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7

Measuring Human Emotion

Proposed Standards

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THE NEED FOR STANDARDS

As Niels Bohr has said, "Science is the observation of phenomena and the communication of the results to others, who must check them."[1] While simple in principle, Bohr's remark describes a social and symbolic process. The "communication of results" only rarely involves actual shipment of the object of study from one scientist to the next, but almost always involves a symbolic exchange of information. Experience must be encoded into symbols to be communicated, and it is the symbolic representations of observations that are actually compared, never the "observations" themselves.

As students of human communication are most well aware, all human communication is fraught with difficulties, including communication among scientists about observations they have made and must check. These difficulties are compounded when conventions about language are only informally developed.

Physical scientists have approached this problem primarily through the medium of conventional standard-setting bodies. These bodies are based on an understanding of the conventional nature of language, including scientific language, and represent socially sanctioned efforts to establish and enforce common rules for encoding and communicating about observations. The present worldwide system of measures, for example, is a result of an international agreement known as the Treaty of the Meter. This treaty establishes the continuing International Committee on Weights and Measures. Each six years this body convenes an international general conference on weights and measures that approves changes and extensions to the original 1960 agreement. The resulting Systeme Internationale des Unites, or International System (SI), has brought considerable order to our collective understanding of "physical" experience.

While there is probably no limit to the range of standards that such bodies might discuss, three are of special interest here. The first of these are standards about the procedures to be employed in obtaining certain observations. The second are standards about the standard unit or scale interval on which observations are to be recorded. The third are standards about the format for arraying data obtained pursuant to the first two standards.

In practice, the first two standards—standard method and standard unit size—are usually defined simultaneously. Klein recounts a sixteenth-century procedure for defining the standard "rood" and "foot": The surveyor should station himself by a church door on Sunday. When the service ends he should "bid sixteen men to stop, tall ones and short ones, as they happen to come out." The chosen sixteen should be made to stand in a line with "their left feet one behind the other." The resulting sum of sixteen actual left feet constituted the length of "the right and lawful rood," and the sixteenth part of it constituted "the right and lawful foot."[2]

Note in this example that the method of performing the measurement and the length of the standard unit are defined jointly. In the classic meaning of the term "operation," a standard defines an operation that one performs in order to create the standard unit.

The third type of standard of interest in this chapter, also set at conferences, refers to standard reference frames against which observations may be arrayed. Thus, for example, the "right ascension" of a star is its angular distance measured eastward along the celestial equator from the vernal equinox to the hour circle through the star, and the "declination" of a star.[3] Each of the terms "eastward," "celestial equator," "vernal equinox," "hour circle," "north," and "south" refer to arbitrary but conventional "landmarks" that jointly determine the orientation of the array of celestial objects that might be observed. Even the more mundane convention of drawing most maps (in the Northern hemisphere) with their tops pointing to the north makes the comparison of map to map greatly simpler than would be the case if each map were oriented arbitrarily.

Even in the absence of these standards, observers could produce maps of the heavens. But in the absence of these standards, these maps would be of arbitrary sizes and lie at arbitrary orientations to one another when made by different observers using different standards. When these scientists communicated their observations to others "who must check them," only under the most fortuitous of circumstances might they be expected to agree. And the distortions that would result if any single observer failed to make use of the same standards when observing the locations of different stars at different times would make meaningful mapping impossible.

Social scientists, on the other hand, have been slow to avail themselves of this approach, with some clear exceptions. Consider, for example, the informally developed standards for factor analyses, a mapping procedure that bears important similarities to the mapping of celestial bodies. No standard unit size is specified by any body, nor has any informal standard unit emerged. Each individual factor analyst rather chooses some arbitrary scale unit (such, for example, as one fifth of the distance between "strongly disagree" and "strongly agree"), and more often than not will use a different unit size for measuring the location of each variable in his or her study. Standard scores or "z scores" are not "standards" in the sense we discuss them here, since the size of a z score itself varies from one sample to the next.

