PSYCHOPHYSIOLOGY
Vol. 3, No. 2

Printed in U.S.A.

SOME EFFECTS OF SPINAL CORD LESIONS ON EXPERIENCED EMOTIONAL FEELINGS

GEORGE W. HOHMANN, PH.D.

Psychology Service, Veterans Administration Hospital, Tucson, Arizona, and Lecturer in Psychology, University of Arizona, Tucson, Arizona

ABSTRACT

In structured interviews, 25 adult males with spinal cord lesions at varying levels were asked to compare certain of their emotional feelings before and after injury. The investigator, himself a paraplegic, knew all subjects well. The major findings follow.

1. Significant decreases in experienced feelings of anger, sexual excitement, fear, and an over-all estimate of change were found.

2. A significant increase in feelings of sentimentality was reported.

3. Although spinal cord lesions decrease some emotional feelings, overt emotional behavior may continue to be displayed.

4. Support was offered for the belief that disruption of the autonomic nervous system and its afferent return causes notable changes in experienced emotional feelings. A trend was noted which suggests that the more extensive the disruption, the greater the decrease in some emotional feelings.

DESCRIPTORS: Theory of imation; ANS: Feelings; Emotions; Spinal Cord Injuries.

This investigation attempted to describe any alterations in certain forms of emotional feeling that may have occurred as a result of spinal cord injury. Its sources come from several people. According to James (1884), emotion is the perception of bodily change; James had in mind changes in smooth muscles, glands, and striated muscles. Lange (1885), on the other hand, considered feeling or perception of visceral events as epi-phenomena and suggested that emotion was primarily changes in the circulatory system. Cannon (1927, 1929, 1931) criticized these views. One of his major criticisms was that the entire sympathetic nervous system could be eliminated without altering patterns of emotional behavior in cats. He also claimed that after injuries to the spinal cord which impair autonomic outflow and afferent return from the viscera, patients still report the experience of emotional feeling and still display signs of emotional behavior;

Data for this study were gathered while the author was a staff member of the Psychology Service, Veterans Administration Hospital, Long Beach, California, and assigned to the Spinal Cord Injury Service. Gratitude is expressed to the Staff and patients of the Spinal Cord Injury Service for their cooperation in making this study possible. The continuing encouragement and guidance of Dr. M. A. Wenger, Professor of Psychology, U.C.L.A., is deeply appreciated.

Address requests for reprints to: George W. Hohmann, 3815 Calle Barcelona, Tucson, Arizona 85716.

this claim concerning human patients was supported by a clinical report published by Dana (1921).

At present there is no generally accepted theory of emotion, nor is there any generally accepted definition of emotional behavior. In 1950 Wenger criticized Cannon's criticisms of the so-called James-Lange theory, and came to the conclusion that emotion should be defined as ongoing visceral action. Later (1956), he specifically extended the definition to include associated patterns of striated muscle action. Like Lange, he regarded emotional feeling as subsequent perception based upon these bodily actions, and, like Dunlap (1928), he regarded emotion as a continuous dynamic process. He speaks, then, not of the presence or absence of emotion, but of changes in emotional patterns, and assumes that different feeling states will result from different action patterns. His position differs from that of James mainly in definition, and in the separation of emotional response from perceptual response.

The positions of James, Lange, and Wenger all would lead to the conclusion that anyone with a complete lesion of the spinal cord at any level would have altered emotional experience. James would have to maintain that the emotion itself was altered, whereas Lange and Wenger would have to hold that emotional feeling would be altered. On the other hand, Cannon would hold that emotional feeling and behavior would remain unaltered. The literature includes few relevant data and no systematic investigations of the question.

In 1955, the writer, in connection with another study, investigated alterations in autonomic balance in a sample of paraplegics but did not interview them concerning any changes in emotional feeling attributed to their injuries. In 1959, McKelligott replicated this portion of Hohmann's study, making use of selected patients with lesions at different levels of the cord, and attempted to interview patients concerning any differences they could detect in emotional feelings since their injuries. He got few reports of changes, but did gain the distinct impression that he was not achieving full cooperation from his subjects during the interviews. His failure led to consultations with Dr. Ernest Bors, Chief of the Spinal Cord Injury Service at the Veterans Administration Hospital at Long Beach, California, and with the present writer, who then was serving as Staff Psychologist on the Spinal Cord Injury Service. At that time the latter had worked with hundreds of paraplegic and quadraplegic patients over a period of 4 years, and Dr. Bors had treated perhaps 2000 such patients for periods varying up to 18 years.

