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Clinical Use of Objective Electronic Measurement in TMD II

Introduction

In the dental literature concerned with TMD, electromyographic, electrosonographic and electrokinetic measurement devices have been used repeatedly in research studies to further understanding of the biophysics and physiology of the head and neck. An issue has been raised in several papers as to whether their use is more appropriate for clinical application than subjective judgment alone. This paper uses epistemological principles to evaluate the case presented by the subjectivists and concludes that arguments against objective electronic measurement in clinical use are unscientific and without merit.

Epistemology is the science of the methods and validity of knowledge. Einstein said, "One must appreciate that observation is a complicated process." Variations in possible observations and observational procedures are infinite. Cognition is observation constructed into information. Cognition is an essential of scientific knowledge, yet each person sees the world a little differently through his own "eyes". The study of epistemology involves evaluation of scientists' efforts to extract information from the world.

Complexity in Scientific Judgment

Facts do not interpret themselves to the scientist. Information must be rendered into intelligible facts through the activities of the inquiring mind. Perception is the act of transforming sensory information into recognizable objects or events (perceiving=seeing). The task faced by scientists as factual perceivers is to identify constancies or stable features in an environment that presents a nearly infinite number of continuous stimuli. Stimuli taken at face value are often misleading. Perception is a matter of extracting information from stimulation, identifying similarities between objects that appear different, differences between objects that appear alike and relationships and patterns that were not previously seen.[3]

Factual seeing is theory laden and complex.[4,5,6,7] Scientists manage their sensory world via a framework of paradigms or theories. Perceiving facts involves prioritization or evaluation of relevancy, ranging from primary, secondary, tertiary, etc. to somewhat irrelevant and totally irrelevant. Many cognitive operations take place outside of conscious awareness so scientists may be unaware of the perceptual process and reasoning that underlie some of their interpretations of the world. Scientific observations can be biased by the observer's model of the world and data can be contaminated by the manner in which the clinician interacts with the patient. Subjective impressions can thus be misleading and as such do not represent definitive scientific evidence or knowledge.

Limits in Human Judgment

Psychological studies of scientists demonstrate strong evidence of cognitive limitations which lead to frequent judgment error and a very limited ability to deal with complex information.[3] Weimer writes, "No methodology that is incompatible with the psychological sciences' account of a scientist's cognitive functioning can be correct." He calls this a meta criterion with which to assess the rival methodologies of scientific research. Thus many scientific descriptions are inaccurate because they utilize reporting procedures that go beyond the scientist's cognitive capabilities.

David Faust, in his classic epistemologic text, "The Limits of Scientific Reasoning" relates findings that the absolute level of performance on many judgment tasks is frequently low. The reliability of subjective scientific judgment is poorer than had been previously assumed. Cognitive limitations are almost certainly the most basic, most prevalent and most troublesome source of human judgment difficulties. The existence of scientists' cognitive limitations is not even an issue, but rather the extent, manifestations and consequences of their judgment errors and how to substantially reduce them.[3]

When making decisions scientists frequently attend to only a few variables or cues, although they believe otherwise. Access to additional information does not increase judgment accuracy. It is not that additional information is uninformative or useless, but that human minds lack the ability to integrate more than a limited amount of information, weigh it properly and select the most useful part. Convincing evidence is available suggesting that humans' ability to detect and comprehend complex configural relationships is very limited.[3] There is little doubt that scientific genius exists but little evidence that most clinicians are geniuses.

Coping with the Human Limitations

A central goal of science is to move beyond superficial appearances, more accurately, the goal is to extend the unaided perceiver's capacity to move beyond superficial appearances. Direct sensory information is being increasingly replaced by information gathered through objective measurement by sense-extending instruments, with theory providing guidance about information that is to be sought and how it is to be obtained and interpreted.[3]

Faust summarizes that "Investigations of the predictive efficiency of subjective impressionistic human judgment (such as that exercised by individual clinicians) versus that of even a crude non-optimized mechanical prediction function is about as clearly divided in favor of the latter as we can ever expect to get." Interjudge reliability among diagnosticians in organic specialities also show cognitive deficiencies and inferiority to objective data combination.[3]

An interesting affirmation of this relative to TMD was reported in a study by Hathaway and Anderson. Four clinicians, trained in TMD diagnosis and

treatment, developed diagostic criteria for TMD. They were then given clinical data consisting of history, clinical findings and radiographs for each of forty patients, and asked to develop a primary and secondary diagnosis for each patient. Despite prescreening agreement by clinicians on diagnostic criteria, they were unable to reliably agree on diagnoses for patients on the basis of clinical data, and clinically significant agreement was not achieved even with joint problems.

