1956

The Effect of Instructions on the Magnitude of the Psychogalvanic Skin Reflex

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THE EFFECT OF INSTRUCTIONS ON THE MAGNITUDE OF THE PSYCHOGALVANIC SKIN REFLEX

by

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A Thesis Submitted to the Faculty of the Graduate School of Loyola University in Partial Fulfillment of the Requirements for the Degree of Master of Arts

February

1956

LIFE OF AUTHOR

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ACKNOWLEDGMENT

The author wishes to express his sincere gratitude to Father Vincent V. Herr, S.J., Chairman of the Department of Psychology, Loyola University, Chicago, whose unfailing patience and help have contributed so much to the successful completion of this piece of research.

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CHAPTER I

INTRODUCTION

An electrical phenomenon of interest not only to physicists and physiologists but especially to psychologists is the psychogalvanic skin reflex. In its totality it is a very complex phenomenon because of the variety of factors that must be considered before it can be satisfactorily understood.

Almost from the time of its discovery this reflex was seen to be closely associated with emotion, and it is still considered today to be one of the most sensitive indexes of emotional disturbance. Now emotion has a double aspect, one physical and the other psychical or mental. As such, it concerns the whole man and not merely a part of him. It is in a particular way an experience of the human composite. For a complete explanation, then, it is clear that both physical and psychical aspects of emotion must be taken into account. The same holds true for the skin reflex, since it ordinarily accompanies and somehow expresses emotional experience.

Many studies of emotion have centered almost entirely on the physical side, while others have emphasized the psychical side. It is in the discussion of the relationship between these two aspects that thorny problems, both theoretical and practical,arise. On the theoretical level, for example, the

whole mind-body controversy comes up. On a more immediately practical level there are the psychosomatic problems of emotional effects on the body. One problem with particular relevance to the connection between the physical and the psychical in man is the problem of the influence that the will has on the body. Voluntary control over the skeletal muscles of the body is a matter of everyday experience. It is another question, however, with regard to the so-called involuntary muscles and organs innervated by the autonomic nervous system. Included among these are the structures responsible for the psychogalvanic skin reflex.

It has long been recognized that this response is not susceptible to conscious control, at least directly. Most people are completely ignorant of the existence of such a phenomenon. It is partly for this reason that it can be used in detecting emotions of which the person is unaware.

From time to time, however, investigators(e.g. Abramowski, Hudgins[1]) have claimed that under specified circumstances, a person may exercise what seems to be indirect control over the skin reflex or other autonomic responses. Although these are rather isolated instances in the volume of psychological literature, it is the report of their success that has prompted the present investigation. Its purpose is to study, in some small way at least, this idea of control over what is ordinarily considered to be a completely involuntary response.

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[1]Edouard Abramowski, "Recherches Expérimentales sur la Volonté," J. de Psych. Norm. & Path., X (November-December 1913), 491-508; XII (January and April 1915), 14-43; 88-118. C.V. Hudgins, "Conditioning and Voluntary Control of the Pupillary Light Reflex," J. Gen. Psych., VIII (1933), 3-51

The first difficulty to be faced was the question of approach to the problem. In his experiments Abramowski used a direct approach, although not in the sense that he thought that the reflex could be controlled as, say, the muscles of one's writing hand. He rather appealed directly to his subjects to use all their will power to remain absolutely calm and indifferent to everything that might come as an excitant. Details of Abramowski's experiments were not available, so there was no question of repeating them. Even so, such a direct approach as he used was rejected for the present experiment because of the possible danger of arousing a preliminary emotional expectancy state which could influence the response but which could not itself be controlled or separately measured. Hence, it was decided that the subject's emotions should be left alone as much as possible except for the experimental stimuli to be used.

The approach, therefore, had to be indirect. If a situation could be produced in which the subject's power of control would be brought into play, could one not reasonably hope that the effect of such control would be reflected on the physiological level by a change in the skin reflex? Such a situation could be brought about by carefully worded instructions.

Therefore, after due consideration and a pilot study, the hypothesis to be tested was formulated as follows: instructions aimed at changing a person's emotional experience under conditions of free association will also change the physiological reaction of the associative act in the direction suggested by the instructions. A secondary hypothesis was also formed, namely: instructions aimed at altering one's emotional experience, while not changing the response in the direction suggested by the instructions, will, however, produce a change which can be predicted for similar situations.

As indicated in the hypotheses, the method of free association was to be used. What were needed, then, were stimuli that would arouse emotions over which the subject could attempt control. For the sake of simplicity, only one type of stimulus was selected, namely, emotionally-toned words to which the subject would free associate. To bring the control factor into play, slanted instructions seemed most suitable, i.e. instructions intended to bring about inhibition or control of the emotional reaction to the stimulus words. For contrast and comparison, it was decided to introduce another type of instruction for some of the subjects, an instruction intended to rouse the emotions to a greater degree. A comparison, then, of the responses under the two types of instructions with each other, as well as with a control situation in which no special instructions were to be given, would yield some idea of the various effects of instructions on the psychogalvanic skin reflex.

This problem seems to have some practical importance, in veiw of the fact that certain psychoanalytic techniques require that the subject be instructed to try not to allow his judgment, or other critical faculties to interfere with his associations, but to remain calm and relaxed so that the recall may be facilitated. If these instructions really produce changes in the total affective state of the subject, there might be expected to be similar changes taking place under laboratory conditions. If the total affective state is changed following upon the instructions, some change would also be expected in the emotional responsivity of the person taking a free association test. Positive results would also be of interest for the field of psychosomatic medicine, since the relation of <u>psyche</u> to <u>soma</u> is so essential to that medical approach; and it is in emotion that both body and mind are so very intimately involved.

Although the chief concern of this study is not theoretical, a brief summary of the theoretical phase of the problem involved will be useful as background and will help to make the picture complete. At the heart of things lies the mind-body controversy. Are mind and body two distinct entities, or is one just a manifestation of the other? If they are distinct, what is the nature of the one and of the other? How are they related? Do they, or can they, interact?

Such questions have been asked in some form or other for over two thousand years, and they are still being asked today. The answers that have been given in the course of history have been many and varied, but most of them can be reduced to three basic explanations: (1) mind and body can be explained satisfactorily in terms of one basic reality, matter; for example, the Greek Atomists held that the soul was made up of very subtle atoms; (2) mind and body are distinct, independent realities, irreducible to each other, but with some link between them; for example, Plato taught that the soul resided in and used the body, much like a rider on a horse;[2] (3) mind and body, though distinct from each other, are incomplete in themselves, but are so united as to form one complete though composite being. This is substantially what Aristotle taught,[3] and in its general lines this form of Aristotelean compositionism came down through Christianity into scholastic philosophy and held sway till

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[2]Frederick Copleston, S.J., A History of Philosophy, (London, 1946-1953), I: Atomists, 72-73, 124; Plato, 207. In this discussion, the terms mind and soul may, at times, be used interchangeably, though strictly speaking a distinction should be made.

[3]Aristotelis De Anima, ed. Paulus Siwek, S.J., (Romae, 1954), II, 1, 412a, pp. 92-93.

the beginning of the seventeenth century.

At this point Descartes came on the scene with his extreme dualism, a doctrine which is fundamentally the same as Plato's. Descartes held that soul and body are opposed to each other in nature and have nothing in common. They are, however, connected at one point in the brain, the pineal gland. Here the soul is situated; or at least it exercises its functions here more particularly than in any other part of the brain or body. A few years later Leibniz's doctrine of independent, immutable monads furnished the basis for what is called psychophysical parallelism.[4] This theory "conceives of psychic events as running a course in which psychical produces psychical but never physical; parallel to this series of events and complementing it in a marvelous manner by a kind of pre-established harmony there is a series of events in which physical produces physical but never psychical"[5]

These theories of interactionism(Descartes) and psychophysical parallelism have been held in some form or other in modern psychology down to the present day. There are some, though, who solve the mind-body problem to their own satisfaction by effectively denying that the problem exists. They subscribe to the monistic view that body and mind are but two aspects of one and the same reality, matter.[6] Gardner Murphy sums up well the modern situation when he says that despite the mass of work on psychosomatics, there has been no

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[4]Cf. Edwin G. Boring, A History of Experimental Psychology, 2nd ed., (New York, 1950); Descartes, pp. 160-165; Leibniz, pp. 165-168.

[5]Thomas Verner Moore, The Driving Forces of Human Nature, (New York, 1950), p. 68.

[6]Cf. e.g. "Introductory Statement," Psychosom. Med., I (January 1939).

"renewed effort at some sort of rational formulation of functional mind-body interdependence, if not some more high-flying philosophical solution of the mind-body problem.... We continue to have our parallelisms, interactionisms, and so on. To be sure, there is a great deal of insistence about the unity of the organism...the psychogenic condition causes the organic damage, and vice versa...psychic processes reflect physical processes. Nothing much really seems to be going on by way of an attempt at a clean formulation of how there can be such a thing as a mind in relation to a body, or how there can be a body in relation to a mind...."[7]

It is neither the intention nor the purpose of this study to attempt this "clean formulation." However, as the remote theoretical basis for the problem here investigated, the scholastic explanation of man is accepted as the only logical and consistent theory. According to the principles of scholastic philosophy, there are distinguishable in man two qualitatively distinct principles--body and soul, matter and spirit, psyche and soma--so united as to form one integrated person. Only such a dual principle united in one person can adequately explain the human psychological facts, for both the unity and the diversity seen in man are preserved. Although these two substantial principles are essentially distinct, still, because of their intimate union, they can and do mutually interact and influence each other. It is this mutual interaction based on the substantial union of body and soul that is the basis for hoping to find some degree of voluntary influence on the psychogalvanic reflex.

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[7]Gardner Murphy, An Historical Introduction to Modern Psychology, 2nd ed., (New York, 1949), pp. 387-388.

CHAPTER II

THE PSYCHOGALVANIC SKIN REFLEX PHENOMENON: A REVIEW OF THE LITERATURE

Since the psychogalvanic skin reflex(PGSR) is the principle variable under consideration, a general review of what it is and of what it is supposed to mean will be the subject of this chapter. In the first place, by PGSR is meant the sharp drop in apparent skin resistance to electricity upon the presentation of a sensory stimulus, the occurrence of an idea, the arousal of an emotion, or some other mental or physiological change. Closely linked with this, and a factor that must be taken into consideration in evaluating the PGSR, is the basic resistance, i.e. the level of a person's skin resistance to electricity in reference to which the temporary drops in resistance(the PGSR) are measured. Although this phenomenon has had various names in its history, such as psychogalvanic reflex(PGR), galvanic skin response(GSR), electrodermal response(EDR), a combination of the first two terms will be used in this thesis in order to include all the essential elements, i.e. psychogalvanic skin reflex(PGSR).

