introduction record. This increase in muscle tension is sufficient to be considered clearly observable.

Heart. The record from the chest lead (Lead I) shows no changes in regularity and/or magnitude; the arm-to-arm leads (V-2) record displays little difference with respect to the same measures. The most interesting aspects of these records are noted when compared with Subject A's record produced during the stress condition. As can be observed, during the erotic/stress period for Subject A an
19 August 1985

<table>
<thead>
<tr>
<th>SUBJECT A</th>
<th>TIME LINE/Sec.</th>
<th>EMG</th>
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</thead>
<tbody>
<tr>
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<td>11:19 - 11:20</td>
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<tr>
<td>HEART</td>
<td>Chest Lead</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$I = 500 \mu \text{V/cm}$</td>
<td></td>
</tr>
<tr>
<td>HEART</td>
<td>Arm to Arm</td>
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</tr>
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<td>GSR</td>
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<td>6.45</td>
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<tr>
<td>TEMPERATURE</td>
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<td>Room 72.0° F</td>
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Physiological Record 3. Erotic.
**CONDITION: EROTIC**  
19 August 1985

<table>
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<th>TIME LINE/Sec.</th>
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<th>11:37</th>
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<td></td>
</tr>
<tr>
<td>= 500 $\mu$V/cm</td>
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<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>HEART Arm to Arm</th>
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</thead>
</table>

<table>
<thead>
<tr>
<th>GSR</th>
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</table>

<table>
<thead>
<tr>
<th>RESPIRATION</th>
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<th></th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>TEMPERATURE</th>
<th>Skin 95.0°F Room 72.0°F</th>
</tr>
</thead>
</table>

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CONDITION: EROTIC
19 August 1985

<table>
<thead>
<tr>
<th>SUBJECT B</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMG</td>
</tr>
<tr>
<td>TIME LINE/Sec.</td>
</tr>
<tr>
<td>12:14 to 12:15</td>
</tr>
<tr>
<td>HEART Chest Lead</td>
</tr>
<tr>
<td>= 500 μV/cm</td>
</tr>
<tr>
<td>HEART Arm to Arm</td>
</tr>
<tr>
<td>GSR</td>
</tr>
<tr>
<td>RESPIRATION</td>
</tr>
<tr>
<td>TEMPERATURE</td>
</tr>
<tr>
<td>Skin 94.2°F</td>
</tr>
<tr>
<td>Room 75.0°F</td>
</tr>
</tbody>
</table>

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Physiological Record 3—continued.

CONDITION: EROTIC
19 August 1985

| SUBJECT B |
|------------------|------------------|
| EMG              |
| TIME LINE/Sec.    |
| 12:20—12:21       |
| HEART Chest Lead |
| I = 500 mV/cm     |
| HEART Arm to Arm  |
| GSR              |
| 4.20             |
| RESPIRATION       |
| TEMPERATURE       |
| Skin 93.8°F      |
| Room 75.0°F      |

INTRODUCTION OF Axillary Secretion collected from Subject A

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**CONDITION: EROTIC**
19 August 1985

<table>
<thead>
<tr>
<th>Subject B</th>
<th>TIME LINE/Sec.</th>
<th>EMG</th>
<th>HEART</th>
<th>Arm to Arm</th>
<th>GSR</th>
<th>RESPIRATION</th>
<th>TEMPERATURE</th>
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<td>12:37 - 12:38</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chest Lead</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.20</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>2.50</td>
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<td></td>
</tr>
</tbody>
</table>

Skin 93.4°F Room 74.0°F

EROTIC
anormal heart rhythm was noted, which was not noted for Subject B during Subject B's baseline record. When Subject B was introduced to the axillary secretion produced by Subject A under the erotic condition, Subject B started to "echo" or "copy" Subject A by producing a cardiac record that appeared to be similar to that of Subject A's. Like subject A, Subject B showed no unusual heart responses during the baseline record. When Subject B's record taken during the introduction of the axillary secretion is compared with Subject A's record taken during the erotic condition, Subject B's record appears to maintain the same patterns produced by Subject A. The differences in Subject B's baseline record when compared with Subject B's sweat introduction record are observably different, including some form of physiological emulation of Subject A's unusual cardiac record.

**GSR.** A drop from 6.95 on the baseline record to 4.20 on the sweat introduction record is noted; this drop is judged to be an observable change from subject B's baseline record and the record taken during the introduction of the axillary secretion produced by Subject A during the erotic condition.

**Respiration.** An observable change in respiration is noted, with subject B's breathing going from a regular pattern noted during the baseline record to a more erratic and deeper pattern of breathing during the sweat
introduction record. The alteration in breathing is clearly an observable difference.

**Body Temperature.** A drop in skin temperature from 94.2°F, taken during the baseline record, to 93.8°F during the sweat introduction record, is registered; A comparison of Subject B's sweat introduction record with the record taken during the erotic condition for the same subject shows a drop in skin temperature also. This drop in skin temperature is also present in comparing Subject A's baseline record with Subject A's stress condition record. The drop in skin temperature is not sufficient alone to suggest a clinical change in comparing the records, yet with the decrease noted in Subject A's records and Subject B's response to the actual stress condition, the difference needs to be noted.

**Findings and Interpretations**

A comparison of the baseline record with the record during the introduction of the axillary secretion suggests that Hypothesis Number 3 should be rejected. Observable changes are noted in all systems recorded.

**Null Hypothesis Number 4**

"There is no observable difference for Subject B in the physiological baseline record and the physiological
record taken during the introduction of the axillary secretion collected from Subject A, during the condition labeled Repulsive."

The procedure to examine Null Hypothesis Number 4 took place on 21 August 1986, from 08:00 to 10:30. No remarkable occurrences were noted during the execution of the procedure.

Data

Psychological Report, Subject A (Donor Subject).

(a) Arrival: Subject A arrived at 07:30 and was evaluated and appeared sleepy. It was noted that the subject was oriented. The subject was asked if he had showered/rinsed prior to arrival. He indicated that he had, his underarms were wiped clean with distilled water and changed into a set of gym clothes.

(b) Following Baseline Record: The subject reviewed the adjective check list and chose the following terms to describe his mood: restful, tranquil, happy, tired, calm, comfortable, apathetic, relaxed, and indifferent.

(c) During Procedure: The subject did not appear overly uncomfortable during the repulsion condition.

(d) Following Procedure: The subject selected the following terms on the adjective check list: happy, comfortable, and relaxed.

(e) Debriefing: The subject reported no unusual
feelings or thoughts during or following the stress condition. When asked about the repulsive stimuli (color slides), he indicated that he found them to be "interesting," stating that he did not find the slides overly distressing.

**Psychological Report, Subject B (Recipient Subject).**

(a) **Arrival:** Subject arrived at 09:00, alert and in very good spirits, and stated that he was enthusiastic about being there. It was noted that the subject had appeared to have some nasal congestion. The subject was questioned as to whether he had showered/rinsed prior to his arrival to the lab. He indicated that he had, the axillary regions were wiped clean with distilled water.

(b) **Following Baseline Record, Prior to Sample Introduction:** During the baseline record the subject became quite uncomfortable, finding it difficult to breath through his nose. The procedure was halted and the subject was allowed to blow his nose. A second baseline was taken and no remarkable information was noted. The subject described his mood with the following descriptors on the adjective check list: excited, restful, tranquil, happy, calm, hopeful, comfortable, anxious, and relaxed.

(c) **During Sample Introduction:** The subject almost immediately became agitated and yelled at one point, "Why in the F... is this taking so long!" he appeared more hostile than agitated.
(d) **Following Sample Introduction, Prior to Repulsive Slides/Repulsion Condition:** The following terms were recorded as responses on the adjective check list: confused, restful, tranquil, happy, calm, hopeful, anxious, and relaxed. After listing these terms the subject added an additional one: agitated.

(e) **During Repulsion Condition:** The subject appeared not to be affected by the repulsive slides.

(f) **Following Repulsion Condition:** The subject reported his mood as restful, repulsed, tranquil, calm (taking a deep cleansing breath), comfortable, and relaxed on the adjective check list.

(g) **Debriefing:** During the debriefing session, the subject reported that he found the slides to be most distressing. When he was asked if he was aware which experimental procedure was going to be conducted on that date, he indicated that he was aware it was going to be the repulsive condition, since it was the only stress condition left.