Nor is the orientation of the resulting "factor space" standardized in any fundamental sense. To be sure, many competing rotation schemes, such as principle axes, varimax, oblimax, quartimax, and so on, may be found, but none of these is sanctioned by any official body, nor, in fact, would any of them be capable of producing an invariant orientation of observations from study to study, since each of them is sensitive to the internal structure only of the data in question. None of them makes any reference to standard reference points, like the equator, the poles, the equinox points, or the like. While careful students of factor analysis (or its relative multidimensional scaling) are well aware of the confused state of the area, few have explicitly recognized the confusion as the result of a failure to establish standard methods of observation, standard unit sizes, and standards of orientation. We should not be surprised, then, that the world of the social scientist is substantially more confused than its physical counterpart.

Comparability

The first and most obvious advantage of standards is that they render observations comparable across time and observers. When an observer notes that an object weights 190 pounds at the north pole, and another notes that the same object weighs 189 pounds at the equator, we can directly compare the two results as a ratio, and learn that an object loses 1/190th of its apparent weight as a result of the centrifugal effects of the earth's rotation. But if the first observer had measured the weight of the object on a scale ranging from "very light" to "very heavy" through five steps or intervals, while the second observer used a 10-point scale from "not heavy at all" to "very heavy," differences in the numerical results would be meaningless, no matter how carefully or precisely measured. Without commenting on the quality of such scales taken one by one, it is nevertheless clear that the fact that each observer is free to choose a scale of measure for each variable and for each study on the basis of whatever local criteria he or she may consider important has led to a serious lack of comparability from study to study in the field of communication.

Cumulation of Knowledge

Among the many criticisms directed at the social sciences, one of the most frequent and damning has been that of lack of accumulation of knowledge. While there is clearly an alternation among theories that are prominent at any moment in communication, it is by no means clear that older theories have been abandoned because they fit observations less well than current theories. Most often theories decline in prominence within communication and the other social sciences because research leads and sources of fresh hypotheses for investigation have dried up before a theory has developed a useful and valuable associated technology, which leads investigators to turn toward other, hopefully more "fruitful" theories.

While one cannot rule out the likelihood that those theories that have fallen from prominence have done so because they were invalid or contradictory or otherwise "false" in some way, it is clear that the absence of standards of the three types discussed here has a debilitating effect on the accumulation of a solid base of knowledge across many investigations. When data have been gathered by standardized methods using standard unit sizes, and arrayed relative to standardized reference frames, all such measures may be readily "spliced" together and made to fit on common "maps," as is clearly the case with celestial charts, for example. Once one has measured the Right Ascension and declination of a new object, for example, it may be located relative to all previously located objects immediately, since these coordinates refer to a standard system directly comparable from study to study. Accordingly, long-term projects, such as the mapping of the heavens, may be undertaken, even though the project will take longer than the life span of any group of observers. To the extent that new observations are made on scales whose unit size relative to previous units is unknown, by methods different from those used in the past, and in the absence of arbitrary but consensual standard reference points to determine the orientation of newly observed patterns relative to already defined structures, no such accumulation is possible.

What this means in practice is that neither factor spaces nor multidimensional scaling spaces grow over years of research, since it is only seldom possible to determine the orientation of newly surveyed domains to those already charted. In the rare case where there is a considerable overlap of concepts in two studies, and where moreover the investigator is in possession of both sets of data, it is sometimes possible to rotate the two data sets to a best fit on one another, but technical difficulties limit this approach in most cases to 40 or fewer total concepts, and data sets of more than 100 or so concepts (or variables) approach the limits of currently available technology. In practice, therefore, communication scientists have collected dozens of maps of small regions of human beliefs and attitudes, but these have not been spliced together into collective charts that could grow and accumulate as the result of further research. While this criticism is true of communication in general, it is particularly relevant to international or cross-cultural comparisons of communication.

Nor is this the only way in which accumulation fails in the current absence of standards. Consider, for example, the area of persuasion. In a classic study, messages alledgedly were sent from a Nobel Prize winning Russian scientist and from the "director of the Fort Worth YMCA" advocating different numbers of hours of sleep per night.[4] Since the unit size (the hour) remained the same from condition to condition, it was easy to determine that advocating 2 hours of sleep per night represents a more "forceful" level of advocacy than advocating 7 hours per night. And this remains true across conditions, so we may reasonably assume that recommending 5 hours of sleep per night represents the same level of advocacy regardless of whether the highly credible (Russian) source or the less credible (Fort Worth) source presents the message.