The electrical properties of living bodies were known as far back as 1786 when Berthelon published L'Électricité du Humain Corps. A report here and there on the same topic appeared in the years following, and in 1879 Vigouroux

published an important work on the galvanic response.[1] However, it is principally in connection with the names of Féré and Tarchanoff that the PGSR phenomenon has been made known. In 1888 Féré found that, if he attached two electrodes to the forearm, connected in series with a weak source of current and a galvanometer, quick deflections of the galvanometer occurred when S was stimulated by a tuning fork, an odor, or a colored object before his eyes. In 1890 Tarchanoff obtained similar deflections without any external source of current. Almost any two parts of the skin, if connected through a galvanometer, showed a potential difference and deflected the galvanometer needle. Stimulation of S caused further movement. These two phenomena are probably both dependent on the same physiological processes,[2] although Thouless was of the opinion that they were fundamentally distinct.[3] Féré's phenomenon, however, has been more generally used in experimental work because it is somewhat easier to record and gives a measure both of the basic resistance between the two electrodes and of the temporary change in resistance caused by a stimulus. This study will be dealing with the phenomenon of Féré.

What Féré noticed was an increased flow of the impressed current through the body, due to a lessening of the effective resistance of the body. He at

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[1]Carney Landis & Henry N. DeWick, "The Electrical Phenomena of the Skin (Psychogalvanic Reflex)," Psych. Bull., XXVI (January 1929), 64.

[2]L.A. Jeffress, "Galvanic Phenomena of the Skin," J. Exp. Psych., X (1928), 130-144, cited in Carney Landis, "Electrical Phenomena of the Skin," Psych. Bull., XXIX (December 1932), 705.

[3]R.H. Thouless, "The Technique of Experimentation on the Psychogalvanic Reflex Phenomenon," Br. J. Psych., XX (January 1930), 219-228.

first thought it was due to static electricity generated by friction of the electrode with dry skin, but Tarchanoff almost from the beginning emphasized the role of the sweat glands.[4]

But what electrical changes took place in the body to bring about the fall in resistance? Gildemeister's researches over the period of years from 1912 to 1928 did most to establish the polarization theory. It was also Gildemeister who brought out the fact that the resistance measured is apparent resistance and not true ohmic resistance.[5] Darrow in 1927 tentatively held that the potential changes were probably due to a function, firstly, of depolarization and the transfusion of liquid through the glandular membranes, and secondly, of the change in relative ion concentration due to the change in relative moisture under the electrodes.[6] Woodworth sums up this aspect of the phenomenon thus: "The exact nature of these changes is not known, but we do know that there are electrical changes in gland cells just before and during the active phase of secretion. Such changes as depolarization and increased permeability of the membranes of thesweat glands would account for both the Tarchanoff and Fere effects."[7]

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[4]Most of the facts about Fere and Tarchanoff have been taken from Robert S.Woodworth & Harold Schlosberg, Experimental Psychology, rev. ed., (New York, 1954), ch. 6.

[5]Cited in Landis and DeWick, 85, and Landis, 699.

[6]Chester W. Darrow, "Sensory, Secretory and Electrical Changes in the Skin Following Bodily Excitation," J. Exp. Psych., X (June 1927), especially 211-212.

[7]Woodworth-Schlosberg, 142.

The physiological basis of the PGSR was a matter of long dispute, but today the generally accepted opinion is that the phenomenon is due to sweat-gland activity. Through the years three main theories have rallied followers: the muscular theory, the vascular theory, and the secretory theory.

The muscular theory considered the PGSR as a potential change under the electrodes produced by overt muscular activity throughout the body.[8] It is common knowledge that muscular contraction is accompanied by electrical activity(spike potentials), so perhaps the PGSR is the summation of muscle potentials in the region of the electrodes. However, by puncturing the skin under the electrode a telling blow is given to this theory. When this is done, practically all bodily resistance is abolished.[9] According to McCleary, only one other study has directly tested whether the skin is necessary. In this study, the outer skin layer was removed by a blistering agent with the result that the PGSR could not be obtained.[10] Hence the skin must be explored to find out what happens.

The vascular theory is much harder to dispose of. Everyone knows that in emotion the tiny blood vessels of the skin dilate and contract. One need only mention the well-known occurrences of blushing and blanching. Féré came

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[8]B. Sidis & L. Nelson, "The Nature and Causation of the Galvanic Phenomena," Psych. Rev., XVII (1910), 98-146, cited in Robert A. McCleary,"The Nature of the Galvanic Skin Response," Psych. Bull., XLVII (March 1950), 100.

[9]C.P. Richter, "Physiological Factors Involved in the Electrical Resistance of the Skin," Amer. J. Physiol., LXXXVIII (May 1929), 596, citing a previous report of his in Proc. Nat. Acad. of Sci., XII (1926), 214.

[10]McCleary, 103.

to think that the basic factor underlying the PGSR was vasodilation. As further progress in physiological research was made, the possibility that vasoconstriction might be the physiological basis was also considered. McDowall combined both ideas into his theory by suggesting two mechanisms for the PGSR: (1) since vasoconstriction reduces the blood content in the skin and whole blood has a higher resistance than extracellular fluid, a lowering of blood content in the layers of the skin would account for the fall in resistance; (2) because change in the contour or tension of the skin can cause electrical changes, vasodilation might have mechanical effects which would, in turn, cause a lowering of skin resistance.[11] McDowall's arguments, though, and the evidence he presents are not very convincing. The most obvious answer to his theory is that what caused the circulatory changes also caused changes in other physiological systems in the same area, such as the sweat glands, the other claimant for the major role in accounting for the PGSR. So the only thing to do was to test and record simultaneously the changes in these two systems to see which correlated most closely with the PGSR.

Darrow in his series of detailed experiments seems definitely to have shown that the PGSR is dependent upon sweat-gland activity. In one of his studies, he simultaneously recorded at the point of attachment of the electrode to the skin vasoconstriction of the blood-vessels, temperature of the skin, volume of sweat secretion, and PGSR variations. The data gathered showed quite clearly that changes in blood volume at the spot in question were

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[11] R.J. McDowall, "The Physiology of the Psychogalvanic Reflex," Quart. J. Exp. Physiol., XXIII (1933), 277-285. Cf. also McCleary, 102.

not related in any consistent way to the PGSRs. PGSR and moisture secretion, though, were related.[12] In his original report, Darrow showed that the increase of moisture on the skin consistently followed the electrical changes by about one second. The peak of the deflection occurred only a fraction of a second after the appearance of the surface moisture, while the maximum of secretion occurred about two seconds after the peak of the change and two seconds before the complete return to normal resistance level.[13] This was confirmed in later studies.

The evidence just mentioned points to the fact that it is the response of sweating, i.e. the changes in the sweat glands themselves, that is responsible for the PGSR reaction rather than the sweat itself. Some thought that the sweat secreted merely provided a good conductor; but if such were the case, the common paste electrodes would be of little value. The relatively quick recovery of body resistance would be hard to explain since sweat would not consistently evaporate so quickly. The exact nature of the changes in the sweat glands is not definitely known, but the evidence for depolarization of the glandular membranes carries the most weight, as has already been indicated.

There is quite general agreement, then, on the role of the sweat glands in the PGSR reaction. With regard to the nervous control of the response, strong evidence points to the fact that the sweat glands are innervated by the sympathetic division of the autonomic nervous system and that the post-

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[12] C.W. Darrow, "Electrical and Circulatory Responses to Brief Sensory and Ideational Stimuli," J. Exp. Psychol., XII (1929), 267-300, cited in McCleary, 108.

[13] Darrow, (1927), 209.

ganglionic outflow provides the final common path for the PGSR. "Numerous investigations have shown by direct surgical approach that the GSR is dependent on an intact sympathetic chain, and conversely, that direct stimulation of the chain or the postganglionic fibers involved will produce a GSR. More quantitatively the amplitude of the GSR is a direct function of the intensity of such sympathetic stimulation and the number of postganglionic fibers left intact."[14] The subcortical brain centers that control the sympathetic fibers in question lie in the hypothalamic region, but the picture is not yet completely clear. And since conscious processes also affect the PGSR to a marked degree, the cerebral cortex has been explored, and one of the main cortical centers is quite definitely in the premotor area(Brodman 6).

Of far greater interest, though, than the physiological is the psychological aspect of the PGSR. Although this phenomenon is a reflex, there is more involved in it than nervous pathways and sweat glands. Psychologists as psychologists are not so much concerned with the physical changes in the organism as with the mental antecedents, or accompaniments, or consequents of these changes. The immediate origin of the PGSR is physiological, and the more known about this the better, but, at least in experiments like the present one, organic changes are excited by mental states, which are, therefore, the ultimate causes of the reflex. It is these that the psychologist wants to determine and interpret.[15]

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[14] McCleary, 112. The other points in this paragraph are also taken from McCleary, 110-112.

[15] Cf. Raphael C. McCarthy, S.J., The Measurement of Conation, (Chicago, 1926), p. 6.

Almost from the beginning of its history the PGSR was connected with the emotions, and many researchers thought that finally a reliable index of emotion and emotional behavior had been found. This response was rather easily measurable, it was a reflex, and was a very sensitive reaction which occurred when other responses failed. By 1932 Landis was able to review over five hundred reports either directly on the phenomenon or closely connected with it.

As research began to increase, it was soon discovered that this response occurred under a variety of conditions and stimulus situations; for example, gross muscular activity, pain, mental activity, even in situations where the psychic element was reported as not functioning.[16] In his 1932 review, after seeing the variety of theories and claims for the PGSR and conducting some research on his own, Landis expressed a rather sceptical attitude as to the value of the phenomenon as a reliable index of any psychological event. "From this literature, giving the results and conclusions of many investigators, the reviewer is convinced that there is really no adequate evidence that these electrical phenomena of the skin are of necessity associated with any psychological event. They are, as Wang points out, strictly physiological in nature and probably have a marked and important psychobiological significance. There is no justification for anyone using any present galvanometric technique or method as a measure of, or a criterion of any of the traditional psychological categories, personality traits, or social relationships of the individual."[17]

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[16] On this last point cf. Landis, 708(Ebbecke) and MCCarthy, pp. 47-48 note.

[17] Landis, 725.

One can understand a certain scepticism in the face of the many and, at times, almost contradictory claims, yet something was happening. Psychic factors were present in many of the reported studies. Why not search for the element that gave a unity?