It soon became apparent in our discussions that both Dr. Bors and I had come to expect certain decreases in emotional feeling in, at least, patients with lesions high in the cord. Dr. Bors, for example, made the statement that he had never seen a patient with a complete cervical lesion who manifested a "full-blown" response of anger. Moreover, it had become clear to both of us in our experience with such patients that they are reluctant to talk to most "normal" people who might wish to interview them. Dr. Bors had gained the confidence of most of them and they had freely expressed themselves to him. They also are willing to talk to me, because I too am a paraplegic. We finally concluded that McKelligott was probably correct in assuming that he was not obtaining the cooperation of

his subjects during the interviews.[1] We concluded that it would be desirable to conduct a thorough study of the possibility of any reduction in emotional feeling in certain specific areas. For this purpose the areas of anger, fear, grief, and sexual feeling were selected, and systematic interviews were conducted in each area with the patients described in the next section.

Subjects

The subjects of this investigation were 25 male veteran outpatients of the abovementioned Spinal Cord Injury Service. All were known to the investigator and all cooperated willingly. The subjects ranged from 27 to 47 years of age, with a median of 36. The time since injury ranged from 2 to 17 years, with a median of 11 years. All were in good health within the limits imposed by their disabilities, and the physical condition of all was considered to be well stabilized.

One consideration in the selection of subjects was that they had no special psychiatric problems. At the time of the investigation all were leading comparatively normal lives in their communities. Twelve were employed, four were students, and nine were unemployed. None had severe socioeconomic problems or gross psychiatric symptomatology, although one (D. B., Group 5) subsequently developed alcoholism. Seven of the subjects had, at some time prior to the interviews, received some supportive psychiatric therapy to help them with various readjustment problems. None had required intensive treatment. Ratings of their over-all adjustment to their disabilities are shown in Table 1.

Another consideration in the selection of subjects was that they have sufficient intelligence to compare feelings since injury with remembered feelings prior to injury, and sufficient verbal facility to communicate and describe their feeling states. To this end, no patient was used who had not completed high school. The group included seven who had college degrees and nine who had had some education beyond the high school level.

Still a third consideration in selection was that the subjects had had sufficient adult heterosexual experience before injury to be able to compare sexual feelings both before and after injury. Fourteen of those selected had been married before injury. At the time of the study, thirteen were married, seven were divorced, and five were single. None reported histories of severe sexual maladjustment prior to injury.

With the above considerations in mind, an attempt was made to find five appropriate subjects who had clinically complete lesions of the spinal cord at each of five levels—cervical, upper thoracic, lower thoracic, lumbar, and sacral. This attempt, in the main, was successful. All subjects and certain of their characteristics are described in Table 1. It should be noted, however, that subjects E. H., W. E., and C. N., with high cervical injuries, cannot be considered to have had complete lesions; otherwise, the function of the phrenic nerve, originating

[1] In the present study, some of the same subjects interviewed by McKelligott were used and their present reports were contradictory to what they had told him. When questioned, regarding these contradictions, they replied, in essence, that "you are one of us" and would therefore "understand." They had not wanted McKelligott to think them "some sort of oddball."

TABLE 1

Descriptive data for the 25 male Ss interviewed in this study

Group	*S*	Level of Lesion	Age	Years Injured	Marital Status	Sexual Functioning					Over-all Estimation of Adjustment[a]
						Psychogenic	Reflexogenic	Erections	Ejaculation	Orgasm	
I	E. H.	C-2–3	27	2	M		*	*			G
	C. N.	C-3–4	29	5	S		*	*			G
	W. E.	C-4–5	31	4	M		*	*			E
	J. S.	C-5–6	34	12	S		*	*	*		E
	A. J.	C-6–7	30	7	D		*	*			E
II	R. P.	T-1	47	6	D		*	*			G
	J. S.	T-3–4	37	4	M		*	*			G
	J. W.	T-3–4	38	15	M						E
	F. L.	T-4	37	14	M		*	*			F
	A. F.	T-4	41	12	D						E
III	H. S.	T-7	43	15	M		*	*			E
	C. W.	T-8–9	31	5	S		*	*			A
	R. B.	T-11	36	14	D						F
	A. A.	T-11–12	47	12	M		*	*			G
	W. S.	T-11–12	34	4	M		*	*			E
IV	H. G.	L-1	42	17	M		*	*			E
	W. C.	L-1–2	29	10	M	*	*	*		*	A
	H. B.	L-1–2	43	15	M		*	*			A
	L. T.	L-3–4	33	6	M	*	*	*		*	E
	C. A.	L-4–5	29	9	M	*		*	*	*	A
V	R. L.	S-1	28	5	S	*		*	*	*	F
	F. D.	S-1–2	44	16	S						G
	B. M.	S-1–2	42	14	D						G
	J. S.	S-2–3	39	11	D						F
	D. B.	S-2–3	35	15	D						P