**Physiological Record/Data.** Five one-minute segments from the physiological records produced by both Subject A and Subject B were selected for comparison. Two one-minute segments from the physiological record were selected for Subject A and three one-minute segments were selected for Subject B. The segments selected from the full physiological record were: (a) Subject A Baseline; (b)
Subject A during the stress condition; (c) Subject B during the Baseline record; (d) Subject B during the introduction of the axillary secretion produced by Subject A; and (e) Subject B during the stress condition (Physiological Record 4). The complete record can be found in Appendix E. The one-minute segments were selected as representative of the record produced during each phase of the entire record.

Data Abridgment and Analysis

From a comparison of the record produced by Subject B during the baseline phase and that of the introduction of the axillary secretion phase the following observations are noted:

Psychological Report. Upon arrival Subject B was judged to be in good spirits; a marked behavior change (yelling) was noted almost immediately after the sweat was introduced.

EMG. No observable differences were noted.

Heart. No observable differences were noted in the records from the chest lead (Lead I) or the arm-to-arm leads (V-2). Noted was some "echoing" of Subject A's unusual cardiac record, as outlined previously in the sexual arousal condition.

GSR. A minor increase in GSR (7.20 to 7.60) was noted between Subject B's baseline record and the record taken
21 August 1985

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<td>HEART Arm to Arm</td>
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<td>GSR</td>
<td>0.84</td>
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<tr>
<td>TEMPERATURE</td>
<td>Skin 94.6°F Room 70.0°F</td>
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</table>

Baseline

Physiological Record 4. Repulsive.

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**CONDITION: REPULSIVE**
**21 August 1985**

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<tr>
<th>SUBJECT A</th>
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<td><strong>HEART</strong></td>
<td>Chest Lead</td>
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</tr>
<tr>
<td></td>
<td>I = 500 μV/cm</td>
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<tr>
<td><strong>HEART</strong></td>
<td>Arm to Arm</td>
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<td></td>
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<tr>
<td><strong>GSR</strong></td>
<td>4.60</td>
<td>5.56</td>
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<td><strong>TEMPERATURE</strong></td>
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<td>Room 70.0°F</td>
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CONDITION: REPULSIVE
21 August 1985

<table>
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<tr>
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<th>GSR</th>
<th>RESPIRATION</th>
<th>TEMPERATURE</th>
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<tr>
<td></td>
<td>9:45</td>
<td>Chest Lead</td>
<td>7.20</td>
<td>Skin 95.4°F Room 72.0°F</td>
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<tr>
<td></td>
<td>9:46</td>
<td>Arm to Arm</td>
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EMG

TEMPERATURE

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Physiological Record 4—Continued.

**CONDITION: REPULSIVE**
21 August 1985

<table>
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<tr>
<td><strong>GSR</strong></td>
<td>7.60</td>
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<td></td>
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<tr>
<td><strong>TEMPERATURE</strong></td>
<td>Skin 90.2°F</td>
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</table>

INTRODUCTION OF Axillary Secretion collected from Subject A

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**CONDITION: REPULSIVE**
21 August 1985

<table>
<thead>
<tr>
<th>SUBJECT B</th>
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<tbody>
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<td><strong>HEART</strong> Arm to Arm</td>
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<tr>
<td><strong>GSR</strong></td>
<td>7.52</td>
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</tr>
<tr>
<td><strong>TEMPERATURE</strong></td>
<td>Skin 89.6°F Room 72.0°F</td>
</tr>
</tbody>
</table>

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during the introduction of the axillary secretion. A very slight decrease in the GSR (7.60 to 7.52) was noted between the record produced during the introduction of the axillary secretion and the record produced when Subject B experienced the stress condition, repulsion.

Respiration. Breathing patterns were observably different for Subject B between the baseline record and the record illustrating the introduction of the axillary secretion; respiration during the introduction of the axillary secretion was shallower and more rapid. A comparison of the breathing record taken during the introduction of the axillary secretion for Subject B, and the record taken during the experiencing of the stress condition by Subject B suggests a physiological movement in a similar direction, as if the subject were experiencing the same stress condition in a less intense fashion when introduced to the sweat sample. The results of the comparison of the entire respiration record are observably different.

Body Temperature. A 5.2°F drop was noted. Subject B's baseline record was 95.4°F; Subject B's temperature dropped to 90.2°F when Subject B was subjected to the axillary secretion. In comparing Subject B's record taken during the introduction of the axillary secretion to Subject B's record taken during the time he experienced the repulsive condition, a 0.6°F drop in skin temperature from 90.2°F to
to 89.6°F is observed. The results show a marked difference, since they reflect an alteration of the record in the same direction.

**Findings and Interpretations**

A comparison of the baseline record and the record during the introduction of the axillary secretion suggests that Null Hypothesis Number 4 should be rejected. The respiration changes noted in Subject B, as well as the temperature changes between the Baseline record and the sweat introduction record are sufficient to be considered empirically significant. The "dramatic" behavioral response (subject yelling) must be viewed with some caution, since the subject was able to determine which stress condition was going to be employed on this date.

**Null Hypothesis Number 5**

"There are no empirical differences among any of Subject B's physiological records, taken during the introduction of any of Subject A's axillary secretions."

**Data**

The data presented for evaluation is a comparison of physiological records summarized in Table 1, Table 2, Table 3, Table 4, and Table 5.
### Table 1

**Summary: Exercise Condition**

<table>
<thead>
<tr>
<th>SUBJECT</th>
<th>EMG</th>
<th>TIME LINE/Sec.</th>
<th>HEART Chest Lead</th>
<th>GSR</th>
<th>RESPIRATION</th>
<th>TEMPERATURE</th>
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<td>A</td>
<td></td>
<td>10:00</td>
<td></td>
<td></td>
<td></td>
<td>Skin 95.2°F Room 72.0°F</td>
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<tr>
<td></td>
<td></td>
<td>10:13</td>
<td></td>
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<td></td>
<td>Skin 95.2°F Room 72.0°F</td>
</tr>
</tbody>
</table>

**CONDITION: EXERCISE**

12 August 1985

**SUBJECT A**

**SUBJECT B**

**TEMPERATURE**

Skin 93.8°F Room 76.2°F

**INTRODUCTION OF Axillary Secretion collected from Subject A**

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Table 2
Summary: Relaxation Condition

<table>
<thead>
<tr>
<th>CONDITION: RELAXATION</th>
<th>14 August 1985</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SUBJECT A</strong></td>
<td></td>
</tr>
<tr>
<td>EMG</td>
<td></td>
</tr>
<tr>
<td>TIME LINE/Sec.</td>
<td>0:24</td>
</tr>
<tr>
<td>HEART Chest Lead</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>HEART Arm to Arm</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>GSR</td>
<td>6.25 mV</td>
</tr>
<tr>
<td>RESPIRATION</td>
<td></td>
</tr>
<tr>
<td>TEMPERATURE</td>
<td>Skin 93.0°F Room 78.0°F</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SUBJECT B</strong></td>
<td></td>
</tr>
<tr>
<td>EMG</td>
<td></td>
</tr>
<tr>
<td>TIME LINE/Sec.</td>
<td>10:19</td>
</tr>
<tr>
<td>HEART Chest Lead</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>HEART Arm to Arm</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>GSR</td>
<td>5.30 mV</td>
</tr>
<tr>
<td>RESPIRATION</td>
<td></td>
</tr>
<tr>
<td>TEMPERATURE</td>
<td>Skin 90.4°F Room 82.0°F</td>
</tr>
</tbody>
</table>