Woodworth-Schlosberg are of somewhat the same disappointed frame of mind with regard to emotion. They feel that the term emotion should no longer be used to express a special mental or behavioral state and that the phrase level of activation would be a better designation of what happens in the organism when stimulated. Emotion is merely one end of a continuum of activation. This attitude, however, tends to leave the psychic element of emotion very much in the background. In fact, it seems to ignore, at least in practice, the well-known distinction between emotion and emotional behavior that Cannon so much insisted on in connection with sham rage.[18] Level of activation describes well the physiological states of the organism, but it does not indicate the very essence of emotion, namely, the conscious awareness of a suitable or unsuitable situation.[19]

Despite these views, the PGSR does follow emotional stimuli, in varying degrees, of course, depending on the individual subject, the kind of stimuli, etc. Perhaps what lies behind the opinion of these authors is their confused

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[18] W.B. Cannon, Bodily Changes in Pain, Hunger, Fear and Rage, (New York, 1915).

[19] Woodworth-Schlosberg, 108-110 and 158-159. Consider their illustration of the build-up of activation--how the organism becomes more and more activated as various stimuli bombard it. It is almost purely physiological, and the role of the conscious element in the whole process is almost completely ignored. Except for the fact that they use the word man, it would be hard to believe that the subject of their description is a real human being.

idea of what an emotion is. In the article referred to, one would gather from the way Landis speaks that the two levels, physiological and psychical, are not very closely connected and that physiological changes have only physiological causes. Woodworth, in the 1947 edition of his Psychology, indicates what to the present writer contains the key to emotion when he speaks of the individual's intellectual perception of the situation as one of the facts to work with in treating of emotion. Yet most of his discussion that follows seems to be physiologically centered to the neglect of the psychic factor. When he speaks of intellectual, he means cortical; when he says emotional, he is referring to the lower brain centers.[20]

Since, therefore, the present experiment makes use of emotional stimuli, it should be made clear just what is meant by emotion. Perhaps in the analysis of emotion reasons may be suggested as to why the PGSR should be susceptible to at least indirect voluntary influence. In the first place, let it be noted that what is here analyzed and described is a normal, adult emotion, and as such the complete emotion is an experience of the person; it is a total reaction. The notion of emotion involves the notion of man as a substantial unity composed of two substantial principles with vegetative, sensory, and intellectual activities. An emotion is not merely a mass of sensations or of physical changes in the organism. These alone might be emotional behavior but would not be the emotion itself. Nor is an emotion a purely intellectual reaction to or evaluation of a particular situation. In such a case the experience

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[20]R.S. Woodworth, Psychology, 5th ed., (New York, 1947), 366-371.

would rather be James' "cold and neutral state of intellectual perception," "a cold-blooded and dispassionate judicial sentence," "a feelingless cognition."[21] No, in out and dry terms, an emotion is "the reaction of the sensory-rational being to the things it knows."[22] Ordinarily all three levels of activity are involved--vegetative, sensory, and rational. In certain situations, however, when the organism is damaged, the bodily accompaniments of an emotion may be absent; but one can still quite properly speak of an emotion despite this.

When it comes to defining or describing emotion in particular terms, the task becomes difficult. Instead of attempting to formulate a new definition or description, those authors who follow the scholastic line of thought will be relied on. Emotion, then, includes the following steps: (1) perception of an object or situation on both the sensory and intellectual levels; (2) the evaluation of the object or situation in relation to the individual; (3) an appetitive or action tendency toward or away from the object or situation; (4) widespread bodily changes according to the situation; (5) perception of these bodily changes and the resulting reinforcing of the emotion.[23] If all

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[21]William James, Psychology: Briefer Course, (New York, 1905), pp. 379-380.

[22]George P. Klubertanz, The Philosophy of Human Nature, (New York, 1953), p. 206.

[23]These bodily changes occur on both the conscious and unconscious levels. It is not necessary that all changes come to consciousness. In milder affective states the normal person is unaware of change in heart action, respiration, etc. (Cf. T.V. Moore, Driving Forces, p. 121; also V. Benussi's experiment on respiration cited in Woodworth-Schlosberg, pp. 186-187.) And most people do not even know they have a PGSR. But this does not mean, therefore, that if it occurs even when the subject says he experiences no affective change, it cannot be considered an indication of emotion. The stimulus may touch on an emotional complex.

this is put into one sentence, an emotion or affect can be considered "as the felt tendency toward an object judged suitable, or away from an object judged unsuitable, reinforced by specific bodily changes according to the type of emotion."[24]

According to this viewpoint, the core of an emotion is the felt tendency following on the evaluative judgment of the object or situation in question. The bodily resonance, on the other hand, which so many discussions of emotion overemphasize, largely plays a role of reinforcement, and is neither the emotion itself nor the direct cause of the emotion. This is in accordance with Cannon's distinction between emotional experience and emotional behavior. This distinction is seen clearly in cases where adrenalin is injected into the bloodstream or where there is an endocrine imbalance. The person may feel as if he were afraid, angry, and so on, because of the changed physiological state, but this would not properly be called an emotion. On the other hand, real emotional experience may be had even though the physical response is definitely ruled out(at least awareness of such response) because, say, of interruption of the nervous pathways between the head and the rest of the body. As examples, there may be cited Sherrington's "markedly emotional dog" which was deprived of nearly all sensation from the interior of the trunk yet with no change in emotional behavior;[25] or Cannon's sympathectomized cats, with the

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[24]Magda B. Arnold & John A. Gasson, S.J., The Human Person: An Approach to an Integral Theory of Personality, (New York, 1954,)p. 294.

[25]Sir Charles Sherrington, Integrative Action of the Nervous System, 2nd ed., (New Haven, 1947), p. 260.

same results. On the human level, there are the clinical cases of paralysis and atrophy reported by Dana in which normal emotions persisted but without bodily expression;[26] or Wilson's pathological cases of laughing and crying when actually the patient's state of mind was in "patent conflict with the apparent emotion."[27]

However, the relation between the bodily reaction and the psychic factor is very close, and a closer study of it may give some hint that will support the idea of voluntary influence of the psychical on the physical.[28] In the description of an emotion or affect given on the previous page, the latter part ran as follows: "reinforced by specific bodily changes according to the type of emotion." When a person faces a situation which makes him, for example, angry or afraid, what happens in the body? Besides movements in the skeletal muscles, the whole of the visceral mechanism is affected; the heart speeds up, the blood vessels contract, digestive processes are inhibited, glandular secretions are poured into the blood, sweat glands secrete, and so on. A typical pattern reaction is brought about under the influence of the sympathetic(and parasympathetic[29]) nervous system which receives its innervation from the

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[26]Charles L. Dana, "The Anatomic Seat of the Emotions: A Discussion of the James-Lange Theory," Arch. Neur. & Psychiat., VI (December 1921), 634-639.

[27]S.A.K. Wilson, "Pathological Laughing and Crying," J. Neurol. Psychopath., IV (February 1924), 299-333.

[28]Although the discussion will be of bodily changes in general, everything will apply to the PGSR since it is one of these changes and very likely the most sensitive of them all.

[29]Cf. Magda B. Arnold, "Physiological Differentiation of Emotional States," Psych. Rev., LII (January 1945), 35-48.

thalamic and hypothalamic centers in the brain stem. Cannon's brilliant work on the autonomic responses of smooth muscle and glands has brought many of these facts to light. The striking fact is that not merely one or other of these changes takes place in a random sort of way, but they occur together as patterned reactions, "...like inborn reflexes of low order, such as sneezing, in which the impulses flash through peculiarly cooperating neurone groups of the central nervous system."[30]

Cannon, though, thought that if only the visceral picture were considered, much the same would be found to be happening for any one of the emotions, so that from the visceral changes alone, it would be difficult to differentiate one emotion from another. In more recent years, however, there has been evidence that it is possible physiologically to differentiate emotional states, at least the more violent ones. For example, Murphy, Murphy & Newcomb state: "The heart, lungs, skin, arterial muscles, and so on participate in patterns which can be differentiated from those of other emotions." In support of this assertion they cite the work of R.C. Davis who reanalyzed the data of Landis's experiment(1924) and showed that "in many respects the different situations produced quite distinctive responses, despite the cumulative mass effect of the stimuli in the long experimental period. Some phases of the fear, disgust, and surprise situations are absolutely distinctive."[31] Arnold reexamined

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[30]Cannon, Bodily Changes, p. 282.

[31]Gardner Murphy, Lois Barclay Murphy, & Theodore M. Newcomb, Experimental Social Psychology, rev. ed., (New York, 1937), pp. 139 & 152; no bibliographical reference to Davis except the date(1934). Cf. also A.F. Ax, "The Physiological Differentiation of Fear and Anger in Humans," Amer. Psychol., VI(August 1951), 271.

Cannon's findings in the light of some of her own observations and of other research data. She came to the conclusion that at least three different physiological states corresponding to the three different emotions of fear, anger, and excitement or elation, could be distinguished.[32]

At the turn of the century, William James held that every emotion had its own pattern[33](though this view was not founded on the experimental evidence that later investigators were to furnish), and this naturally fitted in with his theory of emotions. According to the much-discussed James-Lange theory, it is the bodily reactions which cause the emotion, and not the emotion which causes the bodily changes. To be more precise, it is the awareness of the physiological changes which constitutes the emotion. In James' famous words: "My theory, on the contrary, is that the bodily changes follow directly the perception of the exciting fact, and that our feeling of the same changes as they occur IS the emotion. Common-sense says, we lose our fortune, are sorry and weep; we meet a bear, are frightened and run;... The hypothesis here to be defended says that this order of sequence is incorrect, that the one mental state is not immediately induced by the other, that the bodily manifestations must be first interposed between, and that the more rational statement is that we feel sorry because we cry, angry because we strike,..."[34]

If this state of affairs be true, there seems to be little possibility of controlling the bodily changes, except, perhaps, for some modification of them

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[32]Arnold, "Physiological Differentiation," 35-48.

[33]James, Psychology, p. 378.