[a] Evaluation of over-all adjustment to disability: E = excellent; G = good; A = average; F = fair; P = poor.

from the third through fifth cervical segments, would have been lost and they would have died of asphyxiation at the time of injury.[2]

Table 1 also shows the degree of sexual function which remained in these patients after injury. It may be noted that the majority retained either psychogenic or reflexogenic sexual function, with the most notable absence being seen in Group 5, where, presumably, the absence of all sexual function in four of the subjects was due to lesion of the cauda equina, including the pelvic nerve. Of the total group, it will be seen that fourteen had only reflexogenic erections, while two had psychogenic erections and two had a combination of the two. Ejaculation

[2] Some of the subjects were known to have had anatomically complete lesions, having been visualized at laminectomy. We chose patients with lesions which were judged to be "clinically complete," on the basis of careful neurological examination, for two reasons. First, to have used only those who had had their cords visualized would have limited the number of subjects. Second, even if the spinal cord is visualized prudent neurosurgical procedure often precludes its manipulation, so that sometimes it is impossible to determine whether parts of the cord remain intact, especially on the anterior aspect.

without awareness was experienced by one (J. S., Group 1), and with awareness by two (C. A. and R. L., Groups 4 and 5), whereas any experience of orgasm was retained by only four. It should be noted further that all subjects had engaged in some petting and lovemaking since injury. All had had the opportunity for intercourse and, although 18 retained the capability of erection on certain occasions, only 14 had completed intercourse since injury.

Procedures

A structured interview was used. After care had been taken to establish the best possible rapport, the interview was directed to specific feelings in situations of sexual excitement, fear, anger and grief, and the subject's attention was directed toward his feelings rather than toward the concomitant ideation.

Several of the subjects had been injured a number of years before and had difficulty in recalling their feelings in emotional experiences prior to injury. In an attempt to assist them, they were asked to recall and discuss any emotional experience which had been particularly notable prior to the injury, and a comparable incident following the injury. They then were asked to try to compare their emotional experiences before and after injury in each area under investigation. At the close of the interview they were asked to make an over-all impressionistic comparison of their feelings before and after injury. They also were asked whether there were other feelings or experienced emotions which they felt had been altered by their injury.

It quickly became apparent that one change was almost always mentioned. It was described as increased weeping, feeling a lump in the throat, or getting "choked up" in "sentimental" situations such as saying goodbye, attendance at church services, watching a touching movie or play, or during the expression of tender feelings.

Because of these initial results, which were compatible with the investigator's own experience, it was decided to study this additional area of feeling systematically. This area was termed "sentimentality" and, objectively, might be described as increased frequency of tearing or weeping.

In the analysis of the interview, material symbols were assigned to the reported changes according to the following criteria. If the subject stated that his feelings and emotional experiences were "about the same," "not much different," etc., the report was given the symbol "O". If his report indicated that there had been some change, but did not emphasize the degree of change (e.g. "I feel it less, I guess," or "I believe I feel it stronger now than I used to"), then a symbol of "—" was assigned to the reported decreases and "x" to the increases. If the subject emphasized the change strongly, or used colorful descriptive terms (e.g., "I feel it a helluva lot less," or "the choking is much more apt to happen now"), the reported decreases were labeled — —, and the increases xx.

Results

The principal results of this study are summarized in Table 2. Additional qualitative comments are provided in the following paragraphs.