**BASELINE**

**INTRODUCTION OF Axillary Secretion collected from Subject A**

**RELAXATION**
Table 3
Summary: Erotic Condition

<table>
<thead>
<tr>
<th>SUBJECT A</th>
<th>SUBJECT B</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EMG</strong></td>
<td><strong>EMG</strong></td>
</tr>
<tr>
<td><strong>TIME LINE/Sec.</strong></td>
<td><strong>TIME LINE/Sec.</strong></td>
</tr>
<tr>
<td>11:19</td>
<td>11:38</td>
</tr>
<tr>
<td>11:20</td>
<td>11:27</td>
</tr>
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<td><strong>HEART</strong></td>
<td><strong>HEART</strong></td>
</tr>
<tr>
<td><strong>Chest Lead</strong></td>
<td><strong>Chest Lead</strong></td>
</tr>
<tr>
<td>500 mV</td>
<td>500 mV</td>
</tr>
<tr>
<td><strong>GSR</strong></td>
<td><strong>GSR</strong></td>
</tr>
<tr>
<td>5.45</td>
<td>3.63</td>
</tr>
<tr>
<td><strong>RESPIRATION</strong></td>
<td><strong>RESPIRATION</strong></td>
</tr>
<tr>
<td><strong>TEMPERATURE</strong></td>
<td><strong>TEMPERATURE</strong></td>
</tr>
<tr>
<td>Skin 96.8°F Room 72.0°F</td>
<td>Skin 95.8°F Room 72.0°F</td>
</tr>
<tr>
<td><strong>HEART</strong></td>
<td><strong>HEART</strong></td>
</tr>
<tr>
<td><strong>Arm to Arm</strong></td>
<td><strong>Arm to Arm</strong></td>
</tr>
<tr>
<td>500 mV</td>
<td>500 mV</td>
</tr>
<tr>
<td><strong>GSR</strong></td>
<td><strong>GSR</strong></td>
</tr>
<tr>
<td>5.45</td>
<td>3.63</td>
</tr>
<tr>
<td><strong>RESPIRATION</strong></td>
<td><strong>RESPIRATION</strong></td>
</tr>
<tr>
<td><strong>TEMPERATURE</strong></td>
<td><strong>TEMPERATURE</strong></td>
</tr>
<tr>
<td>Skin 94.2°F Room 75.0°F</td>
<td>Skin 93.4°F Room 74.0°F</td>
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</table>

BASELINE
INTRODUCTION OF Axillary Secretion collected from Subject A
EROTIC

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Table 4
Summary: Repulsive Condition
Table 5

Summary: Axillary Introduction All Conditions

Table 1
CONDITION: EXERCISE
12 August 1985

<table>
<thead>
<tr>
<th></th>
<th>TIME LINE/Sec.</th>
<th>HEART Chest Lead</th>
<th>HEART Arm to Arm</th>
<th>GSR</th>
<th>RESPIRATION</th>
<th>TEMPERATURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMG</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>11:21 - 11:22</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

INTRODUCTION OF Axillary Secretion collected from Subject A

Table 2
CONDITION: RELAXATION
14 August 1985

<table>
<thead>
<tr>
<th></th>
<th>TIME LINE/Sec.</th>
<th>HEART Chest Lead</th>
<th>HEART Arm to Arm</th>
<th>GSR</th>
<th>RESPIRATION</th>
<th>TEMPERATURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMG</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>12:27 - 12:38</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

INTRODUCTION OF Axillary Secretion collected from Subject A

Table 3
CONDITION: EROTIC
19 August 1985

<table>
<thead>
<tr>
<th></th>
<th>TIME LINE/Sec.</th>
<th>HEART Chest Lead</th>
<th>HEART Arm to Arm</th>
<th>GSR</th>
<th>RESPIRATION</th>
<th>TEMPERATURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMG</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>12:20 - 12:21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

INTRODUCTION OF Axillary Secretion collected from Subject A

Table 4
CONDITION: REPULSIVE
21 August 1985

<table>
<thead>
<tr>
<th></th>
<th>TIME LINE/Sec.</th>
<th>HEART Chest Lead</th>
<th>HEART Arm to Arm</th>
<th>GSR</th>
<th>RESPIRATION</th>
<th>TEMPERATURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMG</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10:01 - 10:03</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

INTRODUCTION OF Axillary Secretion collected from Subject A

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**Data Abridgment and Analysis**

Table 1, Table 2, Table 3, and Table 4 strongly suggest physiological arousal of the subject when an axillary secretion produced under different stress conditions is introduced. These tables support the same findings stated in the first four hypotheses above in that they are the same records offered in a different format. Table 5 presents the physiological records taken for Subject B during the introduction of axillary secretion from Subject A during each of the four conditions. Observable differences are noted for each record given in Table 5; these differences are noted individually as well in comparison to the baseline record for each condition.

**Findings and Interpretations**

A comparison of the baseline record and the record during the introduction of the axillary secretion, as well as a comparison of the records from all four stress conditions, focusing on Subject B's record during sweat introduction for each stress condition (Table 5), both suggest that Null Hypothesis Number 5 should be rejected. The findings strongly suggest that the body can and does differentiate among types of sweat produced under different stress conditions.
Null Hypothesis Number 6

There is no discriptively significant aptitude noted in the group subjects' ability to correctly identify a sample as containing axillary secretion.

Data and Analysis

A pool of thirty-eight individuals examined different sweat samples in a total of 124 trials; 81.5%, or 101 trials, were reported correctly as a sample of axillary secretion. On 12 August 1985, 21 members (63.0%) of Group 1 (N=33) identified correctly the sample as human sweat. On 14 August 1985, 21 members (84.0%) of Group 2 (N=25) correctly identified the sample as human sweat. In Group 3 (N=32) on 19 August 1985, 29 (90.6%) members correctly identified the sample as human sweat. On 21 August 1985, 30 members (88.2%) of Group 4 (N=34) correctly identified the sample as sweat.

Table 6
Sample Discrimination

<table>
<thead>
<tr>
<th>No. of N Correct</th>
<th>Percent Accurate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1 (N=33)</td>
<td>21</td>
</tr>
<tr>
<td>Group 2 (N=25)</td>
<td>21</td>
</tr>
<tr>
<td>Group 3 (N=32)</td>
<td>29</td>
</tr>
<tr>
<td>Group 4 (N=34)</td>
<td>30</td>
</tr>
<tr>
<td>Total trials=124</td>
<td>101</td>
</tr>
</tbody>
</table>
Findings and Interpretations

An examination of the number of attempts where the subjects responded correctly--i.e., where the sample did contain axillary secretion--suggests that Null Hypothesis Number 6 should be rejected. An aptitude is noted in the group members' ability to recognize sweat.

Null Hypothesis Number 7

"There is no aptitude noted in the group subjects' ability to accurately identify the gender of the sample donor."

Data and Analysis

Eight-one and five tenths (81.5) percent (101 responses) of 124 trials identified the sample as axillary secretion; sixty-three and three tenths (63.3) percent (64 trials) correctly identified the sweat sample as male. Fifty-nine and three tenths (59.3) percent of the 64 responses identified the male smell as neutral and 39.0% reported the male smell as being unpleasant. On 12 August 1985, 11 subjects (52.3%) of Group 1 (N=21) correctly assigned the sample to a male donor. On 14 August 1985, 16 subjects (76%) of Group 2 (N=21) correctly assigned the sample to a male donor. Of Group 3 (N=29), on 19 August 1985, 17 subjects (58.8%) correctly assigned the sample to
1985, 17 subjects (58.8%) correctly assigned the sample to a male donor; and of Group 4 (N=30), on 21 August 1985, 20 subjects (66.6%) correctly assigned the sample of sweat to a male donor (Table 7).

Findings and Interpretations

The mean averages from each of the four test groups and the mean average of the aggregate total data from the responses from all four groups suggest that Null Hypothesis Number 7 is rejected. The ability of the group members to cognitively distinguish a sample of sweat as coming from a male donor is consistent with current research literature.

Null Hypothesis Number 8

"There are no discriptively significant differences noted in the group subjects' ability to identify the actual condition the donor subject experienced in producing each of the samples."

Data and Analysis

Sixty-three (63) percent of Group 1 identified the sweat sample produced by Subject B during the exercise condition as axillary secretion (Table 6). When the members of Group 1 were requested to determine the stress
Table 7
Axillary Sample Identification

<table>
<thead>
<tr>
<th>Subjects' Response Pattern</th>
<th>No. Correct Responses</th>
<th>Percent Accurate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>11</td>
<td>52.3%</td>
</tr>
<tr>
<td>(N=21)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 2</td>
<td>16</td>
<td>76.0%</td>
</tr>
<tr>
<td>(N=16)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 3</td>
<td>17</td>
<td>58.8%</td>
</tr>
<tr>
<td>(N=29)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 4</td>
<td>20</td>
<td>66.6%</td>
</tr>
<tr>
<td>(N=30)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>64</td>
<td>63.3%</td>
</tr>
<tr>
<td>trials=101</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Subjective Pleasantness of Sample

Sixty-four (64) reactions to the male samples:

- Pleasant: 01.7%
- Neutral: 59.3%
- Unpleasant: 39.0%

condition that produced the sweat they responded as follows: Rest 28.5%; Sexual arousal 19.0%; Work 52.0%; and Fear.