[34]Ibid., pp. 375-376.

after they have occurred. Cannon in particular was very influential in counteracting this topsy-turvy theory. As a consequence of his extensive study of the effect of the autonomic nervous system and of the adrenal glands on the organism, Cannon formulated his thalamic theory according to which the causes of the pattern reactions and of the feeling tone in emotion were centrally, not peripherally, located. An external situation excites afferent impulses towards the cortex. On their way in, these impulses may directly excite thalamic processes appropriate to the situation, or they may go on to the cortex and there arouse conditioned responses which in turn excite appropriate thalamic processes. In either case the peculiar quality of the emotion is assumed to be added to the simple sensation when the thalamic processes are roused. Efferent impulses are then widely discharged into the viscera and skeletal muscles, while afferent impulses are sent to the cortex. Here in the cortex the peculiar quality of the emotion which was added in the thalamus to the simple sensation is perceived, and fear, rage, and so on, as the case may be, are experienced. From the viscera and muscles reinforcing impulses are sent back through the thalamus to the cortex.[35]

According to this theory, the individual patterns of emotional reaction are organized in the thalamic region and discharge not only to the periphery but also to the cortex where they add the distinctive feeling to the sensation. The perception of this peculiar quality added to the simple sensation in the thalamus is the emotion. The basic patterns of reaction, according to Cannon,

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[35]Walter B. Cannon, "The James-Lange Theory of Emotions: A Critical Examination and an Alternative Theory," Amer. J. Psychol., XXXIX (1927), 106-124; "Again the James-Lange and the Thalamic Theories of Emotion," Psych. Rev., XXXVIII (July 1931), 281-295.

are ingrained in the nervous system, and an appropriate situation, simply sensed, is enough to arouse the thalamic processes and ready them for patterned discharges along the neurones of the autonomic nervous system.

At first glance, this whole explanation appears to remain on the physiological level. However, it may be argued that Cannon's primary intention was to explain the physiological aspect of emotion. His insistence on the distinction between emotional behavior on the one hand and emotional experience on the other is well-known; and he explicitly denies that he ever stated "that 'the thalamus is the seat of affectively-toned experiences,' and yet on the basis of facts...he has maintained that the thalamus may be the 'source' of such experiences, as retinal changes are the source of visual sensations."[36] What the thalamus does provide is the neural organization and patterns which are the physiological basis for such emotional experiences. The important part assigned to the thalamic region in Cannon's theory seems to fit in with the present trend among neurophysiologists to look for a final functional integrating center in the diencephalic region of the brain rather than in the cerebral cortex.[37]

However, although the physiological elements as outlined by Cannon can well serve as the basis for a complete theory of emotion, a difference of opinion comes in on the precise role of the cerebral cortex and of the thalamic

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[36] Psych. Rev., XXXVIII, 286.

[37] Cf. Wilder Penfield, "The Cerebral Cortex in Man. I. The Cerebral Cortex and Consciousness," Arch. Neurol. Psychiat., VI (September 1938), 441-442; "Studies of the Cerebral Cortex of Man. A Review and an Interpretation," in Brain Mechanisms and Consciousness, (Oxford, 1954), pp. 284-304.

processes. In Cannon's view, the cerebral cortex plays primarily an inhibiting role, i.e. it serves to keep emotional reactions under control so that they do not run riot, as, for example, in cases of pathological laughing and crying. How the cortex exercises this inhibitory influence is not made clear. It seems that impulses to the skeletal muscles and viscera may be sent out before, or at least at the same time as, the impulses to the cortex. Therefore, in the view that the cortex is essential to conscious experience, and hence to any possibility of voluntary control, the first impulses to the viscera could escape control though subsequent innervation would not.

With regard to the thalamic processes, if one accepts Cannon's explanation unreservedly, then there would seem to take place in the thalamus at least an implicit judgment, since appropriate response patterns are, or can be, made ready for discharge before the cortex comes into the picture. This is hardly acceptable because a judgment implies consciousness, and the cortex is necessary for consciousness.[38] Insofar as Cannon's theory is, therefore, mainly physiological and does not deal satisfactorily, at least in the opinion of the present writer, with the psychological aspect of emotion, a more comprehensive viewpoint must be sought. No doubt there is room for argument as to the sequence of the various nervous pathways, but on this level the excitatory view is more preferable. According to this theory, thalamic-hypothalamic processes are roused by cortical impulses that result from a psychological evaluation

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[38]Penfield, Brain Mechanisms and Consciousness, p. 307.

of the situation.[39]

In his Measurement of Conation McCarthy describes the genesis of an emotion along the same lines as the description given above,[40] but seemingly under the influence of the James-Lange theory, he reserves the term emotion to the consciousness of the organic changes which are brought about by an appetitive disposition(conation) towards or away from the object. He explicitly speaks of "physiological changes of that essential kind which, when they have their repercussion in consciousness, constitute the formal element of emotion." However, McCarthy does differ from the James-Lange theory in that he ascribes the physiological changes not merely to James' "object simply apprehended" but to "dynamic mental states and activities," i.e. appetitive dispositions or conation.[41] Actually, then, what he calls conation is really the felt tendency of the Arnold-Gasson description; and what he labels emotion is rather the reinforcing of the emotional state that already exists.

Although in general McCarthy's analysis is acceptable, his application of terms is apt to be confusing. Besides, a very important point is neglected; that is the felt tendency aspect of emotion. Why, it may be asked, is this felt tendency so central? or what is there about it that justifies its being considered the essential constituent of emotion? The best answer to these questions lies in the reference to the self(at least implicit) that is the

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[39]Magda B. Arnold, "An Excitatory Theory of Emotion," Feelings and Emotions: The Mooseheart Symposium, ed. M.L. Reymert (New York, 1950), pp. 11-33.

[40]P. 18.

[41]McCarthy, pp. 40-41.

distinctive feature of this tendency.[42] Without this self-reference, which is implied in the evaluation of the object as suitable or unsuitable to the individual, the object would have no emotional value, it would not move the subject of the emotion. The relation to the object or situation would be merely on the cognitive level. Any bodily changes that might occur would not be the ones typically occurring in emotion. But when a person evaluates things with reference to himself, the whole of his bodily and mental forces is summoned to action. Appetitive processes, or action tendencies, deep-seated in the person's makeup are called into play, either toward the object if it be judged suitable or away from it if it be judged unsuitable. These tendencies become attached, as it were, to particular situations which evoke them once the quality of the stimulus or situation becomes known by experience. Thus these mental states can be spoken of as dynamic: they are deepseated in the organism and are integrated with many vital functions which mirror, so to speak, by reactions in the various bodily systems the state of mental excitement which is the emotion.[43]

Hence, the emotion with its reference to the self is a reaction of the individual, of the person who will act, in ordinary circumstances, as a unit according to the different levels of his activities. On the bodily level the response is through the internal coordinating mechanisms governed by the autonomic nervous system on both the conscious and unconscious levels. These

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[42]Cf. Vincent V. Herr, S.J., "Integration and the Self-Ideal," in Arnold-Gasson, The Human Person, p. 283.

[43]In this description we have relied on Vincent V. Herr, S.J., General Psychology: Briefer Course, (Ypsilanti, 1948), pp. 138-139.

reactions are patterned. Therefore, it seems that a central cause should be sought. For this role the psychic element seems best fitted rather than a purely physiological one such as Cannon's thalamic elaborations. The reason lies in what has already been indicated. Particular stimuli or situations have particular meanings for one person and another. Because of this a certain pattern of reaction may be set up according to the particular affective value. Subsequent reactions will tend to follow the same pattern. Confirmation of this inference may be found in the evidence for differing patterns of physiological reactions for different emotions. Besides Davis and Arnold already mentioned,[44] Ax found that the difference between fear and anger lay in the degree of activation rather than in the systems which are activated. The results of one of Darrow's researches might also give support to the notion of differing patterns for different emotions. He found that blood-pressure responses and PGSRs varied independently following ideational stimuli and pure sensory stimuli. The at times contradictory results he reviewed in the same article concerning varying cardiac activity, blood-pressure and vasomotor changes in response to the same kind of stimuli might also be explained in terms of patterns set into action. A particular stimulus for an individual subject might have a different total meaning than for another, and the result would be a different physiological picture.[45]

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[44] Supra, pp. 21-22. Ax, Amer. Psychol. is also referred to in note 31, p. 21

[45] Darrow, Psych. Bull., XXVI, esp. 195-197. Cf. also James' statement: "The various permutations of which these organic changes are susceptible make it abstractly possible that no shade of emotion, should be without a bodily reverberation as unique, when taken in its totality, as is the mental mood itself." Psychology, p. 378.

The point of all this is that patterned emotional responses indicate a central cause which is primarily and necessarily psychological, lying, as noted above, in the necessary reference to self that is had in every emotion. If this is the case, then some control, at least, of the bodily manifestations of emotion seems possible, since a person can learn to control his thoughts and attitudes. He can be alert to avoid self-reference of a stimulus or situation. Whether such an attempt will be successful or not is another question.

So far the PGSR has been considered in its physiological aspect and in its relation to emotion. The next step is to examine the PGSR more precisely in its relation to the will, for herein lies the center of voluntary control. A theoretical discussion as to the what and how of the will will not be undertaken. However, for the sake of clarity, by will is meant the rational appetite in man which tends to the good as such; or the faculty of inclining towards an object intellectually apprehended as good. By voluntary control is meant the ability to exercise some domination, at least indirect, over the bodily reactions which ordinarily accompany emotion. Specifically, in this investigation, the question is not of control of voluntary musculature, such as the movement of one's writing hand, but rather of the power of voluntarily influencing the so-called involuntary organic changes, and particularly the PGSR, which are innervated by the autonomic nervous system.

Research on this point has been scarce, and an examination of the literature uncovered, for the most part, only a few vague references to claims of voluntary control. R. R. Sears made a study of the GSR, together with facial grimaces, reflex withdrawal of the leg, respiration and pulse activity, under normal conditions and with hypnotic anesthesia of the stimulated leg. Results

indicated that under the conditions of suggested anesthesia, aside from reduction or elimination of the other responses, the GSR was reduced by 20 per cent. Under normal conditions in which the subject was instructed to inhibit his reactions to pain when the left leg was stimulated, none of the above mentioned reactions were reduced to any extent. Sears concluded that hypnotic anesthesia is distinct from the voluntary inhibition of reaction to pain and commented that the GSR is completely non-voluntary.[46] On this latter statement Landis remarks, "Sears' comment that the galvanic skin response is completely non-voluntary, is open to question, since several writers have pointed out instances in which this response has been obtained voluntarily."[47] The only writers other than Sears that Landis mentions are Bujas(717-718), who stated that the response might be voluntarily inhibited by taking an indifferent attitude, and Abramowski(724), of whom more at length below. Bujas, however, worked with only one subject and reported his method, findings, etc. in terms too general and unprecise. Of Abramowski's work Landis gives no details whatever.

McCleary in his 1950 review of the literature states at the beginning of his article that "like other responses, it [the GSR] usually cannot be voluntarily inhibited, when an adequate stimulus situation is present, though it may sometimes be voluntarily produced."(97) However, he gives no references to back up such a statement.

Woodworth, in the first edition of his Experimental Psychology stated

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[46] R.R. Sears, "An Experimental Study of Hypnotic Anesthesia," J. Exp. Psychol., XV (February 1932), 1-22.