Similarly, at a later time, Woelfel, Cody, Gillham, and Holmes conducted a study in which a highly credible source (Linus Pauling) advocated performing an imaginary act (the "CTP") a certain number of times per day.[5] In another condition, a less credible source, (Timothy Leary), allegedly advocated performing the same act a different number of times per day. Again, since the unit of advocacy (how many times per day the act is to be performed) remains the same across conditions, it is possible to compare the level of advocacy from one source to the other.

It is clearly impossible, however, given the failure to maintain a standard unit size across the two studies, to determine whether the level of advocacy in the sleep study is greater, the same, or less than that in the Woelfel et al., study, and an important opportunity to accumulate knowledge across studies has been lost. Nor is this a minor matter, even within the area of persuasion research, since the variable "level of advocated change" is clearly of major importance in persuasion research, yet we are aware of no two studies in which the level of advocacy can be compared directly, although dozens have been conducted.

While some scholars have set forth philosophical and even theological reasons why human and social knowledge ought not be cumulative, nonetheless the absence of standards of measure provides a simple and compelling basis for understanding our present failure to accumulate consensual bodies of knowledge about cognitive and cultural topics.

A third more subtle but very important example of the barrier to accumulation of knowledge resulting from an absence of uniform standards of measure comes from recent discoveries in the area of the behavior of equilibrium cognitive systems. Several writers have presented evidence that attitudes, beliefs and other cognitive elements appear to obey the differential equation.[6]

$$m\ddot{x} + C\dot{x} + kx = 0. \qquad [1]$$

This evidence has so far been drawn from both Asian and American samples, but it would be premature to claim too much at this early stage of research. If future work supports this theory, the behavior of cognitive systems can be seen as functions of the three coefficients m, C and k, where m is the mass of the cognitive element under study, C is the viscosity of the medium through which it moves, and k is the magnitude of the restoring force that acts to move the system back toward its equilibrium position.

Research in the area has been complicated by the fact that these three parameters are mutually interdependent. In practice, at least one of these parameters must be stipulated to determine the values of the others. In the absence of standards of distance, different workers cannot make the same stipulations from study to study, and so, in general, coefficients determined in one study may not be compared to those estimated in another. A first step in the rationalization of this area of study is the stipulation of a standard unit of distance, so that the distances that any element has been displaced from its equilibrium position may be compared from study to study. Further stipulations of the standard units of mass, force and viscosity are contingent on this initial arbitrary stipulation.

STANDARDS FOR MEASURING EMOTIONS

In order to answer the problems described above, the present chapter proposes a research effort designed specifically to provide a rational basis for the adoption of international standards of measure for a specific domain of cognitive processes. While there is no inherent reason to select one area of inquiry over others for such initial standards, pragmatic concerns dictate that the domain chosen be of relatively widespread interest to the scientific community. Since the standards are hoped to have international significance, a domain of cross-cultural significance would be particularly useful.

For these reasons, we suggest that initial standards might be set for the measurement of human emotions. Woelfel and Fink have suggested a basis for such a campaign.[7] They suggest that each emotion may be considered an "object" that may be represented as a point in a multidimensional space. The differences between any two emotions may be modeled as the geodesic distance between the two points that represent those emotions in the space. By identical procedures, individual persons or cultures may be represented as objects with locations in the space of the emotions. The extent to which any person or culture is experiencing any one of the emotions can be represented as the inverse of the geodesic distance between the self-point and the emotion in question.

The Woelfel and Fink model is particularly suitable as a vehicle for standardization for several reasons. First, since it is completely mathematized, the Woelfel and Fink method may be very precisely specified, thus minimizing communication difficulties among researchers. Second, these procedures have been very heavily standardized on an informal basis, and formalized computing software is readily available for any researcher who chooses to make use of it. Third, the model is isomorphic with both theoretical and empirical procedures commonly used by physical scientists, and so standards based on the Woelfel and Fink model can be made completely compatible with already established international standards. As suggested earlier, initial proposed standards will include a standard method for making observations, a standard unit size for recording observations, and a standard reference frame for displaying data resulting from the observations.