Eighty-four (84) percent of Group 2 identified the sweat sample produced by Subject B during the relaxation...
condition as axillary secretion (Table 6). When Group 2 was requested to determine the stress condition that produced the sweat they responded as follows: Rest 23.8%; Sexual arousal 4.8%; Work 57.1%; and Fear 14.2%.

Ninety and six tenths (90.6) percent of Group 3 identified the sweat sample produced by Subject B during the sexual arousal condition as axillary secretion (Table 6). When the participants in Group 3 were requested to determine the stress condition that produced the sweat they responded as follows: Rest 17.2%; Sexual arousal 20.6%; Work smells 34.4%; and Fear 27.6%.

Eighty-eight and two tenths (88.2) percent of Group 4 identified the sweat sample produced by Subject B during the repulsion condition as axillary secretion (Table 6). When the members of Group 4 were requested to determine the stress condition that produced the sweat they responded as follows: Rest 20.0%; Sexual arousal 26.6%; Work 36.6%; and Fear smells 16.7%.

"Work" was the most frequently chosen classification (see Table 8) regardless of which stress condition produced the sweat sample. If the "Work" selection is eliminated from Table 8, in column 2 "Rest" is the second selection. In columns 3 and 4 a most interesting situation is noted; in column 3 (Erotic) the second most frequent response was "Fear," and in column 4 (Repulsion) the second most frequent choice was "Sex."
Table 8
Axillary Sample Classification

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Rest</td>
<td>28.5%</td>
<td>23.8%</td>
<td>17.2%</td>
<td>20.0%</td>
</tr>
<tr>
<td>Sex</td>
<td>19.0%</td>
<td>04.8%</td>
<td>20.6%</td>
<td>26.6%</td>
</tr>
<tr>
<td>Work</td>
<td>52.3%</td>
<td>57.1%</td>
<td>34.4%</td>
<td>36.6%</td>
</tr>
<tr>
<td>Fear</td>
<td>00.0%</td>
<td>14.2%</td>
<td>27.6%</td>
<td>16.7%</td>
</tr>
</tbody>
</table>

Findings and Interpretation

An examination of the data presented offers limited results in attempting to answer if cognitive discrimination of emotional/stress states is a human ability. Group 1 selected the correct stress condition (work) that produced that specific sample. Noted, however, was the selection "Work" made by Group 1, was also the most common selection made by all other groups, though other stress conditions were employed in the production of those samples. It is uncertain if humans may have an ability to discriminate "Work" from this study, if "Work" is the predominant sample selection regardless of the stress condition. It is questioned if the choice of "Work" was some unidentified artifact of the questionnaire, or simply whether work smells are the odors our culture
recognizes—as the smelling of this body secretion is currently socially acceptable (health clubs, locker rooms, etc.) and most noticeable. Since cognitive discrimination requires repeated experience with a specific sample it is most possible that only slight nuances of odor differences exist in the different stress produced sweat samples, and therefore discrimination may become difficult. The fact that subjects selected "Work" as their primary choice regardless of the actual stress condition could also be a by-product of familiarity; as an observation, if the selection of "Work" is disregarded for the other three conditions listed on Table 8, the second choice suggests some discrimination (i.e., "Rest" is selected for the sweat produced under a relaxation condition; "Sexual arousal" is selected for sweat produced under repulsive condition; and "Fear" is selected for sweat produced under the sexual arousal/erotic condition). Although the choice for Group 3 and Group 4 does not correspond with the identified condition that produced the sweat sample, the psychoanalytic literature suggests that there is a strong correlation between fear and sex (Freud, 1910), therefore further investigation is warranted. There appeared to be no influence of choice based on the subjective ratings of the subjects on the "pleasantness" or "unpleasantness" of the sample. Due to methodological constraints the mixed results presented the Null Hypothesis Number 8 fails to be
Eight null hypotheses were established to examine the question of the extent of human ability to differentiate physiologically and to discriminate cognitively emotional states through olfactory chemosensory communication. The first four null hypotheses were rejected, which suggests that humans are physiologically aroused by the sweat productions of others. Null Hypothesis Number 5, dealing with physiological differentiation, was rejected, which suggests that humans have the ability to physiologically differentiate among axillary secretions produced under different stress conditions. The last three hypotheses focused on human ability to cognitively discriminate biological and emotional states from human sweat odors. Null Hypothesis Number 6 was concerned with the ability to distinguish an odor as axillary secretion; as the results of the study support the idea that human subjects are able to identify an odor as sweat, as such Null Hypothesis 6 is rejected. Null Hypothesis Number 7 was concerned with group members' ability to discriminate gender from the sweat samples. The data suggests an agreement with current literature, that is, individuals appear able to perceive gender from the axillary sample; consequently, Null
Hypothesis 7 is rejected. Null Hypothesis Number 8 was interested with the group members' ability to discriminate the stress conditions that produced a given odor. The results were not conclusive; the data suggested that members of the group were able to discriminate odor produced under the stress condition of exercise, but not under the other three stress conditions. Thus, Null Hypothesis Number 8 cannot be rejected.

To conclude, the study suggests that humans appear to have an ability to differentiate physiologically among axillary secretions produced under different stress conditions, and to discriminate cognitively axillary secretion and gender from these same secretions, but due to methodological constraints, the ability to identify the actual stress condition was not shown. The issue if humans can discriminate stress conditions from body odor needs further study.
CHAPTER IV

SYNOPSIS AND CONCLUSIONS

Synopsis

Both scientific and popular literature offer a large number of examples where animals have the ability to detect biological information from members of the same species through olfactory chemosensory communication. Such information may pertain to, among other things, gender, sexual receptivity, kin, and emotional states. The same literature suggests that humans may have the this ability of transmitting and receiving biological information through olfactory chemosensory communication as well, yet the medium or excreta (pheromone) for transmission has been supposed to be apocrine gland secretion only, and the mechanism for olfactory or airborne chemosensory reception is not fully understood. The purpose of this study was to examine the extent of human ability to differentiate physiologically and/or to discriminate cognitively different human axillary secretions produced under different stress conditions through olfactory chemosensory communication.

To examine these issues two studies were conducted: the primary study focused on the human ability to
differentiate physiologically fresh sweat produced under four different stress conditions, with the recipient receiving the sample via olfaction; the secondary study centered on cognitive discrimination by means of the use of smell of "aged" (held at 39° F for circa twelve hours) sweat samples produced under different stress conditions, through the medium of smell.

**Primary Study**

The subjects for this study were a single male dyad, both in their twenties. One subject acted as donor subject (Subject A) and the other as recipient (Subject B). The donor subject (Subject A) was prepared so that his axillary secretions were collected on a cotton gauze pad. The donor was attached to physiological monitoring devices and then underwent a specific stress condition. After stressing, the cotton pads which were presumed to contain a fresh non-odoriferous axillary secretion, were removed, sandwiched between two paper surgical masks, wrapped in a plastic film, and refrigerated. Less than forty-five minutes later the sample was removed from the refrigerator and placed over the recipient subject's (Subject B) nose and mouth. The recipient's physiological responses were recorded on a polygraph. Later these physiological records were compared to the physiological record of the donor taken during the stress condition, the baseline record.
produced by the recipient subject prior to sweat introduction, and the physiological record produced by the recipient subject during the introduction of the axillary secretion. The four stress conditions employed were (1) Exercise, (2) Relaxation, (3) Sexual Arousal, and (4) Repulsion. Results. Subject B's physiological response patterns changed when the sweat samples were presented. The way in which these patterns were altered suggested that some form of "biological empathy" took place. When the recipient was exposed to the sample produced by "Exercise," muscle tension increased slightly, his heart rate increased, breathing changed, and skin temperature increased. When the recipient experienced the sweat sample collected during the "Relaxation" condition, muscle tension reduced and heart beat became regular, GSR increased, breathing became shallow and regular, and skin temperature increased. When the recipient was offered the sweat sample produced under the "Erotic" condition, muscle tension increased, heart rate became irregular and slightly increased, the GSR decreased, respiration changed to deeper and slightly slower breathes, and skin temperature decreased slightly. In this instance it was particularly notable that the recipient subject began producing a cardiac record that was similar to the cardiac record produced by Subject A; this unusual arrhythmia was almost a direct duplication of the donor's cardiac record produced during
the erotic condition. When the recipient was exposed to the sample produced under the "Repulsive" condition, physiological response patterns altered, with the muscle tension slightly increasing, the heart rate and GSR increasing, respiration changing by becoming more rapid and shallow, and skin temperature decreasing. In each case the physiological response pattern of the recipient (Subject B) was altered, displaying a similar but less intense version of the physiological response pattern produced by the donor subject when the donor experienced the specific stress condition.