[47] Landis, Psych. Bull., XXIX, 720.

flatly, "The psychogalvanic reflex is not subject to voluntary control."[48] In the second edition this assertion is somewhat modified. In one place the authors say that"the GSR is involuntary in the sense that O cannot control it on demand, but it is certainly not independent of instructions, sets and attitudes."[49] To illustrate this latter point the following example is given: if experimenter remarks, "There, that part is finished, so I'll turn off the shock," and snaps a switch, a conditioned GSR will drop out immediately in some subjects partly depending on whether the subject believes the experimenter. Later, in the chapter on conditioning there is a more detailed treatment of attitudinal and 'volitional' factors in relation to responses that are supposed to be involuntary. The only reference to PGSR is the example just given. Reported at length is Razran's work on the salivary response, also 'involuntary'. In one set of his experiments neither conditioning nor extinction proceeded in a regular fashion. Razran concluded that this was due to the subjects' attitudes, which had not been rigidly determined by instructions. In another series of experiments he gave his subjects positive and negative instructions at different times. If, for example, he told them to try to associate the nonsense syllable with eating pretzels, he usually obtained positive results; but if he told them to avoid forming the association, zero or negative conditioning was apt to occur. Woodworth-Schlosberg then ask the question: how can attitudes control a response like salivary secretion, which is involuntary? Their answer is as follows:

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[48] R.S.Woodworth, Experimental Psychology, 1st ed.,(New York,1938), p.282.

[49] Woodworth-Schlosberg, p. 152.

> You cannot control salivary secretion directly, but you can do so in an indirect fashion. If you wish to stimulate the flow of saliva, you have but to think of a nice, juicy steak. When you 'think' of a steak, you are undoubtedly setting up central processes--and perhaps even peripheral ones, like subvocal speech--that have been associated with steak in the past. These symbolic processes are presumably stimulus-released, like any others--perhaps by verbal stimuli, administered by E or by the subject himself. What Razran's subjects were controlling by their attitudes was the formation of associations between Sc(a light, for example)and Su(the salty taste of pretzels).
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> The attitudinal factor that Razran demonstrated so clearly probably complicates all studies of the CR in man.[50]

What has here been said can be applied also to the PGSR, but with limitations. The salivary response is more closely connected with strictly sensory stimuli, while the PGSR, at least in the present experiment, is bound up with emotional stimuli and situations, and the emotional response involves a total reaction. However, the point of indirectly controlling such 'involuntary' responses is well taken and gives a hint of how voluntary control may be achieved.

Previously mentioned was Abramowski's work on voluntary control of the PGSR. In the Driving Forces of Human Nature Moore cites with evident approval a series of articles by Abramowski on this topic,[51] but unfortunately only the first article was available to the present writer at the time of the experiment. From this article, however, the general trend of Abramowski's work can be seen.

Abramowski first speaks of what he calls the fundamental emotivity of the individual. This has been produced and elaborated by the personal history of

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[50] Woodworth-Schlosberg, p. 574. The reference to Razran is 1) "Conditioned Responses: an Experimental Study and a Theoretical Analysis," Arch. Ps. N.Y., #191 (1935); and 2) "Studies in Configural Conditioning. II. The Effects of Subjects' Attitudes and of Tasksets upon Configural Conditioning," J. Exp. Psych., XXIV (January 1939), 95-105.

[51] Moore, pp. 323-324. For full reference to Abramowski cf. p. 2 above.

the individual person. It belongs to all past habits and memories, and conditions and influences one's present thoughts and conscious reactions. As such it does not change or cease over night. This concept seems to correspond to what some call the dynamic personality which is the background for the present experiential personality.

In his experiments Abramowski used five subjects and submitted them to two series of experiences. The first was the free or control series and consisted of visual, auditory, and tactile stimuli, always unexpected; free association to interesting words; rather difficult multiplication problems. In the second series the subject was begged to use all his will power to remain absolutely calm and indifferent to everything that would come as an excitant, to use the same technique to master emotions as used in moral situations of everyday experience. The stimuli were of the same type as those used in the free series and were always unexpected.

What did the results show? According to the tables given, the inhibited series showed a total decrease in response of about 30 per cent, and every subject showed an overall drop(though one was very slight). Some of the drops were very striking. For example, J dropped from 134 to 14 for attention and from 135 to 64 for tactile stimuli(units of measurement were in millimeters). O had an overall drop from 61 to 20.

In his discussion Abramowski ruled out two possible explanations: (1) the repetition of experience, because the stimuli for the inhibited series were new, except for the general anticipation from knowledge of the PGSR; (2) interference of deviations, because the intervals between stimuli were much greater

than the longest latent reaction. He concluded, therefore, that the influence of the will was the cause of the inhibition. This influence, he felt, was exercised, not by receiving impressions in a state of distraction but by a process of intellectualisation. The inhibition of the emotion brought about by this intellectualization did not consist in the destruction of the emotion once aroused, but in its inhibition before it was formed, weakened, so to say, at the moment of birth. It was as if the will acted on a certain substratum of emotion which conditions all emotions. The subject adapted himself to an advance inhibition,a moment before the experience began. In any case, he concluded, it was certain that the single act of the will could strangle emotions and diminish the PGSR, as surely as chemical substances can calm, or hypnotic suggestion can paralyze certain organic functions and abate emotivity.

As to the merit of these findings and the subsequent theorising, it is difficult to pronounce judgment with such limited detail of technique and without further confirmation of the results. However, Abramowski's reported data give at least an indication that the will can exercise some influence on such a delicate indicator of emotion as the PGSR, even though among the results there are instances of greater emotivity in the inhibited series than in the free series. In relation to this last there is the interesting fact that the only two subjects who were given verbal stimuli reacted much more strongly in the inhibited series than in the free series--65 and 17 respectively for the one subject and 68 and 50 for the other. The difficulty is that the stimulus words are not given, but they were said to be interesting.[52]

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[52]Since this was first written, Abramowski's original articles have been

About ten years after Abramowski's work, Raphael McCarthy, S.J. published his doctoral dissertation, The Measurement of Conation: An Enquiry into Volitional Processes. Since the present report also deals with the relation between will activity and the PGSR, though from a different viewpoint, an examination of some of McCarthy's results and observations may be helpful.

McCarthy proposed to study the conscious mental activity during the time of conflict, when the individual is simultaneously stimulated to contrary courses of action. He wanted particularly to test Ach's hypothesis that the Associative Equivalent[53] was a reliable scientific measure of the strength of the will. PGSR records were taken with the hope that the PGSR would prove to be a serviceable measure on the physiological level of will or conative activity.

McCarthy first had his subjects develop a strong associative connection between the syllables of disyllabic nonsense words. In the experimental situations the first syllable of the disyllabic words was the stimulus and one of four different tasks was made known to the subject by the color of this syllable. In this way the subject's attention was centered on the task at the time of reaction, since he found out what to do only when he saw the stimulus.

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consulted. The approach and general interpretation of results in all the articles remained the same as outlined above. Although some individually interesting cases are reported, the results on the whole are not completely convincing. Certain important details of method, control, and handling of data are not clearly reported, and in some instances seem to have been neglected. As a result, proper evaluation of the experiments is still difficult. Abramowski at times gives the impression of being over-enthusiastic in drawing conclusions from his data.

[53]The Associative Equivalent is defined as that strength of association which can just be overcome by the determining tendency of a previous resolve; p. 86.

In keeping with his conception of conation as "an inclination towards, or away from, some object apprehended as good or bad," and of emotion as the consciousness of the bodily changes consequent upon conation, McCarthy analyzed his data into four different types of PGSR deflections: (1) those in which emotion was conspicuous in consciousness(179 responses at a 2.82 average percentage fall in resistance); (2) those in which conation was reported, but no conscious emotion(89 responses with a 1.40 average fall); (3) those in which both emotion and conation were consciously present(66 responses with a 3.20 average drop); (4) those 'automatic' reactions in which the subject was conscious neither of emotion nor of conation(345 responses with a 1.37 average drop). This classification of deflections was based on and confirmed by the introspective reports of the subjects. It is worthy of note that the size of deflection corresponds roughly to the degree of consciousness reported.[54]

Although McCarthy's principal results clearly demonstrated that Ach's Associative Equivalent is far from being a scientific measurement of the strength of the will, the picture was not clear as far as the PGSR was concerned. McCarthy himself admitted his disappointment in failing to find in the PGSR the measure of conational activity that he had hoped for. All he felt justified in saying was that his data showed that the psychogalvanic reflex is influenced by conation, and that the size of the deflection bears some proportion to the amount of conative energy released during the reaction.[55]

The primary reason for this disappointment was the unexpected discovery

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[54]McCarthy, pp. 40-41.

[55]Ibid., p. 102.

of the important role that attention and its selective power play in will-activity. Because attention can be influenced by a variety of factors, both voluntary and involuntary, which it is practically impossible adequately to control, it is extremely difficult to say in a given situation whether the will act was strong or weak. The selective operation of attention may subordinate an objectively stronger motive to one that is much weaker, so that any attempt at measuring the activity of the will by means of the strength of motives or of the strength of obstacles to be overcome is almost certainly doomed to failure. That there should be a corresponding difficulty in determining whether the PGSR deflections reflect the strength of a given will act or acts is evident.

Perhaps it is best to leave the matter rest as it is. Yet the question remains: just what do the PGSR responses in McCarthy's experiments indicate? According to McCarthy, they correspond roughly to conation. Here, since conation involves will activity, there is a temptation to see a rough correspondence to the activity of the will, and hence some confirmation of the hope that the will can influence the magnitude of the PGSR. However, conation is made up of such a complexity of factors, both sensory and rational, that it might not be wise to pursue this idea too far. From another view point it might be argued that, if the criticisms levelled at McCarthy's distinction between conation and emotion are valid,[56] then it would be more proper to say that the galvanic responses corresponded to emotion. This interpretation would have the advantage of being able to explain the many 'automatic' reac-

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[56] Cf. supra, p. 26.

tions(almost half of the total responses) which McCarthy explains on the basis of the subject's self-assertive instinct. This instinctive desire urges the subject unconsciously to exert himself to put forth that conative activity which will insure the right reaction. According to the analysis of emotion already proposed, this self-assertive instinct would be brought into play precisely by that self-reference of the stimulus situation which is the very center and core of emotion.

To sum up: in this chapter the literature dealing with the physical, physiological, and psychological aspects of the PGSR phenomenon have been reviewed. The PGSR refers to the drop in apparent skin resistance to electricity upon the presentation of a sensory stimulus, the occurrence of an idea, the arousal of an emotion, or some other mental or physiological change. Physically, investigators now generally agree that the potential changes that occur are due to polarisation phenomena in the skin and increased permeability of glandular membranes.