Feelings of Sexual Excitement. In Group 1 (cervical lesions), it may be seen

TABLE 2

Comparisons of emotional feelings before and after spinal cord lesions in 25 male Ss[a]

Group	Subject	Level of Lesion	Sex	Fear	Anger	Grief	Sentiment	Over-all Estimate
I	E. H.	C-2–3	— —	— —	— —	*	x	— —
	C. N.	C-3–4	— —	— —	— —	*	x	— —
	W. E.	C-4–5	— —	— —	—	—	xx	—
	J. S.	C-5–6	—	—	—	—	x	—
	A. J.	C-6–7	— —	— —	—	—	0	— —
II	R. P.	T-1	— —	— —	— —	*	xx	— —
	J. S.	T-3–4	—	— —	—	*	x	—
	J. W.	T-3–4	— —	—	—	*	x	—
	F. L.	T-4	— —	—	—	0	xx	—
	A. F.	T-4	— —	— —	—	—	xx	— —
III	H. S.	T-7	—	—	—	0	x	—
	C. W.	T-8–9	— —	— —	— —	*	xx	— —
	R. B.	T-11	—	0	—	—	x	—
	A. A.	T-11–12	—	—	— —	0	x	—
	W. S.	T-11–12	—	—	0	*	xx	—
IV	H. G.	L-1	—	—	0	x	x	—
	W. C.	L-1–2	—	—	—	*	xx	—
	H. B.	L-1–2	— —	—	—	0	x	—
	L. T.	L-3–4	—	—	— —	*	xx	—
	C. A.	L-4–5	—	0	x	x	x	x
V	R. L.	S-1	0	x	—	*	x	x
	F. D.	S-1–2	—	0	—	0	x	—
	B. M.	S-1–2	—	0	0	x	0	0
	J. S.	S-2–3	—	x	x	x	x	x
	D. B.	S-2–3	—	x	—	*	x	—

[a] The symbols describing emotional feelings since injury indicate the following: — — = greatly decreased; — = decreased; 0 = unchanged; x = increased; xx = greatly increased; * = unable to make comparisons.

that four of the five subjects described a marked decrease in feelings of sexual excitement, whereas the other reported some decrease. Qualitatively, E. H. stated "My wife is sorta cold and not very 'interested,' so I don't feel much. If I thought it would please her, I would want to have sex, but as it is, I don't feel any push for it." C. N. said, "Before I got hurt I was always on the prowl, and I would get a hot, tense feeling all over my body. I've gone out and necked a few times since I was hurt, but it doesn't do anything for me. I daydream once in a while about it, and when I'm around a bunch of guys I talk big, but I just dont get worked up any more. I think if I had more feeling in my body, I would at least get something out of it." An intelligent and sensitive man, A. J., stated that his sexual adjustment in his marriage had been excellent. He was divorced after his injury and since then had engaged in intercourse to the satisfaction of several partners. He said, "It is meaningful to me only if I care very much about the woman. I picked up a stranger and went to bed with her. It was nothing; I didn't feel anything! I have a strong need for close relationships with women and this ultimately leads to sex, but unless I feel close to them, I don't care about sex

The main thing is the feeling that I am pleasing someone I care about. It's a mental, thinking kind of thing rather than physically driven feeling."

Of Group 2 (high thoracic lesions), four men reported a marked decrease in sexual feelings and one reported some decrease. Qualitatively, their responses were similar to those of Group 1 with the exception that mention was made of secondary erogenous zones by two subjects. For example, J. S. said, "If my wife kisses me on the lips, or around the ears or neck, I get a sort of tingling, excited feeling. She usually starts it by subtly letting me know she is ready. I don't think I have ever been in love before, so in a way it has more meaning. Before, I had intercourse just to relieve myself, but now it would be meaningless unless I really cared for the person. I don't feel as 'horny' as I used to. I stepped out on both my previous wives, but now I have no desire to do so."

In Group 3 (low thoracic lesions), only one man reported a marked decrease in sexual feelings, whereas four described some decrease. C. W. said, "I guess I've never really cared about anyone but myself, so now it doesn't seem to mean anything. If I am perfectly honest, I would have to admit I don't have any drive for it. I used to be always on the hunt, but now I'm not. In fact, I've passed up a lot of opportunities." Three others in this group reported feelings of some sexual excitement due to stimulation of erogenous zones, especially the nipples, and two reported what they considered to be peculiar erogenous zones which had appeared since injury, in the center of the back, just above the existing effective sensory level. They said that stimulation of these areas caused some feelings of sexual tension and they felt some pressure to continue the contact. Feelings of warmth and body contact in the coital position were stressed as being exciting.

Group 4 (lumbar lesions) had one man who reported a marked decrease in feelings of sexual excitement and four who reported some decrease. This group also contained more subjects who had retained psychogenic sexual function. Although most experienced orgasm, they characterized it as being less exciting than before injury. As one put it, "It's the same feeling, but the edge is taken off it," and another characterized it as "a sort of para-orgasm." L. T. seemed to represent this group in his comments. "I believe the pressure I feel for sex is just a bit less. It's hard to tell because now I am married, and of course the emotional part of it is greater because I want to please my wife, and that makes it confusing to try to say what my own feelings inside myself are. I used to be always on the hunt, maybe to make a conquest and reassure myself. All told, it seems there is less tension and pressure for sex."