Secondary Study

A single subject was employed to provide the axillary secretions produced under the four different stress conditions (same conditions as in the Primary Study): (1) Exercise, (2) Relaxation, (3) Sexual Arousal, and (4) Repulsion. Each sample was collected on a cotton gauze pad placed in the axillary regions of the donor subject. After the donor subject experienced a specific stress condition, the sample was taken from the subject, put in a non-odoriferous plastic container and placed in a refrigerator for twelve to fourteen hours.

Each sample was presented to four groups which smelled the sample and filled out a forced choice questionnaire; the groups were formed from a core pool of
38 subjects, as such some group members participated in the identification of more than one sample. **Results.** The information discriminated by the groups was limited to (a) whether a container contained an axillary sample or not, (b) the gender of the donor who produced the samples, and (c) the stress condition the donor subject experienced in the production of the axillary secretion samples. The four groups, in 124 trials, identified the samples as axillary secretion 81.5% of the time. The four groups, in 101 trials, accurately identified the donor as male 63.3% of the time. The group subjects' ability to discriminate stress states was not determined. The group members accurately, with a high percentage frequency (52.3%), selected "Work" for the axillary secretion produced under the exercise condition; however, "Work" was the most common response regardless of the stress condition that produced the sample. If the response "Work" was discounted, the next greatest response given for the relaxation produced sample was "Rest." In identifying the sample produced under the sexual arousal condition the second largest number of respondents chose "Fear." For the sample produced under the repulsive condition the group's second choice was "Sexual arousal."
Conclusions

Owing to the differences in the nature of the two studies, the conclusions and implications of each are presented separately in this section. A general assessment of the methodological constraints marking the research as a whole and the directions for further study implied therein.

Primary Study

The findings from the primary study suggest that humans not only have the ability to differentiate physiologically emotional states via olfactory chemosensory communication in a type of "biological empathy," but that they appear to have little awareness of or control over this phenomenon. Since fresh sweat produced under any stress condition has little or no odor, and therefore is not subject to conscious cognitive discrimination, humans may have little control over this "echoing" of the emotional states of others.

The implications and ramifications of the results of the physiological differentiation study may be far-reaching. The discovery of an unconscious ability to emulate another individual's emotional states could have problematic as well as positive effects. This "biological empathy" may play an important role in such fields as
psychology, psychiatry and medicine. In the realm of treatment, for example, it would affect the way in which health care authorities house/hospitalize patients with mental illness, or stress disorders, or individuals who are experiencing a stress-filled situation; it might affect the way in which therapists set up their therapeutic environment, e.g., air treatment during therapy sessions. On a broader level it would influence the way in which we regard tension and distress in family and marital therapy. In the field of pharmacology, it opens up the potential of creating a psychotropic compound that can be administered through the olfactory system, thus avoiding some of the problems that are present in standard pharmacology by bypassing the blood brain barrier. In criminology and sociology, a fuller understanding of this "biological empathic" process has implications, both positive and negative, for aiding in the function of crowd control. In politics, labor relations and diplomacy "biological empathy" may prove a useful tool in processes of mediation and conflict resolution. The potential significance of this phenomenon should not be underestimated.

Secondary Study

The results of the secondary study are in keeping with current research literature, suggesting that the
gender of an individual can be discriminated from body odors. The nature of the ability to discriminate stress states is unclear. From this study it is uncertain if humans have the ability to discriminate cognitively stress conditions; this type of discrimination takes experience/learning, cultural factors also seem to play a considerable role. The data suggest that stress states that are culturally acceptable (i.e., work and exercise) might be distinguishable, with less familiar stress smells (e.g., rest, sexual arousal, repulsion, etc.) may require direct training and/or conscious experience to be differentiated; but due to methodological limitations this cannot be asserted from this study.

The most significant aspect of the findings noted from the secondary study was a side issue, the length of sample contact for cognitive recognition of gender. The average length of sample contact was less than ten seconds.

General Limitations of Study

A number of factors have the potential to threaten the validity of this study, ranging from the fact that human excreta are altered by almost every life condition (e.g., food intake, medication, environment, health, etc.), to the fact that neither the medium for biological information transfer via an airborne transmission nor the mechanism for reception of the airborne transmission is
fully understood at this time.

However strong the research design may be, the presence of so many unknowns is one of the greatest factors to threaten this type of study. Moreover, because of the small sample utilized, the findings can only be presumed.

Although the directions for future research posed by the findings in the Primary and Secondary Studies are numerous, the first and most important step must be replication of the experiments, followed by an expansion of the process. Only then will it be possible to investigate other mechanisms more fully.
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Appendix A

Physiological Arousal Screening Form
PHYSIOLOGICAL AROUSAL TO OLFATORY STIMULATION RESEARCH

SCREENING FORM

RETURN FORM TO:

ROBERT G. PERRA
11081 GREER DRIVE
RICHLAND, MICHIGAN 49083

(Addressed, stamped envelope enclosed.)
PHYSIOLOGICAL AROUSAL TO OLFATORY STIMULATION RESEARCH

SCREENING FORM

This screening form has two purposes, firstly, to give you enough information to decide whether or not you are interested or able to participate in this study, and secondly to find out if you meet our requirements for participation in this study.

We thank you for giving us a few minutes of your time, to consider whether or not you are in a position to help us in this research project. If you are selected as one of the participants you may be committing yourself to between six (6) to fourteen (14) early mornings. Although we are somewhat flexible in the definition of "early morning", and are willing to attempt to work with you to set up a mutual timeframe, we are interested in gathering the information we need as quickly as possible, and as such you may have to find time between 7:00 AM and 12:00 noon (the exact time(s) will be agreed upon between the selected subject and the researcher).

At this point, if you have not ruled out the possibility of being a participant, please understand that if selected you may be required to refrain from certain "product types" (deodorant soaps, shampoos, etc.) that you may use on a regular basis; to refrain from drinking alcoholic beverages, or taking any other recreational drugs (including, but not limited to, tobacco, etc.); to be required to keep a diary of your food intake; and/or to be required to engage in other tasks that may/can disrupt your normal lifestyle.

IF AFTER READING THE ABOVE YOU ARE NOT WILLING TO PARTICIPATE IN THIS STUDY PLEASE RETURN THIS FORM TO THE RESEARCHER; AND THANK YOU FOR YOUR CONSIDERATION.

IF AFTER READING THE ABOVE YOU ARE WILLING TO CONSIDER PARTICIPATION FURTHER, PLEASE CONTINUE READING.
PARTICIPANT DUTIES/FUNCTIONS

LEVELS/STAGES OF SCREENING

STAGE ONE

Participants will be asked to fill out the attached questionnaire; based on the answers given, and a random selection process developed, ten (10) subjects will be selected for this study.

TIME REQUIREMENT: 20 Minutes.

STAGE TWO

The ten (10) subjects selected will be asked to make arrangements for psychological testing and a screening interview, the arrangements can be according to the subjects schedule, but will be required to be completed within ten (10) days. From the "profiles" from the screening and psychological test, and by a random selection process we have developed, four (4) to six (6) subjects will be selected.

TIME REQUIREMENT: 1 1/2 to 2 hours for the testing.
1/2 hour for interview.

STAGE THREE

Four (4) to six (6) subjects will undergo further testing, where they will be asked to smell standardized samples of different substances. From that screening session, two (2) of the group will be selected for this study, the rest will be dismissed.

TIME REQUIREMENT: Two mornings (about 6 hrs.)

STAGE FOUR

The two (2) subjects will be "hooked up" to monitoring equipment, and once comfortable with the equipment attached to their body, each subject will be subjected to different visual and/or olfactory stimulation, and/or will be asked to engage in a specified physical activity (the visual material may include sexually explicit material and/or physically repulsive material; the physical activity may include relaxation and/or physical exercise).

TIME REQUIREMENT: Four to eight mornings (8 to 16 hrs.)
IF AFTER READING THE ABOVE YOU ARE NOT WILLING TO PARTICIPATE IN THIS STUDY PLEASE RETURN THIS FORM TO THE RESEARCHER; AND THANK YOU FOR YOUR CONSIDERATION.