Three main theories have attempted to explain the physiological basis of the PGSR, namely, the muscular theory, the circulatory theory, and the secretory theory. The muscular theory was disposed of by puncturing the skin under the electrode; PGSR disappeared. Darrow's experiments seem definitely to have shown that it is the secretory activity of the sweat glands that is responsible for the galvanic changes of the PGSR. Circulatory phenomena did not correlate consistently with the electrical changes. As for nervous control, the sweat glands are innervated by the sympathetic division of the autonomic nervous system. Subcortical centers seem to lie in the hypothalamic region, and cortical centers in the premotor area of the cerebral cortex.

Psychologically, the PGSR has been closely linked to emotion almost from the beginning of its history, and despite the bewildering variety of claims as to its precise significance, it is still considered the most sensitive indicator of emotion. Several theories of emotion were reviewed and criticized with a view to their being possible bases for some degree of voluntary control over the PGSR. The theory considered most acceptable is that which regards emotion as "the felt tendency toward an object judged suitable, or away from an object judged unsuitable, reinforced by specific bodily changes according to the type of emotion." This explanation was preferred because it gives the psychological aspect of emotion the proper emphasis and importance that is necessary for an adequate theory of emotion. It likewise stresses the unifying concept of self-reference as the core of emotion.

Few reports were found to deal directly with the relationship of the PGSR to the will. Most investigators feel that the PGSR is beyond voluntary influence, although the effect of attitudes on such reflex phenomena is coming more and more to be recognized. Abramowski claimed that the will can strangle an emotion and with it the galvanic response as one of emotion's physiological accompaniments. His reports, however, were not convincing, though some modern attempt at confirming his results might be fruitful. McCarthy attempted to measure will or conational activity. He came to the conclusion that because of the extreme complexity of the factors involved, any such attempts at measurement were for all practical purposes futile. His PGSR data, however, did show a rough correspondence to conational activity.

CHAPTER III

INVESTIGATION OF THE PROBLEM

By way of introduction, the matter to be investigated can be expressed again in the following way. The central problem posits the question: can the will influence the magnitude of the PGSR, at least indirectly? To investigate this problem an indirect approach through associative activity to the emotions seemed most practical. PGSR reactions to emotionally-toned words under conditions of free association would provide the data. By means of pointed instructions S's will could be brought into play for the control of his emotions. In such a situation it was hoped that the effect of the will activity would be reflected in the size of the galvanometric deflections. A control period without instructions could be used as a basis for matched groups of subjects, while two contrary types of instructions in the experimental or test period could furnish data for a comparison of the effects of instructions on the PGSR. This method gave promising results in a preliminary experiment, and so, with such a lead, the present experiment was designed. The main hypothesis to be tested was formulated as follows: instructions aimed at changing a person's emotional experience under conditions of free association will also change the physiological reactions of the associative act in the direction suggested by the instructions.

Before describing the main experiment, a brief summary of the preliminary investigation will serve as background. The purpose of this investigation was

to study (1) the inhibiting effect of soothing instructions on the PGSR, and (2) the effect of a social situation on the PGSR(a third person was introduced, and E razzed S). The stimuli were fifteen emotionally-toned words arranged in three matched sets of five words each. Each S freely associated to each of the three groups of words: one group was presented under ordinary free-association instructions, another group was presented with soothing or inhibiting instructions, and the third with razzing instructions. To balance out interaction between words and instructions and to counteract possible advantages of position both the slanted instructions and the word groups were rotated in a systematic way.

The results showed firstly, that the introduction of both kinds of slanted instructions had a decided lowering effect on the magnitude of the average PGSR association responses, although the overall drop in responsivity did not reach statistical significance; secondly, the PGSR association responses which followed inhibiting instructions were significantly different from the association responses which followed the razzing instructions; this occurred only when the inhibiting situation followed the razzing situation. Other differences, though not significant, were nevertheless in the expected direction.

The Main Experiment

Apparatus. A Leeds and Northrup galvanometer in combination with a closed critically damped bridge circuit was used. This means that the amount of current passing through all SS(who were in series with one arm of the bridge), when balanced, was constant regardless of the amount of their basic resistance. This kind of circuit has the advantage of controlling the important factor of

the amperage through the S. In the present experiment a constant current of 160 microamperes was used. The scale was linear up to deflections of two thousand ohms. Changes in current indicative of the change in skin resistance were registered continuously on 7.2 cm.-wide photographic paper which was moving at the rate of 7.3 cm. per minute. A pinpoint of light flashing off and on every second gave a time record, and a silent pushbutton switch by which the flashing light was interrupted gave a record of the time of the presentation of the stimulus. Before each stimulus the basic resistance level was noted down. From these and the photographic records it was possible to compute the ohms resistance at the point of maximum drop, and hence the change in ohms resistance, and consequently to relate them to the basic resistance values. The subject-electrodes were two copper strips inserted in two glass cups which were filled to a convenient level with a one-tenth normal saline solution. S inserted the index and fourth finger of his left hand into these cups. A slanted arm rest was provided to help prevent strain.

Subjects. Twenty-nine out of a group of forty-one male undergraduate college students from the day Arts and Commerce divisions of Loyola University were used as subjects. From a set of student number records arranged in rank order for the whole university every thirtieth student in the above mentioned divisions was selected. If the thirtieth, sixtieth, ninetieth, etc. happened to be a coed or a student used in the preliminary experiment, the next qualified male student was taken, and the counting continued from that point. Twenty-nine of the forty-one students thus selected were used. All SS were naive as regards the experiment and unknown to the experimenter.

Stimulus List and Instructions. The stimuli used were ten emotionally-toned words arranged into two matched sets of five words each as follows: (1) closed, God, sweetheart, afraid, sin; and (2) open, hospital, breast, sick, sex. These words were taken from a list of sixteen words specially prepared for the purpose of testing the strength of emotional responses and used in the Herr-Kobler "Psychogalvanometric Test for Neuroticism."[1] In this and in other experiments at Loyola University the average PGSR response to these words under normal free association instructions had been found to be fairly constant. For this reason they were considered apt for testing the possible influence of slanted instructions on their response. The two groups of words were balanced with each other according to their responsivity in the Herr-Kobler experiments. The arrangement within each group was from the lowest average response in the first place to the highest average response in the last place. This within-group order was maintained unchanged throughout the experiment.

Each S reacted to all ten words. For the first five words no instructions were given except the introductory remarks at the beginning to acquaint S with what he was to do. The second group of words was subjected to the special experimental instructions.

Before each emotional word a buffer word was inserted in order to counteract or dissipate somewhat the influence of one emotional word on another; and before the actual measured session three neutral words--horse, field, table--were used in order to test the constancy of the basic resistance following the

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[1]Vincent V. Herr (S.J.) and Frank J. Kobler, "A Psychogalvanometric Test for Neuroticism," J. Abn. & Soc. Psychol., XLVIII (July 1953), 413.

four to six minute adaptation period.

The special experimental instructions consisted in two sets of five slanted instructions, one instruction before each emotional word of the second word-group. They are as follows:

Inhibiting or Soothing Instructions (I)

Before open: "Now don't try to reason but simply report the first word that comes to your mind as quickly as possible."

Before hospital: "That's good. Now try not to let your feelings interfere but simply give the first word that comes to mind as quickly as possible."

Before breast: "That's better. Try to feel as much at ease as possible, letting nothing interfere, but simply give the first word as quickly as possible."

Before sick: "Fine. Resolve now to avoid all resistance to the flow of imagination and simply report the first word that comes to mind as quickly as possible."

Before sex: "Perfect. Now resolve to respond as freely as possible, letting neither judgment nor feelings nor choice interfere in any way with the recall. Simply give etc."

Razzing Instructions (II)

Before open: "Hmm. I wonder if you can hide your emotions on this one."

Before hospital: "Your unconscious emotions seem to be showing up. I wonder what this one will show."

Before breast: "Your mental state should have a lot to do with the emotion on this one."

Before sick: "You seem to be getting more disturbed and embarrassed. Try this one."

Before sex: "You don't seem to be able to control your emotions very well. Try this one."

Experimental Procedure and Session. In contrast to the procedure of the preliminary investigation, in the present experiment each S reacted either to

soothing or to razzing instructions, not to both. In this way, with the two groups of subjects balanced according to their reactivity in the control situation, a more valid comparison of the effect of the contrasting instructions could be made. To facilitate this comparison, word-group 1 was always given first with no special instructions, and word-group 2 was always given second with the slanted instructions. Another reason for not varying the order of the word-groups for the different subjects was the possibility that there might be an interaction between a particular word and the type of instruction.

One of the randomly selected students was usually contacted by E immediately after an afternoon class and asked to be a subject. On the way to the laboratory E told S how he happened to be selected, but any questions about the experiment were put off in a polite way. Everything was done to avoid tampering with S's emotions. As a general practice S washed his hands with soap before the experiment. On entering the laboratory booth most SS looked at the apparatus with puzzlement and some apprehension, so after the third or fourth S, E, in order to allay unwanted fears, told every S that there would be no electric shock. Despite this assurance one S actually said that he still expected a shock up to the very end of the experiment. S was asked to take a comfortable sitting position and to put the index and fourth finger of his left hand into the two cups of saline solution as far as he could and to let his arm rest relaxed on the armrest. The only preliminary instructions given were the following: "In this experiment we want to see how well the nervous system works when it is studied in relation to the sweat glands and other unconscious bodily processes." If S asked any questions about the instrument or the experiment, he was politely asked to wait till after the experimental session.

S was instructed to close his eyes and to keep them closed throughout the sitting. Some SS were rather fidgety and had to be told to avoid unnecessary movements of the head and body as well as heavy breathing.

The adaptation period varied somewhat with the subject, but it ordinarily lasted five or six minutes. To hasten adaptation S was asked after the first couple of minutes to take one or two deep breaths. When the instrument had finally been adjusted and S's basic resistance had levelled off, E instructed S as follows: "I am going to pronounce a series of words. When you hear a word, give the first word that comes to your mind as quickly as possible. There are no right or wrong answers. Just give the first word that comes to your mind." These were the only instructions given for the first group of words. No ready signal was given for the individual words since in the previous experiment a deflection of the galvanometer usually occurred at such a signal. At this point the three buffer words--horse, field, table--were given, in order to gauge somewhat S's reactivity and to get him, as it were, into the swing of things. After this the time clock was turned on, S's basic resistance level recorded, and the words for the control situation presented--first the buffer word, then the emotional word, and so on. Verbal responses were recorded and deflections of the galvanometer noted down in millimeters. Basic resistance was checked after each stimulus word and any necessary adjustments to keep the light close to the zero point were made. Since some SS recover more quickly than others, there was no set interval between stimuli. When S began to level off, the next stimulus was given.