In Group 5 (sacral lesions), four subjects reported some decrease in feelings of sexual excitement, whereas one reported no change. The last, R. L., gave a sexual history suggestive of promiscuity both before and after injury, and said, "It's about the same, I would say, although my feelings have changed some. I guess I have grown up some, and am a little more realistic about sex, but as far as the feelings, like that hot, excited, tense feeling and the limp feeling afterward, are about the same." The responses of the other four men were typified by the comments of B.M., "The feelings when I neck or play around working up to it are about the same or maybe a little less. I feel heated up, my heart pounds, and I pant, but then I'm left up in the air because I can't go through

with it. I don't believe I get quite as worked up as I did before, but it's still a lot. It's like sitting down before a good juicy steak when you're hungry and not being able to eat. It's awfully frustrating, and if a guy had any sense, he wouldn't let himself in for it, but no matter what I do, I seem to find myself driven back into sex situations, knowing all the time I'm going to end up more frustrated than ever." This group described feelings of sexual excitement from stimulation of secondary erogenous zones, and three of them described stimulation of the inner aspect of the thigh as being particularly exciting.

In summary, it would seem that experienced feelings of sexual excitement are markedly decreased after cervical and high thoracic lesions, and that these *Ss*' descriptions of their experienced feelings are similar. Sexual feelings in the subjects with low thoracic and lumbar lesions were decreased and, particularly, there seemed to be some decrease in the "pressure" or "drive" for sexual activity, even though more of the men in Group 4 had psychogenic sexual function than in any other group. Four of the subjects in Group 5 (with sacral lesions) reported a decrease in feelings of sexual excitement and tension after injury, but they seemed to experience more drive for sexual activity and felt more frustration with such activity than any other group.

Feelings of Fear. Four subjects of Group 1 reported a marked decrease in feelings of fear, whereas one reported some decrease, after injury. As an example of the nature of these responses C.N. said, "I sit around and build things up in my mind, and I worry a lot, but it's not much but the power of thought. I was at home alone in bed one day and dropped a cigarette where I couldn't reach it. I finally managed to scrounge around and put it out. I could have burned up right there, but the funny thing is, I didn't get all shook up about it. I just didn't feel afraid at all, like you would suppose." W. E. described his feelings this way: "I say I am afraid, like when I'm going into a real stiff exam at school, but I don't really feel afraid, not all tense and shaky, with that hollow feeling in my stomach, like I used to."

In Group 2 three men reported marked decrease in experienced feelings of fear, whereas two reported some decrease following injury. Description of feelings was similar to that of Group 1, but two men mentioned getting a cold feeling and three mentioned sweaty palms. J. W. told of being some distance from shore in his fishing boat on a lake when a storm came up and a log punctured the hull. "I knew I was sinking, and I was afraid all right, but somehow I didn't have that feeling of trapped panic that I know I would have had before."

Group 3 had one subject who reported a marked decrease in his feelings of fear, three reported some decrease, and one reported no change. All who reported decreased feelings of fear referred to lessened bodily symptoms such as muscle tension, perspiration, and tightness in the stomach; four of these men said that although they felt frightened, it didn't seem to last as long as it had before injury. The one subject who reported no change (R. B.) stated, "I've always been calm during an emergency and get shook up later and it's still that way. In one way maybe I don't feel as shook as I did but then I've had so many things go wrong since my injury that I always expect the worst and so I am bothered more. Guess it would average out about the same."

In Group 4, decreases in feelings of fear were reported by four subjects and no change was reported by one. Those reporting decreases stressed that the feelings were probably equally intense, but that they did not seem to last as long. Typical of the responses of this group were those of H. G. who said, "If I barely miss having a wreck in my car, like the time I was barrelling up over the Ridge Route and had a blow out, I get plenty scared, but it doesn't seem to last long. It's all over as soon as I know everything is O.K. Before, it would take me two or three hours to calm down."

In Group 5, two subjects reported no change in feelings associated with fear and three reported increases. Of the latter, two had to use Canadian crutches in ambulating and the third had an above-the-knee amputation and used a prosthesis. In describing their increased feelings of fear, all three reported incidents related to falling. The two subjects who reported no change were able to walk with only a slight limp. It seems possible that the increased feelings of fear reported by three of this group were generated by preoccupation with the particular fear of falling.