IF AFTER READING THE ABOVE YOU ARE WILLING TO CONSIDER FURTHER PARTICIPATION PLEASE CONTINUE.

The rest of this form is broken into three sections, that will take about five (5) minutes to ten (10) minutes to complete. The first section deals with "consent giving"; second with general background; and third with habits.
SECTION I

RESEARCH CONSENT FORM

PHYSIOLOGICAL AROUSAL TO OLFACTORY STIMULATION

I, the undersigned, understand that participation in this research project is voluntary, and that I may withdraw my active participation at anytime, without notice; I also understand that withdrawal in no way will create a personal or academic liability, stated or implied.

It is my understanding that the design of this research is considered "neutral" as judged by a team of psychologists and a "human subjects committee"; this means that this study has been judged to have little to no risk to the participants. It should be noted that no study can state nor imply total and complete absence of risk, and the participant takes responsibility in that understanding.

I further understand that no person other than the researcher shall be allowed to obtain any individual's scores or other data without the expressed permission of that individual. The information obtained will be utilized for research purposes only.

( ) I would or ( ) I would not like to request an abstract of the results of this research.
(If an abstract is desired please give following)

Name: ____________________________

Address: __________________________

I certify that I am over eighteen (18) years of age, that I have read and understood the above statement; and I read a description of the activities that are involved; with this I give my informed consent to participate in this project.

______________________________  ________________________
Signature                          Date
SECTION II

BACKGROUND INFORMATION ON PARTICIPANT

1.) GENDER:
   ( ) Male
   ( ) Female

2.) DO YOU SMOKE?:
   ( ) Yes
   ( ) No

3.) AGE:
   ( ) 18 yrs to 25 yrs
   ( ) 26 yrs to 30 yrs
   ( ) 30 yrs to 40 yrs
   ( ) 41 yrs to 55 yrs
   ( ) Over 55 years old

4.) GENERAL HEALTH
   ( ) Excellent
   ( ) Very Good
   ( ) Good
   ( ) Fair
   ( ) Poor

5.) ETHNIC/NATIONAL/RACIAL ORIGIN:
   ( ) Caucasian/European
   ( ) Caucasian/Mediterranean
   ( ) Middle Eastern/Mediterranean
   ( ) African/Mediterranean
   ( ) African/Black
   ( ) Oriental/Asian
   ( ) American Native
   ( ) Other/Mixed

6.) EDUCATION:
   ( ) Freshperson
   ( ) Sophomore
   ( ) Jr./Sr.
   ( ) Grad./MA
   ( ) Grad./PhD
   ( ) Faculty
   ( ) Univ. Empty
   ( ) Other

7.) ANY CURRENT ILLNESSES FOR WHICH MEDICATION IS BEING TAKEN?
   ( ) Yes
   ( ) No

8.) ARE YOU ON ANY MEDICATIONS?
   ( ) Yes
   ( ) No

9.) DO YOU HAVE ANY SINUS CONDITIONS?
   ( ) Yes
   ( ) No

10.) DO YOU HAVE A COLD / ALLERGY?
     ( ) Yes
     ( ) No

11.) I GREW UP MOSTLY IN THE FOLLOWING TYPE OF AREA:
     ( ) Metropolitan/Industrial Area (>500,000)
     ( ) Urban Area (Large City, >200,000)
     ( ) Urban Area (Small City, <200,000)
     ( ) Suburban Area (Large City)
     ( ) Suburban Area (Small City)
     ( ) Town
     ( ) Rural Area

12.) HAVE YOU RECENTLY (last 14 days) USED ANY MEDICATIONS AND/OR DRUGS THAT YOU INHALED THROUGH YOUR NOSE?
     ( ) Yes
     ( ) No
PLEASE ANSWER THE FOLLOWING QUESTIONS "TRUE" OR "FALSE"
If you find it difficult to answer the question TRUE or FALSE, then please ask yourself if it is MOSTLY TRUE or MOSTLY FALSE, and answer accordingly.

13.) I have a cough most of the time.
   ( ) TRUE
   ( ) FALSE

14.) I am in just as good physical health as my friends.
   ( ) TRUE
   ( ) FALSE

15.) There seems to be a fullness in my head or nose most of the time.
   ( ) TRUE
   ( ) FALSE

16.) Everything tastes the same.
   ( ) TRUE
   ( ) FALSE

17.) Peculiar odors come to me at times.
   ( ) TRUE
   ( ) FALSE

18.) I am attracted by members of the opposite sex.
   ( ) TRUE
   ( ) FALSE

19.) I believe my sense of smell is as good as other people's.
   ( ) TRUE
   ( ) FALSE

20.) My mouth feels dry almost all the time.
   ( ) TRUE
   ( ) FALSE

21.) On a scale of one (1) to five (5), with five (5) being the highest sense of smell, I believe my sense of smell to be measured as:
   <most>( )"5" ( )"4" ( )"3" ( )"2" ( )"1"<least>

22.) ****WOMEN ONLY****: Currently on birth control pills?:
   ( ) YES
   ( ) NO
SECTION III

The following questions are interested in personal habits, please remember that ALL information given is confidential, and its use will be used for research only.

23.) I have no medical skin conditions which I have been treated for within the past year.
( ) TRUE
( ) FALSE

24.) I have never been diagnosed as having any medical disorders associated with taste and/or smell.
( ) TRUE
( ) FALSE

25.) I have not used (and I am willing not to use for the duration of this study) any psychotropic (mind altering drugs/compounds) drugs, including alcohol and tobacco, for a minimum of seven days.
( ) TRUE
( ) FALSE

26.) I have not used any marihuana for a minimum of twenty (20) days, and I'm willing not to use any for the duration of this study.
( ) TRUE
( ) FALSE

27.) I am not morally offended or repulsed by sexually explicit materials.
( ) TRUE
( ) FALSE

28.) I am sexually aroused by sexually explicit materials.
( ) TRUE
( ) FALSE

29.) I have been diagnosed as having a mental condition.
( ) TRUE
( ) FALSE

30.) I shower rather than taking a tub bath when I clean.
( ) TRUE
( ) FALSE
31.) I clean (shower or bath) regularly (once per week or more).
   ( ) TRUE
   ( ) FALSE

32.) When I wash I use deodorant soaps and sprays regularly.
   ( ) TRUE
   ( ) FALSE

33.) I regularly use body oils, after shaves, colognes, and/or perfumes.
   ( ) TRUE
   ( ) FALSE

34.) I find that I sweat or perspire more than other people.
   ( ) TRUE
   ( ) FALSE

35.) I have been diagnosed as having a heart condition or other related conditions.
   ( ) TRUE
   ( ) FALSE

IF AFTER FILLING OUT THE ABOVE QUESTIONNAIRE YOU ARE NOT WILLING TO PARTICIPATE IN THIS STUDY PLEASE RETURN THIS FORM TO THE RESEARCHER; AND THANK YOU FOR YOUR CONSIDERATION.

IF AFTER FILLING OUT THE ABOVE QUESTIONNAIRE YOU ARE WILLING TO PARTICIPATE IN THIS STUDY PLEASE PRINT YOUR NAME, ADDRESS, AND TELEPHONE NUMBER BELOW, AND THEN RETURN THIS FORM TO THE RESEARCHER.

Name: __________________________________________
Address: _______________________________________
          _______________________________________
Phone: __________________________________________

THANK YOU
Appendix B

Olfactory Discrimination Survey
OLFACTORY DISCRIMINATION SURVEY

Thank you for taking a few minutes of your time to help with this research project; we estimate that your participation will take about five (5) to (10) minutes.

This survey will ask of you three different categories of information. The first is "informational/consent giving", it will ask from you to sign a consent form, giving your permission for us, as researchers, to use the information you are considering to provide us; the second is background information about you...your gender, age, sexual history information, ethnic background, etc.; the third is asking you to "smell" (on different days) four (4) samples and give, on the reporting sheet, one or two pieces of information.

IF AFTER READING THE ABOVE YOU ARE WILLING TO PARTICIPATE PLEASE TURN THE PAGE AND CONTINUE.

IF AFTER READING THE ABOVE YOU ARE NOT WILLING TO PARTICIPATE IN THIS STUDY PLEASE RETURN THIS FORM TO THE RESEARCHER; AND THANK YOU FOR YOUR CONSIDERATION.
SECTION I

RESEARCH CONSENT FORM

OLFATORY DISCRIMINATION RESEARCH

I, the undersigned, understand that participation in this research project is voluntary, and that I may withdraw my active participation at any time, without notice; I also understand that withdrawal in no way will create a personal or academic liability, stated or implied.