At the end of the first group of words, the recording apparatus was turned off for not more than a minute. After that short interval the second group of

words was given--first the neutral word, the instruction, and finally the emotional word, and so on. The SS who were to make up Group I received the inhibiting instructions, while those who were to make up Group II were subjected to the razzing instructions. No third person was introduced in this experiment. E tried to read off these instructions in a level tone of voice. The time required for reading each instruction was from five to eight seconds.

Early in the experiment a rather consistent deflection of the galvanometer occurred at the instructions themselves, especially the razzing instructions, so that E had to wait for S to level off again before the stimulus word could be given. This fact turned out to be of some importance as shall be explained later on. After the experimental session was over, introspections were taken and recorded.

CHAPTER IV

RESULTS

Since the raw scores, or ohms drop, do not give anything like a normal distribution, some transformation of scores was necessary. In line with the Herr-Kobler study the individual scores, recorded in millimeters and converted to ohms by means of a standard table, were all converted into logarithmic units by means of the following formula:

$$\text{score} = \frac{\log \text{ohms plus } 1.29}{\text{basic resistance}} \times 10^4 \text{ units.}$$ [1]

The constant was derived from the distribution of the logs of the scores according to the basic resistances. The best fitting line was drawn through the ordinate of the log scores. Finally, the distance from the abscissa to the point where the line crossed the ordinate was taken as the constant. Special tables based on this constant were used for the conversion.

Since two kinds of instructions were used and the association responses following them were to be compared, the subjects had been divided into two groups simply by alternating the instructions for each S. Because of the small number of SS, the distribution of these two groups was tested according to the level of their basic resistances. The distribution was found to be normal.

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[1] Herr-Kobler, p. 412.

However, when it came to comparing the responses of the two groups, one S of the inhibited group with an extreme basic resistance level was dropped to make the groups even at fourteen SS each. Summing the scores of the control situation revealed that Group I(i.e. inhibited) was a bout 17 per cent higher than Group II(i.e. razzed). In order to match the groups more closely according to their responsivity in the uninstructed situation one pair of extremes in scores was dropped from each group, namely, two highs of Group I and two lows of Group II. There were now two closely matched groups of twelve SS each. The average response per S per word in the control situation was 501 log-ohms for the SS of Group I and 503.2 log-ohms for the SS of Group II. This matching was the basis for the comparison of the two groups in the experimental or test situation. The mean scores of these two matched groups are shown in Table 1.[2] The scores are the means for the responses to the five stimulus words of the first, or control, part of the experiment. Because of the matching the overall means do not differ from each other although their SDs do differ to some extent. Neither the difference between the means nor the difference between the SDs even approaches significance.

The scores to be compared with each other in testing the major hypothesis are the association scores of the inhibiting and the razzing conditions, since the matched SS under these conditions received the opposite types of instructions with the same set of stimulus words. The scores to be compared for testing the secondary hypothesis are the scores of part one of the experiment with those of part two since the same SS responded to both of these conditions.

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[2] p. 50.

Table 1

Mean Scores for PGSR Response to Five Words in Matched Groups I & II: Control Situation

S	Mean I	S	Mean II
Nll	674.4	Sle	689.0
Oll	617.8	Oen	680.6
Hof	611.6	Car	587.2
Mel	554.4	Zer	583.8
Cen	532.4	Hin	518.6
Wer	525.4	Jes	512.4
Mhy	491.0	Rly	510.0
Pri	482.8	Cer	505.2
Fox	433.6	Oan	495.2
Mrr	416.6	Ski	362.2
Lrt	392.0	Lky	339.0
Hen	280.0	Ser	255.0
M	501.00		503.18
SD	110.04		130.82
SEM	33.18		39.44

Table 2[3] shows the mean scores for responsivity of the two groups under inhibiting conditions and under razzing conditions. The response to instructions scores are included to facilitate comparison, but they will be discussed further on. A glance at the scores shows that, contrary to original expectations and the major hypothesis, there is practically no difference in response between the group that was razzed and the group that was inhibited. This result caused considerable surprise, not only because it was contrary to the findings of the preliminary experiment but also because the relative value of the scores is actually in the opposite direction to what one would expect. The razzed SS were less responsive than the soothed SS!

On the other hand, there is a difference between the two groups. While their means are close and in favor of the inhibited group, the amount of scatter indicated by the SDs is greater for the razzed group than for the inhibited group. That this difference may be due at least partially to the larger inherent variance of the razzed group can be gathered from the difference in scatter in the control situation where the inhibited group has an SD of 110.04 and the razzed group an SD of 130.82. However, it may be worthy of mention that the difference in scatter in the instructed situation does not remain proportional. The inhibited group shows an increase of 17 per cent while the razzed group increases 32 per cent. This fact may be of slight importance and statistically insignificant, but still it may be considered as evidence of the effect that different instructions have on a person.

Despite the negligible difference in response to the two types of instruc-

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[3] p. 52.

Table 2

Mean Scores for PGSR Responsivity to Emotionally-Toned Words under Inhibiting and Razzing Instructions

S	Group I		S	Group II	
	Resp. to words	Resp. to instructions		Resp. to words	Resp. to instructions
Nil	542.6	192.2	Sle	719.4	593.8
Oil	527.8	445.0	Oen	704.6	612.0
Haf	664.8	375.8	Car	531.2	
Mel	336.8		Zer	393.0	379.0
Cen	420.2	67.8	Hin	212.0	398.0
Wer	350.4	131.8	Jes	348.0	138.4
Mhy	238.6	143.8	Rly	458.6	373.8
Pri	412.4	140.8	Cer	321.0	570.4
Fox	454.8	491.0	Oan	315.8	369.0
Mrr	397.2	194.4	Ski	332.8	254.2
Irt	277.0	73.2	Iky	196.2	292.0
Hen	251.4	134.0	Ser	281.9	241.2
M	406.17	217.25		401.20	383.80
SD	128.77	148.84		172.48	154.05
SEM	38.83	47.07		53.01	48.72

Combined uninstructed mean	502.09
Combined instructed mean(resp. to words)	403.68
Mean difference	98.41
Critical ratio	2.47
P with 22 d.f.	.02-.05

tions, the instructions as instructions did bring about a noticeable change. Whereas the overall average response per word per S in the uninstructed situation was 502.09 log-ohms, the overall average for the instructed situation (i.e. inhibited and razzed responses combined) was only 403.68. Tested for significance the difference between the means has a Critical Ratio of 2.47, which with twenty-two degrees of freedom is significant between the .02 and .05 levels of confidence.

Why this drop in responsivity in part two? One possible explanation would be adaptation to the instrument or to the whole experimental set-up. Against this explanation is the fact that in all previous work with these words and with this logarithmic unit score where there has been no special type of instruction given, this drop failed to appear. Inspection of the individual association responses shows that the change is, for the most part, an abrupt one and not a gradual decline. Moreover, the drop in part two can scarcely be attributed to the emotional value of the words themselves because the relative emotionality of the two word-groups was known from a number of previous experiments conducted at Loyola University. Even under the variety of conditions to which these same words were subjected in the preliminary experiment, their relative emotional value remained the same. As a matter of fact, the same kind of drop in responsivity occurred in the preliminary experiment when the slanted instructions were introduced. The example from Woodworth-Schlosberg already cited[4] in which the subject's PGSR almost drops out when experimenter tells

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[4] p. 31.

him the shock is turned off might be considered similar to the phenomenon here being discussed. However, this offhand information is hardly comparable to the kind of instructions used in the present experiment, but it shows the influence that attitudes can have on a person's reactivity. Finally, in a recent experiment at Loyola in which a "threat of shock" was given prior to the task of forming associates with the same stimulus words used in this experiment, there also occurred a drop in responsivity at the actual time of forming the associations.

Although the difference between the association responses to the soothing and to the razzing instructions was practically non-existent, and even in the wrong direction as far as the major hypothesis is concerned, an unlooked for phenomenon occurred that should be recorded. Early in the experiment E noticed that a galvanic response was given to the instructions themselves, and he had to wait for the galvanometer to level off again. Only then was the stimulus word given. At first not much attention was paid to this response, but since it continued to occur and was noticed especially among the SS who were being razzed, a written record was kept. There is a difficulty here with regard to accurate data because for a number of SS no written record was made of such drops. However, an examination of the photographic records revealed in most instances a characteristic drop within fifteen to twenty seconds before presentation of the stimulus. Since instructions before the words each took from five to ten seconds reading time, such a drop within the time noted and for which no written record had been taken was considered with practical certainty to be the response to the instructions. Any drops about which there was a

reasonable doubt were ignored.

The data compiled for these instruction responses are interesting and are shown in Table 2 where they can be compared with the responses to the emotional words.[5] The mean score for the inhibiting instruction deflections was 217.2 with an SEM of 47.07; this drop is about half as large as the mean drop during the association itself(406.17). The mean for the razzing instruction drops was 383.8 with an SEM of 48.72; and this is nearly as large as the drop(401.2) for the associations themselves. The difference between these two instruction drops is significant at about the .02 level of confidence, the CR being 2.46 with twenty degrees of freedom.

Here more systematic introspections might have provided some light, but unfortunately the introspections taken were general and not complete. However, in the light of the statistical findings the introspections that were taken provide some interesting points. For example: the purpose of the inhibiting instructions was to soothe S, to make him feel at ease,and thus to inhibit the emotional response. In several instances, though, these instructions seemed to have a contrary effect. Fox expressly said that he thought the instructions affected him this way; he felt tight and felt that the instructions made him more so. His mean scores were: uninstructed, 433.6; inhibited, 454.8; instruction response, 491. This is hardly a soothing result, but it corresponds, nevertheless, to S's state of consciousness. Nil felt ill at ease through the whole situation and thought E was analyzing his reactions on the spot. As

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[5] P. 52. There are only eleven SS in each group for the instruction-drop comparison because of an unavoidable defect in S Car's record.

evidence of his discomfort, his right hand at the end of the session was wet with sweat. But note his mean scores: uninstructed, 674.4; inhibited, 542.6; instruction response, 192.2. In this case, though S has a rather high score, the effect is more in correspondence with the direction of the instructions than with S's conscious experience.

Three of the inhibited subjects who had to be dropped so that matched groups could be had reported the same conscious phenomenon. One seemed to feel that E talked to him because he was not doing his best, although he himself thought he was. Perhaps others felt the same way. Another expected an electric shock. The third said he felt anxious all the way through, even more so when instructed. Mrr was quite evidently disturbed during the whole time, at least from outward appearances, and the instructions seemed to have no soothing effect. Still there was a small drop in responsivity during the inhibited period: 397.2 as compared with 416.6 for the uninstructed part.