Human cognition is the final path in the construction of scientific knowledge. Thinking must be applied in constructing a scientific picture of the world. How well a scientist extracts information about the world determines their level of understanding. Information gathering begins with measurement. Measurement cannot exist without factual perceiving. Validity of a measurement procedure is determined by conceptualization of what is being measured. Interpretation of the results depends on higher level constructions variously called theories, paradigms, disciplinary matrices or prescriptive programs.

The scientific method encompasses collection, organization, interpretation and evaluation of information. Given the low level of reliability discussed earlier regarding human judgment, mechanisms are sought by scientists for accurate and thus reliable measurement. A sine qua non for validity of measurement is reliability. Devices that reliably collect, organize or evaluate information contribute to scientific progress and are referred to as decision aids.

In research involving the study of temporomandibular disorders, electromyographic measurement, electrokinetic measurement, electrosonographic measurement have been used repeatedly in research studies to further understanding of the biophysics and physiology of the head, neck and TMJ. These electronic measurement devices are safe and noninvasive. Neither their accuracy nor safety has been seriously questioned for research purposes.

At issue in the dental literature is not whether such decision aids are accurate or useful in advancing scientific knowledge but whether their use is more appropriate for clinical application in the treatment of temporomandibular disorders than subjective judgment alone.

The "Gold Standard"

Mohl has stated that the only logical gold standard that can be used to identify the presence or absence of TMD is the evaluation of a patient's chief complaint history, clinical examination and when indicated, radiographs.

Greene also submits that the most logical diagnostic approach for patients suffering from craniofacial pain disorders and musculoskeletal problems is the interpretive one. As an analogy to support this position he cites Horal's paper in which 212 low back pain patients were carefully matched with 212 controls based

on detailed histories, physicals and radiographic exams. The two groups were indistinguishable with regard to illness criteria with two exceptions: the control subjects did not consider themselves sick and did not seek treatment.

Thus, if Horal's study is credible and relates analogously to TMD, the Gold Standard of Mohl and Greene reduced to its lowest common denominator becomes, "You've got it if you say you've got it and you don't if you say you don't." Unfortunately, in an imperfect world there are such phenomena as hypochondriasis, insurance fraud, psychosomatic illness, dishonesty and attorneys who would be ecstatic to initiate lawsuits based on such irrefutable criteria.

A mitigating factor is that good clinicians do not treat "TMD". TMD is an epidemiologic "catch-all" term. Imagine how ludicrous it would be to go to a physician with a stomach ache, have them do a complete physical, history, diagnostic workup and appropriate tests and then say that the diagnosis is "stomach problem". TMD is a generic term analogous to stomach problem. The only treatment appropriate for a generic diagnosis is generic care such as nonprescription analgesics. Clinical treatment of patients for TMD on criteria such as "You've got it if you say you've got it, etc." as primary diagnostic criteria should be deemed imprudent, unscientific and dangerous.

Greene's stated position relative to TMD is that one of the most dangerous diseases is diagnosis.[204] According to Welden Bell[210], however, "An accurate diagnosis is the first step in the treatment of any disorder and the process cannot be abridged. A diagnosis should do the following:

1. Identify and classify the disorder properly;
2. Establish the mechanism of dysfunction and the source of pain;
3. Determine the etiology if at all possible; and
4. Provide a basis for prognosis in the light of effective therapy.

Overwhelming evidence has been documented by Faust and others in his text, that scientists' levels of subjective judgment performance is poor and that it can be far surpassed by computers utilizing objective measurement in conjunction with either actuarial programs for analysis of data or such computer software as neural networks and genetic algorithms for pattern recognition. The computer's capacity to manage information far more complex than that with which the unaided mind can deal has given scientists the information processing capacity and capability to move significantly forward in the development of systems approaches[3] for more appropriate treatment of temporomandibular disorders and evaluation of their results.