It is understood that the design of this research is considered "neutral" as judged by a team of psychologists and a "human subjects committee"; this means that this study has been judged to have little to no risk to the participants. It should be noted that no study can state or imply total and complete absence of risk, and the participant holds responsibility in this understanding.

I further understand that no person other than the participant shall be allowed to obtain any individual's scores or other data without the expressed permission of that individual. The information obtained will be utilized for research purposes only.

( ) I would or ( ) I would not like to request an abstract of the results of this research.

(If an abstract is desired please give following)

Date: ____________________________

Address: ____________________________

I certify that I am over eighteen (18) years of age, that I have read and understood the above statement; and I read a description of the activities that are involved; with this I give my informed consent to participate in this project.
SECTION II

BACKGROUND INFORMATION ON PARTICIPANT

1.) GENDER:
( ) Male
( ) Female

2.) DO YOU SMOKE?:
( ) Yes
( ) No

3.) AGE:
( ) 18 yrs to 25 yrs
( ) 26 yrs to 30 yrs
( ) 30 yrs to 40 yrs
( ) 41 yrs to 55 yrs
( ) Over 55 years old

4.) GENERAL HEALTH
( ) Excellent
( ) Very Good
( ) Good
( ) Fair
( ) Poor

5.) ETHNIC/NATIONAL/RACIAL ORIGIN:
( ) Caucasian/European
( ) Caucasian/Mediterranean
( ) Middle Eastern/Mediterranean
( ) African/Mediterranean
( ) African/Black
( ) Oriental/Asian
( ) American Native
( ) Other/Mixed

6.) EDUCATION:
( ) Freshperson
( ) Sophomore
( ) Jr./Sr.
( ) Grad./MA
( ) Grad./PhD
( ) Faculty
( ) Univ. Emply
( ) Other

7.) ANY CURRENT ILLNESSES FOR WHICH MEDICATION IS BEING TAKEN?
( ) Yes
( ) No

8.) ARE YOU ON ANY MEDICATIONS?
( ) Yes
( ) No

9.) DO YOU HAVE ANY SINUS CONDITIONS?
( ) Yes
( ) No

10.) DO YOU HAVE A COLD / ALLERGY?
( ) Yes
( ) No

11.) I GREW UP MOSTLY IN THE FOLLOWING TYPE OF AREA:
( ) Metropolitan/Industrial Area (>500,000)
( ) Urban Area (Large City, >200,000)
( ) Urban Area (Small City, <200,000)
( ) Suburban Area (Large City)
( ) Suburban Area (Small City)
( ) Town
( ) Rural Area

12.) HAVE YOU RECENTLY (last 14 days) USED ANY MEDICATIONS AND/OR DRUGS THAT YOU INHALED THROUGH YOUR NOSE?
( ) Yes
( ) No
PLEASE ANSWER THE FOLLOWING QUESTIONS "TRUE" OR "FALSE"
If you find it difficult to answer the question TRUE or FALSE, then please ask yourself if it is MOSTLY TRUE or MOSTLY FALSE, and answer accordingly.

13.) I have a cough most of the time.
   ( ) TRUE
   ( ) FALSE

14.) I am in just as good physical health as my friends.
   ( ) TRUE
   ( ) FALSE

15.) There seems to be a fulness in my head or nose most of the time.
   ( ) TRUE
   ( ) FALSE

16.) Everything tastes the same.
   ( ) TRUE
   ( ) FALSE

17.) Peculiar odors come to me at times.
   ( ) TRUE
   ( ) FALSE

18.) I am attracted by members of the opposite sex.
   ( ) TRUE
   ( ) FALSE

19.) I believe my sense of smell is as good as other people's.
   ( ) TRUE
   ( ) FALSE

20.) My mouth feels dry almost all the time.
   ( ) TRUE
   ( ) FALSE

21.) On a scale of one (1) to five (5), with five (5) being the highest sense of smell, I believe my sense of smell to be measured as:
   <most> ( ) "5" ( ) "4" ( ) "3" ( ) "2" ( ) "1" <least>
22.) ****WOMEN ONLY****: Currently on birth control pills?:
   ( ) YES
   ( ) NO

23.) Have you had your tonsiles removed?
   ( ) YES
   ( ) NO

24.) Have you had your adenoids removed?
   ( ) YES
   ( ) NO
SECTION III

Directions: Along the table you will see a "smelling box", labeled either "Sample A", "Sample B", or so on. You are asked to smell the sample and indicate whether the smelling box is "empty/no perceivable odor" (contains 'no real' sample), or "loaded" (contains a 'real' sample); if you believe that the "smelling box" is "loaded", you are asked to identify the sample as being one of the following: "rest smells", "sexual smells", "work smells", "fear smells"; once you have examined the sample, if you believe it to be "loaded", you are asked to label the sample as pleasant or unpleasant, and then indicate if the donor was male or female.

SAMPLE A

( ) Empty/No Perceivable Smells
( ) Loaded (Contains a 'real' sample.)
   ( ) Rest Smells
   ( ) Sexual Smells
   ( ) Work Smells
   ( ) Fear Smells
IF "LOADED" PLEASE ANSWER THE FOLLOWING:

( ) Pleasant Smell ( ) Neutral ( ) Unpleasant Smell

The sample came from a ( ) Male ( ) Female donor

SAMPLE B

( ) Empty/No Perceivable Smells
( ) Loaded (Contains a 'real' sample.)
   ( ) Rest Smells
   ( ) Sexual Smells
   ( ) Work Smells
   ( ) Fear Smells
IF "LOADED" PLEASE ANSWER THE FOLLOWING:

( ) Pleasant Smell ( ) Neutral ( ) Unpleasant Smell

The sample came from a ( ) Male ( ) Female donor
SAMPLE C

( ) Empty/No Perceivable Smells
( ) Loaded (Contains a 'real' sample.)
( ) Rest Smells
( ) Sexual Smells
( ) Work Smells
( ) Fear Smells

IF "LOADED" PLEASE ANSWER THE FOLLOWING:

( ) Pleasant Smell  ( ) Neutral  ( ) Unpleasant

The sample came from a ( ) Male  ( ) Female donor

SAMPLE D

( ) Empty/No Perceivable Smells
( ) Loaded (Contains a 'real' sample.)
( ) Rest Smells
( ) Sexual Smells
( ) Work Smells
( ) Fear Smells

IF "LOADED" PLEASE ANSWER THE FOLLOWING:

( ) Pleasant Smell  ( ) Neutral  ( ) Unpleasant Smell

The sample came from a ( ) Male  ( ) Female donor

PLEASE RETURN THE FORM TO THE RESEARCHER

THANK YOU
Appendix C

Modified Psycho–Neurological Evaluation Form
SCREENING EVALUATION FORM

Name: ________________  File No.: __________________

Age: _______  D.O.B. ___________  D.O.E. _______

Height: _______  Weight: ____________

Marital Status: ( ) Single ( ) Married ( ) Divorced

Satisfied with lifestyle: ( ) No ( ) Yes

Children: ( ) No ( ) Yes, _____# M, _____# F

Occupation: ________________________________  No. of Yrs. ______

Satisfied with job: ( ) No ( ) Yes

PRESENTING PROBLEM(S):

INTERVIEW/SESSION SUMMARY:

OTHER INFORMATION:

RAPPORT WITH SCREENER:

< > EXCELLENT (Comfortable, information exchange)
< > GOOD
< > FAIR (Subject slightly uncomfortable and guarded)
< > POOR (No trust noted)

SUBJECT MOTIVATION:

< > EXCELLENT
< > GOOD
< > FAIR
< > POOR
MEDICINES--PRESCRIPTION & OVER-THE-COUNTER

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<th>Dose</th>
<th>Frequency</th>
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NOTED/REPORTED MEDICAL CONDITIONS
< > None Reported. < > Condition(s) Reported:

OTHER SIGNIFICANT INFORMATION
< > None offered at this time. < > Information offered:

SUICIDAL IDEATION
< > None Noted; < > Issue specifically evaluated.
< > Suicidal Ideation Noted: Comment fully on back.