In summary, it would appear that experienced feelings of fear are greatly reduced in individuals with cervical and high thoracic lesions, and that some decrease is characteristic of those with low thoracic and lumbar lesions. Subjects with sacral lesions reported no change or an increase in feelings of fear following injury.

Feelings of Anger. In Group 1, two subjects reported marked decrease in experienced feelings of anger and three reported some decrease. C. N. said, "I used to have a hot temper but now it's nothing compared to what it was. Now I get kinda mad one minute, and the next minute it'll be like nothing happened. Seems like I get thinking mad, not shaking mad, and that's a lot different." A. J. said, "Now, I don't get a feeling of physical animation, it's sort of cold anger. Sometimes I act angry when I see some injustice. I yell and cuss and raise hell, because if you don't do it sometimes I've learned people will take advantage of you, but it just doesn't have the heat to it that it used to. It's a mental kind of anger."

In Group 2, one subject reported a marked decrease in feelings of anger, whereas four reported some decrease. All subjects stressed decrease in one or more of the bodily correlates of anger, such as sweaty palms, shaking, dryness of mouth, and the feeling of being heated up. Three felt that they were more mature and had better judgement and control in regard to their angry feelings, and a fourth said he was more "cautious because of my disability, and I know I couldn't take care of myself." Despite this, all stated that they felt less anger. R. P. remarked, "Where I used to blow my stack, feel all shaky and that sort of thing, and I would strike out and get in several fights, now many less things upset me, and the uspet has left me before I know it."

For Group 3, two subjects reported marked decreases in the experience of angry feelings, two more reported some decrease, and one reported no change. The responses were similar to those of subjects in Group 2. For example, R. B. said, "Before, I was red hot. I never argued, I'd just sock the person and whip them or get whipped. Now I'm a lot slower on the trigger. I don't get that feeling of being about to bust and I find I can take time to think before I flip."

In Group 4, one man reported a marked decrease in feelings of anger, two reported some decrease, one reported no change, and one reported some increase. The reports for this group have a different tone than those of the first three groups in that the changes reported seemed to indicate less emphasis on the description of the change. H. B. said, for example, "Well, I believe I feel a little less tension when I get mad now. I don't shake so much, and it is easier to control. Maybe I get over it a little quicker, but I always did get over it fairly quickly anyway."

For Group 5, three men reported some decrease in experienced feelings of anger, one reported no change, and one reported an increase. Their descriptions resembled those of the subjects of Group 4 and reported changes seemed to be minimal.

In summary, it would seem that experienced feelings of anger are decreased in subjects with cervical or thoracic lesions. Emphasis was placed on ideational and "thinking" aspects of any anger they do experience. For subjects with lesions at lumbar and sacral levels, the changes described seemed to be less marked.

Feelings of Grief. The data elicited regarding feelings of grief warrant few, if any, conclusions. The subjects seemed to have difficulty recalling grief experiences well enough to make comparisons and, although many described their reactions to their injuries as grief, they felt that this experience was so overwhelming that nothing prior to the injury was comparable. Some were able to base their comparisons on the deaths of someone close to them, before and after injury. Of the entire group, 11 did not believe that they could make a comparison. Five reported no change in feelings, five felt that feelings of grief were decreased, and four felt that they were increased after injury. If any trend is suggested by these data, it is that the subjects with higher lesions have experienced a decrease in feelings of grief, whereas the ones with lower lesions have experienced an increase.

Feelings of Sentimentality. It will be noted from Table 2 that, with only two exceptions, all subjects reported increases or marked increases in feelings which, for want of a better term, have been called "sentiment" or "sentimentality." The two who reported no change in this area both described themselves as having always been very sentimental and strongly disposed toward "choking up and crying over touching situations." All groups seemed to report these changes with about the same quality, with the possible exception of the group having sacral lesions. None of Group 5 reported marked increase in experienced feelings of sentimentality.

Overall Comparison. The subjects found this comparison difficult. Examination of the symbols in Table 2, however, shows what appears to be a direct relationship between decrease in general feelings and the degree of disruption of the autonomic nervous system.

Although these results do depend on memories over varying periods of time and are entirely subjective, it is the belief of the investigator that the subjects cooperated well, were truthful to the best of their abilities, and have yielded information which deserves statistical analysis. To this end, a summary of the results shown in Table 2 is presented in Table 3, and a minimal statistical analysis is presented.

