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Multidimensional scaling of pain experiences

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Multidimensional scaling (ALSCAL) was used to analyze 25 terms that represent pain-producing stimuli, events, or popular clinical labels for pain-associated conditions. The resulting scale is noteworthy in that body parts cluster separately, consistent with a parallel mapping of a homunculus. The scale effectively clustered terms in a way that is interpretable in three dimensions (body location, speed of pain conduction, and body surface). In contrast to other multidimensional scaling analyses of pain terms, this analysis provided more of a perceptual mapping of the pain experience as an environmental property rather than of the qualities of the private event.

The analysis of verbal behavior constitutes a major emphasis in the study of pain (Agnew & Merskey, 1976). As a private experience, pain and its descriptors are highly dependent on the language and symbolism that have evolved and that are used by both the sufferer and the comforter. Often the language of pain is interpreted as providing an index or validation of pain (or a criterion for a pain response). So too might personality variables affect the particular choice of pain descriptors (McCreary & Turner, 1983). Early studies using factor analytic techniques determined that three dimensions account for most of the variance among "pain words," namely an evaluative dimension (e.g., annoying), a sensory dimension (e.g., aching), and an affective dimension (e.g., tiring) (Melzak & Torgeson, 1971). Such research strategies, however, commonly suffer from various response biases and employ terms that are a priori expected to reveal the underlying fabric of a reified concept of pain. In this report, we discuss an attempt to employ multidimensional analysis with several important refinements. First, we chose a multidimensional scaling (MDS) procedure because of its ability to better represent a cognitive mapping in which distances rather than factor loadings provide the basis for describing internal organization. We also elected to scale terms that are commonly used by a sufferer in which either an affected body part or the environmental conditions responsible for the trauma or injury are the sole descriptors. In practice, one is more likely to complain of a "migraine" or a "grease burn," and only upon intensive inquiry are "throbbing," "unbearable," etc., volunteered as added descriptors. In other words, we wished to examine the scaling of terms in which stimuli (or stimulus conditions) associated with noxious outcomes are perceived relative to each other as well as the scaling of diagnostic labels that are assumed to convey some uniform description about pain (e.g., toothache). In this exploratory study, we were primarily interested in learning whether any rationally interpretable scaling profile of diverse items would emerge that would reveal more about painful encounters than about the quality of the internal and private experience itself.

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METHOD

Subjects

Ten male subjects, ranging in age from 18-33 years, were each tested individually. None had had any recent chronic pain or hospital encounter, or any psychiatric history. Each volunteered without pay.

Procedure

Each subject was shown a list of 25 words and told that he would be presented with pairwise comparisons of the entire set. The subject was to mark along a 5-in. rating line his estimate of the similarity of the elements of each pair. Each pair of terms was presented on a slip of paper and appeared above a line anchored at one extreme as "very similar" and at the other as "very dissimilar." Booklets of 60 stapled slips each were prepared for the set of $N(N-1)/2$ total comparisons. The terms were: banged funnybone; banged shin; bitten tongue; blister; bruise; burnt tongue; chapped lips; charley horse; earache; grease burn; hangnail; hypo injection; cold teeth; ice-cold toes; looking into sun; loud noise; migraine headache; muscle cramp; paper cut; pulled muscle; sprained muscle; stomach cramp; stubbed toe; sunburn; and toothache. The stimulus pairs were arranged in random order in the booklets. The subject proceeded at his own pace throughout the test.

Analysis

The 300 judgmental responses were converted to millimeter distances (dissimilarities) and examined in a MDS analysis using the ALSCAL algorithms (Schiffman, Reynolds, & Young, 1981). Ordinal solutions for two, three, four, and five dimensions were derived.

RESULTS AND DISCUSSION

Individual response matrices were examined and found to be acceptably similar. The combined set of matrices was then combined to provide a single (averaged) scale. Using conventional guidelines, the large numeric decrement in stress was seen to favor a three-dimensional solution (stress = .098), although stress values contined to decrease (while RSQ increased with analyses up to and including five dimensions). The three-dimensional solution is favored and discussed here because of parsimony and reasonableness of interpretability—quite apart from the fact that factor analytic solutions of pain terms also favor three-dimensional descriptions. Individual differences were not assessed because of the small sample size.

Identifiable clusters of stimulus words emerged in a most interesting way. Intracranial pains grouped themselves in quadrant IV. Pains associated with musculature were clustered in quadrant I, and "sharp" pains were grouped in quadrant II. Terms to the upper left tended to represent localized pains associated with the body surface, and those clustered to the lower right were typically diffuse and internal pains. It is of interest to note that pain is indeed mediated by the c-pain fibers and by a-delta-pain fibers that transmit dull and sharp pains, respectively.

Another organizing feature also emerged from the scaling solution. Starting at "stomach cramp," one can follow the pattern of stimulus words in a circular clockwise direction that corresponds to an orderly mapping of body parts. This ordering mimics the sensory homunculus familiarly drawn above a coronal section of the postcentral gyrus. In similar fashion, body parts that are represented by large surface areas of the sensory cortex are also represented by large areas in the conceptual space of the MDS pain analysis.

It is impressive that these findings are relatively consistent over subjects. We are not informed about other characteristics of our sample that might otherwise have allowed us to achieve greater internal homogeneity, to meaningfully test between subjects, and to arrive at solutions with considerably lower values of stress. Our analysis did not clearly show evidence of clusters arranged according to chronic, tonic, or persistent events versus periodic, phasic, or intermittent ones. These preliminary investigations do not adequately permit us to examine fine-grain properties that might be possible from applying canonical regression models, analyses of homologous scales, or analyses of angular variation. We are, however, encouraged that such a tactic may prove to be a clinically useful application and a basis for added direction in pain research.

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