Hypotheses and theories originate as ideas from the minds of human beings. One cannot test a theory without first stating it. Karl Popper regarded as one of this century's greatest epistemologists[3,] states that, "An observation always

presupposes the existence of some system of expectations. There is no such thing as an unprejudiced observation."

Popper has introduced as criteria for separating science from non-science the capacity of science to pose testable hypothesis.

Knowledge advances when a sound hypothesis or theory which appears to be the best solution to a particular problem is tested rigorously and withstands repeated attempts to demonstrate that it is false. Falsification is thus a critical element in the advance of knowledge.[214]

Corroboration does not confirm or prove a hypothesis or theory but strengthens it, thus increasing preference for it over other theories that have not withstood critical testing. Hypotheses must also not be so vague that any conceivable observation confirms them.

Application of Popper's scientific views applied to the problem of clinical diagnosis demands that a diagnostic hypothesis be possible to refute. Mohl in a recent article confirmed that differential diagnosis may be accurately described as the process of ruling out diagnostic choices that do not apply to the given patient instead of ruling in the clinician's diagnostic choice.[207]

Thus testability, falsification or refutability lays down an important condition upon predictions deduced from a hypothesis. Problems arise when diagnostic criteria are not clearly defined, when the doctor is not sure that disease is present or absent, and when these signs are only obtained subjectively, because the patient's subjective complaint of pain is irrefutable.

Subjective observations are merely statements about an individual's beliefs and so by Popperian standards are unscientific. Thus by any reasonable standards of science (including Mohl's own diagnostic guidelines) the Gold Standard of Mohl and Greene ("you've got it if you say you've got it, etc.") must be rejected resoundingly. Based on the use of subjective data it is unreliable. Based on the patient's complaint of pain it is untestable. Based on weak and unsubstantiated diagnostic criteria it is vague. Basing any treatment, other than generic, on such non-science must be considered inappropriate and dangerous.

Measurement of Subjective Beliefs

Greene has advanced a theory that the more accurate electronic measurement modalities are, the more they simply reinforce what he already knows clinically.[204] McNeill has advanced a similar theory that electronic measurement modalities cannot do anything more accurately than his measurement using a one dollar ruler and a stethoscope.

The subjective clinical skills of Greene and McNeill are testable against the

objective measurements of electronic instrumentation. The belief, however, of these individuals that their subjective clinical skills are as accurate as electronic measurement borders on ludicrous. It is clearly in opposition to the currently held, repeatedly corroborated and here-to-fore unfalsified findings of Faust and others referenced in his text regarding the superiority of objective paraclinical measurements over subjective skills. The burden of proof rests on Greene and McNeill.

Greene cites eleven Canadian neuroscientists and five meetings in which the electronic measurement devices have been criticized.[204] Science by a "consensus" of IADR, American Association of Orofacial Pain, and eleven Canadian neuroscientists is an example of political decision making based on weak criteria which lack a logical base or scientific principle, and are often fallacious. Appeal to authority or consensus opinion has never been a guarantee of correctness.

The recent trend in the biomedical literature[201,202,203,204,205,206,207,208] relative to TMD has emphasized ad hominen evaluation, via subjective literature search based on the reputation or affiliation of its authors, rather than by judging the accuracy, the data or the logic of the arguments. This is dangerous because it extols the use of prejudice to judge research rather than judging a work on its own merits. Findings should stand or fall by virtue of the accuracy of data and its logic not by the imputed viewpoint, philosophy, personal biases or tyrannical authority of its critics, which in this case are unscientific.

Conclusion

Rothman has said "The fallibility of scientific knowledge about nature appears to be inherent in its dependence on observations which are themselves fallible, and the inescapable limitation that observations are finite, and thus cannot take into account the infinity of conceivable circumstances in which the laws of nature can be applied."

United States Supreme Court Justice Benjamin Cardozo may have summed it up best when he said, "If you can measure something it is a fact, if not it is an opinion."