It seems clear that the null hypothesis was supported for only one area of feeling explored in this study—grief. It seems clear, also, that spinal cord injury

TABLE 3

Summary of changes in emotional feelings after spinal cord lesion in 25 males (from Table 2)

Feeling	Greatly Decreased, — —	Decreased, —	No Change, 0	Increased, x	Greatly Increased, xx	Unable to Compare, *	χ^2
Sex	10	14	1	0	0	0	22.04[b]
Fear	8	10	4	3	0	0	9.33[a]
Anger	6	14	3	2	0	0	13.14[b]
Grief	0	5	5	4	0	11	0.0
Sentiment	0	0	2	15	8	0	21.04[b]
Over-all estimate	6	15	1	3	0	0	12.04[b]

[a] = < 0.01.
[b] = < 0.001.

results in significant decreases in feelings of sexual excitement, anger, and fear, and general emotional feeling. It is obvious, also, that such injuries serve to increase signs and feelings of sentiment.

Discussion

Before this investigation, Dr. Bors and the writer had observed that individuals with major disruptions of the autonomic nervous system (i.e., men with cervical cord lesions) showed markedly decreased sexual feeling. Further, the nature of such sexual gratification as remained appeared to be largely ideational in nature. Men with such lesions seemed to find little gratification in sexual liaison unless a close relationship existed and they knew that the sexual act was pleasing to someone about whom they cared.

As this study progressed it became apparent that the experienced sexual feelings of other men who had less impairment of the autonomic nervous system also decreased in intensity. For them, some afferent return was still possible from autonomically innervated functions and from secondary erogenous zones. Nevertheless, it seems clear that spinal cord injury, at almost any level, may effect a reduction in feelings of sexual excitement, and a reduction in sexual drive.

Reports of experienced feelings of fear in this study followed a parallel course. It was noted that in those individuals with the most severe autonomic disruption the experience of fear which remained appeared to be reduced and to be predominantly ideational in nature. Only when afferent return from the sympathetically innervated viscera was possible did the reported experienced feelings of fear begin to approach those recalled before injury. Only men with sacral lesions reported no decreased feelings of fear; the increases reported by three of this group seemed to be specific and related to the nature of their injuries.

In regard to anger the experienced feelings also were markedly diminished. It was in this particular area of emotional expression that Sherrington (1900) and Cannon (1929) observed that their animals acted emotionally after extensive disruption of the sympathetic nervous system. We submit that it was acting, and can find no better substantiation for this belief than the statement of A. J., (who had a neurological deficit comparable to that of Sherrington's dogs). He

said, "Sometimes I *act* angry when I see some injustice. I yell and cuss and raise hell, because if you don't do it sometimes, I've *learned* people will take advantage of you, but it just doesn't have the heat to it that it used to. It's a mental kind of anger."

Paraplegic patients with cord injury below the cervical region often are regarded as being extremely aggressive. They swear, they throw their urinals around, they show overt signs of anger. It seems possible that such acts represent learned reactions, and are more or less devoid of feeling. In other words, it seems possible that certain forms of emotional expression may occur in the absence of corresponding changes in emotional feeling. This possibility had been foreseen by Wenger (1950, 1956).

The data presented here suggest that unless a person is neurologically intact at or above the sacral area, there will be a reduction in the experienced feelings, but not necessarily the acts, associated with the emotional behaviors called anger, fear, or sexual excitement.

Experienced feelings of sentiment deserve particular consideration. They increased in all groups, and no subject showed a decrease. One possible explanation is that what we have called sentiment is related to depression. In 1956, Wenger suggested that some forms of depression might be described as a condition in which the sympathetic branch, and possibly both branches of the autonomic nervous system are in a hyporeactive state.

If sentiment, as here described, is related to reduced Sympathetic Nervous System activity it should show increases from Groups 5 to 1. Group 5 shows no marked change, but no trend for the other four groups can be distinguished. It seems possible, then, that the increase in this aspect of emotional feeling is a correlate of spinal cord injury and is not related to level of cord injury.

The other major area of emotional feeling investigated in this study, grief, showed no significant changes. The data are inconclusive. In part, this may be attributable to the fact that few subjects were able to compare feelings of grief before and after their injuries. It is of interest that this was the only area of investigation which did not show significant changes. Perhaps grief deserves further study with similar subjects.