PSYCHOPATHOLOGY
< > None Noted.
< > Psychopathology noted, mild.
< > Major psychopathy suggested, further testing required.
< > Personality Disorder noted,
< > Situational/Developmental problems noted.
< > Developmental problems noted.
< > Other issues and/or concerns (note below):
### MENTAL STATUS IMPRESSIONS (Brief)

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<th>Abnormal Findings</th>
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(Thought content continued)
< > None noted  < > Delusions
Type:
< > None noted  < > Illusions
Type:

Coordination
< > Normal  < > Impaired  Comment (on back)

Fundamental Knowledge (Clinical judgement)
< > Normal  < > Impaired  Comment:

Appearance
< > Normal Limits  Clothes  < > soiled
< > wrinkled
< > Not age approp.
< > Other:
< > Erect  Posture  < > Slouched
< > Other:
< > Steady  Gait  < > Stumbling
< > Limping
< > Shuffling
< > Other:
< > Acceptable  Grooming  < > Not acceptable

GENERAL OBSERVATIONS:
< > No remarkable findings noted.
< > Remarkable findings (Comments below):

---------
< > Mental Status Impressions NOT REMARKABLE
No MS exam required
< > Findings suggest further information
required, evaluate with MS exam

Therapist ___________________  Date ___________
DIAGNOSIS
< > No diagnosis offered.  
< > DX: ICD-9 No. __________

Diagnostic rationale:

CLINICAL COMMENTS

DISPOSITION
< > Self referral (DX within therapist's scope of practice)
< > Referral (within clinic)
< > Referral (out of clinic)

->Referral: _______________________________________

Commentary:
< > None.
MENTAL STATUS EXAM (Complete)

Memory

Immediate Recall-Digits

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Four Word Recall
(Pen, Table, House, Dictionary)

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<td>30 minutes</td>
<td></td>
</tr>
</tbody>
</table>

Current Events
Recall two (2) major news events.
Event one < > offered < > none
Event two < > offered < > none

Remote Memory
List past Presidents starting with the most current (stop after six consecutive correct).

Number Correct

When were you born?
Correct < > Incorrect < >

Approximate dates of World War II.
Correct < > Incorrect < >
New Learning Verbal Recall

Alica, / a pretty / 6 year old
girl / sat patiently / awaiting the
start / of the fireworks display. /
However, once the fireworks began / she
became afraid / covered her ears / and
closed her eyes / and jumped / back into
her father's arms. /

(Total memory passages = 12)
Number correctly recalled
Confabulations?  <> Yes  <> No

SUMMARY OF FINDINGS (Memory)
<> Normal  <> Abnormal (Note comments on back)

General Information, Insight & Judgement

Similarities
How are a baby and a midget alike?
<> Correct  <> Incorrect
<> Concrete  <> Abstract

How are a paintbrush and a pencil alike?
<> Correct  <> Incorrect
<> Concrete  <> Abstract

Judgement
What should you do to protect yourself during a severe thunderstorm?
<> Correct  <> Incorrect
<> Concrete  <> Abstract

If you are in a boat and it begins to sink, what should you do?
<> Correct  <> Incorrect
<> Concrete  <> Abstract

Why should you read instructions before mixing chemicals?
<> Correct  <> Incorrect
<> Concrete  <> Abstract
Proverbs
A stitch in time saves nine.
<> Correct <> Incorrect
<> Concrete <> Abstract

One shouldn't change horses in the middle of a stream.
<> Correct <> Incorrect
<> Concrete <> Abstract

A drowning man will grasp at a straw.
<> Correct <> Incorrect
<> Concrete <> Abstract

SUMMARY OF FINDINGS (General Info, Insight & Judgement)
<> Normal <> Abnormal (Note comments on back.)

MENTAL STATUS ASSESSMENT
<> NO REMARKABLE FINDINGS  <> ABNORMAL FINDINGS (note clinical remarks below:)

Therapist __________________________ Date __________________________
LATERAL DOMINANCE EXAM

HAND

Preferred Hand
With which hand do you:
Write < > Right < > Left
Flip a coin < > Right < > Left
Use a knife < > Right < > Left
Throw a ball < > Right < > Left

Total Right
Total Left

EYE

With which eye do you:
Look through a telescope < > Right < > Left
Aim a pistol < > Right < > Left

FOOT

With which foot do you:
Kick a ball < > Right < > Left
Step on a bug < > Right < > Left

DOMINANCE

Hand < > Right < > Left < > Mixed
Eye < > Right < > Left < > Mixed
Foot < > Right < > Left < > Mixed

Findings
< > Not Remarkable. < > Remarkable.
CRANIAL NERVE I

Olfaction (I)

Peppermint
Right Nostril
< > Detect
< > Absent

Clove
Right Nostril
< > Detect
< > Absent

Left Nostril
< > Detect
< > Absent

Findings
< > Not Remarkable.

< > Abnormal findings:
CRANIAL NERVES IX, X, and XII
BULBAR FUNCTION

IX and X

< > Normal Symmetric Gag < > Abnormal
< > Normal Reflex < > Abnormal
< > Normal Speech Quality < > Abnormal

Describe:

< > Normal Swallowing < > Abnormal

XII

< > Normal Protrude Tongue < > Abnormal
R < > L < >
< > Normal Tongue Symmetry < > Abnormal
R < > L < >
< > Normal Tongue Appearance < > Wasting
R < > L < >
< > Absent Fasiculations < > Present

Findings

< > Not Remarkable.
< > Remarkable (note below).
Appendix D

Adjective Check List
ADJECTIVE CHECK LIST

Choose the word(s) that most fit your present mood.

( ) Horrified ( ) Tired ( ) Sensuous
( ) Excited ( ) Calm ( ) Drained
( ) Confused ( ) Hopeful ( ) Anxious
( ) Worn Out ( ) Fatigued ( ) Sexy
( ) Restful ( ) Comfortable ( ) Ridiculous
( ) Silly ( ) Apathetic ( ) Passionate
( ) Repulsed ( ) Exhausted ( ) Relaxed
( ) Tranquil ( ) Disappointed ( ) Horny
( ) Happy ( ) Nervous ( ) Indifferent
( ) Joyful ( ) Afraid/Scared ( ) Desperate
Appendix E

Complete Physiological Record for
Subject A and Subject B
CONDITION: EXERCISE
SUBJECT A
12 August 1985
0950 - 1040
RECORD NUMBER 833 - 843

Record Outline:

<table>
<thead>
<tr>
<th>Baseline</th>
<th>837/8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exercise</td>
<td>839</td>
</tr>
<tr>
<td>Resolution</td>
<td>842</td>
</tr>
<tr>
<td>Flow</td>
<td>500 Mv</td>
</tr>
</tbody>
</table>
CONDITION: EXERCISE
SUBJECT B
12 August 1985
1105 - 1150

Record Number: 844 - 855

Record Outline:

Baseline 846
Axillary Introduction 848
Exercise 851
Resolution 854

Flow: 500 μ
CONDITION: RELAXATION

SUBJECT A

14 August 1985
08:34 - 09:44

RECORD NUMBER 1506-1519

Record Outline:

<table>
<thead>
<tr>
<th>Baseline</th>
<th>1515</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exercise</td>
<td>1517</td>
</tr>
<tr>
<td>Resolution</td>
<td>1518</td>
</tr>
<tr>
<td>Flow</td>
<td>500  μV</td>
</tr>
</tbody>
</table>

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CONDITION: RELAXATION
SUBJECT B
14 August 1985
0954 - 1055

Record Number: 1520-1531

Record Outline:

Baseline 1524
Axillary Introduction 1524
Exercise 1528
Resolution 1530

Flow: 500 μV
CONDITION: EROTIC
SUBJECT A
19 August 1985
1100 - 1150

RECORD NUMBER 2534-2547

Record Outline:

Baseline 2540
Exercise 2542
Resolution 2545/6
Flow   500 µv

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CONDITION: EROTIC
SUBJECT B
19 August 1985
1200 - 1254

Record Number: 2549-2560

Record Outline:

Baseline 2551
Axillary Introduction 2552
Exercise 2555
Resolution 2559

Flow: 500 µV
CONDITION: REPULSION

SUBJECT A

21 August 1985
0800 - 0845

RECORD NUMBER 3570-3582

Record Outline:

Baseline 3575
Exercise 3578
Resolution 3581
Flow 500 mL/min
CONDITION: REPULSION
SUBJECT B
21 August 1985
0933 - 1025

Record Number: 3583-3599

Record Outline:

Baseline 3587/8
Axillary Introduction 3591/2
Exercise 3595
Resolution 3598

Flow: 500 \( \mu \text{v} \)
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