A Proposed Standard Observation Method

The observation method proposed here as a standard is the informally standardized method described in Woelfel and Fink. It is a two-part procedure. The first part consists of in-depth interviews with selected samples of the participating cultures. The purpose of these initial interviews is to determine the subset of emotions most salient to the populations sampled. In practice, we propose that a duly constituted committee coordinate a series of in-depth interviews conducted by participating scientists in a large sample of world cultures. The Standard Committee would be responsible for the development of a standard protocol for the interviews.

Data obtained from these interviews would be analyzed at a central facility designated by the committee. Analysis would consist of a numerical count of the emotions named, followed by a diameter method cluster analysis of the data based on the frequency of co-occurrence of emotions in individual interviews. On the basis of the analysis of the interviews, a standard set of emotions and appropriate additional attributes would be established.

The second part of the observation method would consist of the development of a standardized direct magnitude estimation paired comparisons questionnaire that would be administered to large samples of members of the participating cultures over a period determined by the committee. These data would then be analyzed at a central site selected by the committee. Analysis would consist of the establishment of a mean dissimilarities matrix for the data within each participating culture and for all cultures taken as a whole.

A Proposed Standard Unit

Once the initial dissimilarities matrix has been established, the designated research unit would scan the mean distances to find that distance whose overall uncertainty is smallest on an intercultural basis, and propose that an initial unit be designated as a fraction of this distance. This procedure is completely in accord with the original definition of the standard meter as one ten-millionth of a quadrant (or quarter) of an arc of meridian.

A Proposed Reference Frame

Woelfel and Fink discuss three kinds of reference frame. The first type they call "accidental," and by this term refer to sets of objects that "happen" to be conveniently located to provide a reference function. Prominent landmarks, such as stones, mountains, buildings, and the like, can be used to establish locations and directions, although they were not originally constructed for such a reference function. The second type they call "contrived," and by this they refer to signs and objects deliberately constructed to serve a reference function. Street signs, fences, labels, and other such devices are this second type. The third type they call "mathematical," and by this they refer to nonmaterial reference systems abstracted from experience. Lines of longitude and latitude, the celestial equator, cartesian coordinate systems, and other such systems are examples of this third type.

The reference frame proposed here is of the third type. Since any reference frame is initially arbitrary, no particular system is required, but a reference frame of wide applicability and easy access is most likely to be of widespread utility. Consequently, we propose that the principle axes of the joint set of emotions data from all sites as of a specific week designated by the ad hoc committee be designated as the initial standard reference frame. These coordinates should be obtained by a metric decomposition of the cen-

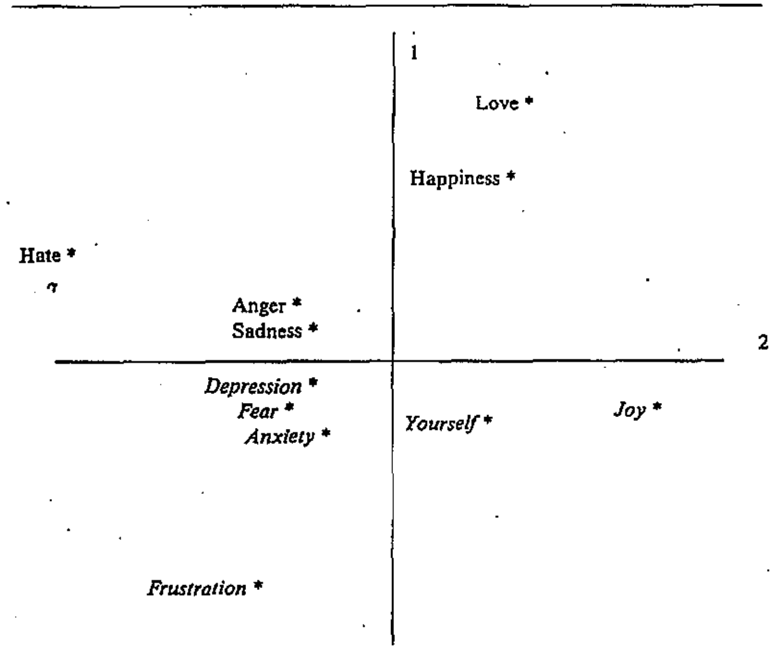

Figure 7.1: Principle Emotions—Albany Metro: December 9, 1981 Emotions Dimensions 1 & 2 t7

troid scalar products of the combined mean pair comparisons data from all participating sites. These coordinates would be maintained on a computer at a central site designated by the committee and made available to subsequent investigators, who could project any subsequent observations on the same coordinates. Rotation software for such projections should be based on the rotation algorithm currently implemented in the Galileo (TM) version 5.2 computer package.