On the other hand, among the razzed SS only half of them felt irked or uncomfortable because of the instructions, while the others said that the instructions had little or no effect. One S, dropped when the groups were matched, remarked, "I know I can control my emotions. I sat down and was calm all through." Of the total twenty words, buffers included, he reacted only to six, to five emotional words and one buffer. Only three of these responses were more than 400 log units. Furthermore, his basic resistance did not vary more than 160 ohms. It is hard to say whether this lack of responsivity was due to a remarkable ability to control himself of to some other unknown cause.

Of the others Jes did not consider himself emotional and looked on the razzing instructions as just part of the experiment. Still, he did not seem

very much at ease; and yet his drop from 512.4 to 348.0 is considerable. Oan likewise shows a big drop from 495.2 to 315.8. Although he said the instructions had little effect, he still thought his reactions would be excessive because of some trouble that was giving him concern. His responses to instructions had a mean of 369.0. Oen was very high on all counts: uninstructed, 680.6; razzed, 704.6; instruction response, 612.0. Although he said he did not feel the razzing, he did mention that he had high blood pressure and a slight nervous condition. About the middle of the session his left hand felt as if it were going to sleep. Sle simply thought that E was trying to throw him off by talking, and said he was not bothered by the instructions. These last two subjects were highest in each of the three sets of scores.

The implication of all these reports is that, compared with those who felt the instructions, the SS who said they weren't bothered are the more highly responsive group as a whole, and their drop in responsivity in the instructed situation is comparatively less than that of those who said they were bothered.

The picture, then, that is gathered from the introspections is not, generally speaking, reflected in objective data of the PGSR, and the relation between the conscious state of mind and the galvanic responses is not clear. More extensive introspective information from every S might have made the picture clearer. However, the trend seems to be that the psychogalvanic responsivity of the person has an inverse relation to the subject's consciousness of predicament. It may be that some of the available energy is expended through the conscious awareness and drained away from the unconscious autonomic activity.

CHAPTER V

SUMMARY AND DISCUSSION

In this study an attempt has been made to show at least an indirect influence of the will on the activity of the autonomic nervous system as evidenced by the PGSR. From the data obtained it seems reasonably certain that the type of instruction given immediately prior to the time a subject is to form a free association does not appreciably affect the size of the galvanic associative response in the direction suggested by the instruction. Since the difference in response to what were intended to be contrary instructions turned out to be practically nil, evidence of voluntary control failed to show up. The major hypothesis, therefore, was not substantiated, i.e. that instructions aimed at changing a person's emotional experience under conditions of free association would also change the physiological reaction of the associative act in the direction suggested by the instructions.

Yet why have others, e.g. Abramowski, found some voluntary control over the PGSR? Perhaps it is just that some subjects have more control than others; for example, in the present study, Mel, Mry, Nll. Or it may be that there was a faulty interpretation of data due to the use of an inadequate unit of measurement or some other error in technique. Woodworth-Schlosberg bring this latter possibility out very clearly in their discussion of the importance of the type of circuit, electrodes, unit of measurement, etc. that are necessary

for reliable study of the PGSR.[1] Abramowski attributes the control he found to intellectualization, to a throttling of emotion before it had a chance to show itself. What the merit of this explanation is is an open question, and the answer may not be so simple.

Another distinct possibility to be considered lies in the matter of stimuli. The reaction to mainly sensory or intellectual stimuli may be much easier to control than the reaction to stimuli that touch deeper emotional complexes that involve the whole person or self. The stimuli used in the present investigation were emotional stimuli whereas Abramowski's were mostly sensory or intellectual. He did use free association to "interesting" words for two SS of the report that was available, but these two SS showed rather a lack of control in the inhibited series of word experiences.

This matter of stimuli and their ability to arouse the subject is an important point which fits in with the idea that the core of emotion lies in the reference to self. The more intimately the stimulus touches the self, the more likely it is to be difficult of control. Emotionally-toned words, for example, would seem to have a better chance of touching the self than many of the auditory, visual, mental, etc. stimuli that are frequently used. A good example to illustrate this point is provided by Woodworth-Schlosberg. A student once tried to measure PGSRs of psychiatric patients, using words and names from the individual case histories as stimuli. His first subject was a schizophrenic woman. Sometimes she gave large responses to her husband's name, but at other times she gave no response. Obviously, as might be expected of a schizophrenic

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[1] Woodworth-Schlosberg, pp. 138-141.

patient, the name did not penetrate on every trial.[2] McCurdy, in his survey of many articles dealing with conscious emotion and the PGSR, found consistently high correlations between PGSR and reported strength of emotion. He concluded that it is fundamentally the assessment of the stimulus by S which determines the magnitude of the galvanic reaction.[3] This, of course, makes the study of the PGSR more complicated, but, because mental disorders are so intimately bound up with a person't conception of or concern about himself, further experimentation along these lines should be fruitful.

Although the major hypothesis was not confirmed, the introducing of instructions was not without effect in the present experiment. There is still the overall drop in responsivity in the second part of the experiment to contend with. Because of the equating of the two groups of words in previous experiments, this significant drop is hardly due to the emotionality of the words themselves or to mere adaptation to the situation. A plausible explanation suggested itself only after intensive study of the records in the light of the experimental set-up used. The fact has already been mentioned that a drop occurred in response to the instructions themselves and that the difference between the response to inhibiting instructions and that to razzing instructions was significant. Now could it not be assumed that the response to the instructions forms a dynamic unity with the response to the task of forming a free association, since the instruction alerts S to act in accordance with it as

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[2] Woodworth-Schlosberg, p. 154.

[3] H.G. McCurdy, "Consciousness and the Galvanometer," Psychol. Rev., LVII (November 1950), 322-27.

best he may? This is not presumptuous because the time lapse between the hearing of the stimulus word is always under twenty seconds, and generally speaking more than this length of time is required for the completion of a reasonably large skin response.

In line with this train of thought, the ohms drop in response to instruction was added to the ohms drop in response to the corresponding stimulus; these scores were then converted into logarithmic units as before. The mean response for the inhibited group now becomes 516.2; SD, 159.9; and SEM, 50.56. This double response now surpasses that produced by the association responses in the uninstructed or control situation(502.09). Similarly, the mean for the razzed group becomes 589.8; SD, 190.32; and SEM, 60.19. Here the responsivity excels by a still greater margin the response produced by the same persons in the uninstructed situation. However, none of the mean differences resulting from these new scores is statistically significant.

Due to the lack of complete certainty with respect to this instruction-response data, speculation cannot be carried too far. Yet, if there is any merit in the above explanation, it would mean that the shock of hearing the instruction takes away some of the autonomic energy available at the time for the production of the response to the stimulus word. A couple of SS seem to illustrate this. Iky, for instance, had good association responses in the uninstructed situation(mean was 339). To the first two razzing instructions he dropped 323 and 306 respectively, while to the corresponding stimuli his resistance not only did not fall but actually went up slightly. Hin shows practically the same: uninstructed association responses and responses to instruction were good, but for three of the five stimulus words there was almost no

association response at all.

Someone might object: since the drain of the inhibiting instructions was significantly different from that of the razzing instructions, should one not expect this difference to be reflected in the association response, especially since the two groups of subjects had been matched for responsivity according to the uninstructed situation? Instead of being a difficulty, this may merely be emphasizing the fact that although the instructions caused responses reflecting their own immediate effect on S, they had no appreciable influence on the association responses except for a general lowering in responsivity. The fact that the association responses are practically the same may be precisely the reflection of the difference in drain caused by the instructions and of the fact that the word-groups themselves are matched.

This discussion of the fall in responsivity due to responses to instructions leads to the conclusion that the secondary hypothesis has been confirmed, namely, that instructions aimed at altering a person's emotional experience, while not changing the response in the direction suggested by the instructions, will, however, produce a change which can be predicted for similar experimental situations. The specific change is the overall drop in psychogalvanic responsivity to stimulation. If the explanation of this phenomenon is true, any subsequent attempt to evaluate the autonomic activity following instructions would be a very difficult task indeed. Is a particular galvanic response a reflection of the amount of nervous energy available at any given moment? and if so, to what extent? Since the PGSR is recognized as a fair indication of autonomic activity, and autonomic activity a sign of general bodily responsivity, it seems clear that every disturbance in autonomic activity should be interpreted

against the background of the total amount of energy available at any one time. Before a final solution to the problem can be had, much detailed and patient experimentation will have to be carried out, using, perhaps, combinations of EEG and PGSR techniques.

As far as can be judged from the approach used in this investigation, the will has little influence on such a delicate reaction as the PGSR. One difficulty with voluntary control is the factor of expectancy involved in an emotional reaction. If this is active in a self-referential way, then it will be hard to inhibit the initial reflex reactions; any control has to be exercised in the very beginning. The key, then, would seem to be in the possibility of the control of the self-reference involved in emotion. How might this be accomplished? A person evidently cannot directly command the autonomic processes as he ordinarily can the skeletally controlled members of his body. However, self-reference depends on a judgment as to how this stimulus affects the individual. If, therefore, the judgment could be controlled, it seems that the bodily resonance might also be controlled. The judgment, in turn, is influenced by the imagination. If, then, the imagination could be controlled by a previous determination of the will, the bodily changes would also be affected. This would require a good bit of alertness and assurance, because first reactions to stimuli are usually pretty much automatic. It is ordinarily only on a second take, so to speak, that the system of controls is thrown into gear.[4] This seems especially true when there is question of stimuli that are loaded

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[4]Cf. e.g. R.C. Davis's analysis of the startle response into two components, one fast and the other slow: "Motor Effects of Strong Auditory Stimuli," J. Exp. Psychol., XXXVIII, (1948), 257-275; "Responses to 'Meaningful' and 'Meaningless' Sounds," Ibid., 744-756.

with meaning for the person.

The conclusion, then, is this. Unless a person has a marvelous degree of self-control and self-mastery based on an assured appraisal of himself, it seems difficult to see how he can effectively control the subtle response to stimuli which, when recognized, strike home through all barriers of defense and touch the inner self.

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APPROVAL SHEET

The thesis submitted by Paul Samuel Kehres, S.J., has been read and approved by three members of the Department of Psychology.

The final copies have been examined by the director of the thesis and the signature which appears below verifies the fact that any necessary changes have been incorporated, and that the thesis is now given final approval with reference to content, form, and mechanical accuracy.

The thesis is therefore accepted in partial fulfillment of the requirements for the Degree of Master of Arts.

Jan. 30, 1956
Date

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Signature of Adviser