In addition to the above specific forms of feeling, it should be emphasized that the over-all estimates of changes in emotional feeling decreased consistently from Groups 5 to 1. Apparently, SNS outflow and the related afferent return furnishes an important component of emotional feeling.

In conclusion, this study offers substantiation of the belief that disruption of the autonomic nervous system and its afferent return causes notable disturbances in the mental correlates of emotion. It has shown that the more extensive the Autonomic Nervous System disruption is, the greater the decrease in some emotional experiences is. It also has shown that one form of emotional feeling and expression increases after spinal cord injury. At present, the factors responsible for this significant change are undefined. They may be physiological but, since they are found in all groups, they may be psychological. Even those with spinal cord injuries who appear to have made a good adjustment to their loss may still have a chronic, mild, pervasive feeling of depression. It may also be true that the

process of successfully adjusting to their disability has made them more sensitive to nuances of their own feelings, which may generalize to cause a greater awareness of feelings of tenderness and sympathy for others.

Except for this one increase in reported feelings of emotion, and except for feelings of grief, for which many subjects had no background for comparison, it is evident that emotional feeling is decreased after spinal cord injury. Moreover, in each of the other areas investigated (fear, anger, sex, and over-all feeling), there is a significant change and a detectable trend. Those with higher lesions experience greatest reductions in emotional feeling. It is concluded that SNS reactions, and their afferent return, are important components of emotional feelings.

Finally, it should be restated that one of the byproducts of this investigation served to substantiate the assumption that produced it, i.e., that McKelligott's subjects were not cooperative in interviews. Some of his subjects frankly admitted to the writer that they had given false information to McKelligott.

This experience again throws doubt on many clinical reports where the utmost care has not been taken to insure that the subjects have a deep feeling of confidence, understanding, trust, and nonjudgemental concern with the investigator.

Conclusions

The results of this study support the following conclusions.

1. Individuals with spinal cord lesions report significant decreases in experienced emotional feelings associated with sexual excitement, anger, fear, and an over-all estimate of emotional feeling, as compared to those experienced before injury.

2. Such subjects report a significant increase in emotional feelings related to sentimentality.

3. The data further indicate that in spite of decreases in some emotional feelings, overt emotional behavior may continue to be displayed.

4. Experiences in this study again demonstrate the necessity of insuring the complete cooperation of subjects if investigations using clinical methods are to be valid and meaningful.

5. Substantiation is offered for the belief that disruption of the ANS and its afferent return causes notable disturbances in the mental correlates of emotion. A trend was noted which suggests that the more extensive the disruption is, the greater the decrease in some emotional experiences is.

REFERENCES

Cannon, W. B. The James-Lange theory of emotion: A critical examination and an alternative theory. *Am. J. Psychol.*, 1927, *39:* 106–124.

Cannon, W. B. *Bodily changes in pain, hunger, fear and rage.* New York: D. Appleton & Co., 1929.

Cannon, W. B. Again the James-Lange and the thalamic theories of emotion. *Psychol. Rev.*, 1931, *38:* 281–295.

Dana, C. S. The autonomic seat of the emotions: A discussion of the James-Lange theory. *Arch. Neurol. Psychiat.*, 1921, *6:* 634–639.

Dunlap, K. Emotion as dynamic background. In M. L. Reymert (Ed.), *Feelings and emotions: The Wittenberg Symposium.* Worcester, Mass.: Clark University Press, 1928.

Hohmann, G. W. *Stress and spasticity in paraplegia.* Unpublished doctoral dissertation, University of California at Los Angeles, 1955.

James, W. What is emotional *Mind,* 1884, *19:* 188–205.

Lange, C. The emotions. (Denmark, 1885). Translated by I. Haupt in K. Dunlap (Ed.), *The emotions.* Baltimore: The Williams & Wilkins Co., 1922.

McKelligott, J. W. *Autonomic functions and affective states in spinal cord injury.* Unpublished doctoral dissertation, University of California at Los Angeles, 1959.

Sherrington, C. S. Experiments on the value of vascular and visceral factors for the genesis of emotion. *Proc. roy. Soc. London,* 1900, *56:* 390–403.

Wenger, M. A. Emotion as visceral action: An extension of Lange's theory. In M. L. Reymert (Ed.), *Feelings and emotions: The Chicago-Mooseheart Symposium.* New York: McGraw-Hill, 1950.

Wenger, M. A., Jones, F. N., & Jones, M. H. *Physiological psychology.* New York: Holt, Rinehart and Winston, 1956. Chapter 21, Emotional behavior.