AN EXAMPLE

Figure 7.1 represents an example of the result of these recommended procedures applied to a random sample of residents of the Albany, New York, metropolitan area. Between December 3 and December 20, 1981, 342

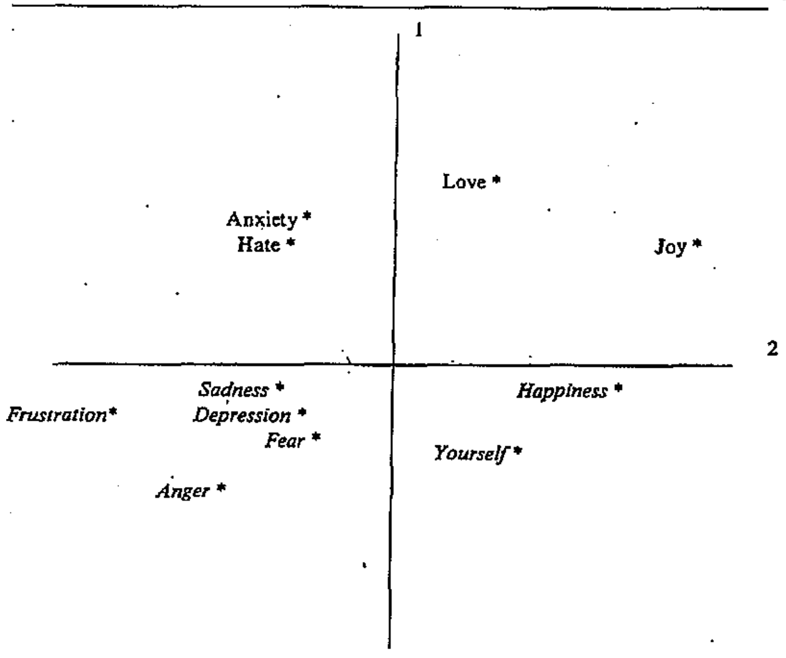

Figure 7.2: Principle Emotions—Albany Metro: December 10, 1981 Emotions Dimensions 1 & 2 t7

telephone subscribers were drawn randomly from the Albany-Schenectady-Troy Metropolitan telephone directory and asked by telephone to identify the principle human emotions, as well as the emotions they were currently experiencing. The ten most frequently mentioned emotions, along with the term "yourself," were then included on a standardized Galileo-type pair comparison questionnaire. Respondents were told to consider the difference between fear and happiness to be 100 units, and to rate all other differences as proportions of this distance.

On December 9, 1981, 37 randomly selected residents of the Albany metropolitan area completed this questionnaire by telephone. Figure 7.1 presents the first two dimensions of the configuration resulting from this administration. On the following day, 56 additional respondents completed the same instrument, and the first two dimensions of that solution are presented in Figure 7.2.

As indicated earlier, the position of each emotion indicates the perceived relationship between them, and the extent to which the sample is experiencing an emotion is inversely related to the distance between the self-point and that emotion. "Snap-shots" such as these would be generated or measurements taken over extended periods of time and concatenated to yield continuous, "movie-like" representations of the dynamics of the emotional climate of the sample. Moreover, this longitudinal design forms the basis for establishing the standard unit that, as mentioned earlier, will be a function of that distance relationship that is the most stable over time.

CONCLUSION

In the preceding pages we have outlined a proposal for establishing standards for measuring human emotions. To this end we briefly discussed some important issues surrounding standards of measurement. We outlined the need for such standards in the development of scientific disciplines and the problems faced without them: In short, standards allow for meaningful comparison of observation between observers and over time. This is a necessary condition for cumulation of knowledge in a scientific discipline. In recognition of this need, we have proposed a standard method for observing aggregate human emotions, a standard unit size for recording these observations, and a standard reference frame for projecting data based on these observations.

To be sure, the development of useful measurement standards of high precision and reliability is a very long process that requires constant modification and refinement, as the examples above illustrate. The fruits of such an effort will provide a firm basis for theoretical advancement in the discipline.

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