

Hearing, the perception of sound and expert evidence in litigation

Donald Woolford (1), David Alais (2), Virginia Best (3), Carolyn Semmler (4) and Paul, D.Niall (5)

(1) W-P-Consulting Pty Ltd., PO Box 212, Unley B/C. SA. 5061, Australia. woolforddh@dodo.com.au

(2) Dept. Psychology, Univ. of Sydney, NSW. Australia. davida@psych.usyd.edu.au

(3) National Acoustic Laboratories, Sydney, NSW. Australia. virginia.best@nal.gov.au

(4) Dept. Psychology, Univ. of Adelaide. SA. Australia. carolyn.semmler@adelaide.edu.au

(5) Consulting Audiological Physician. NSW. Australia. pniall@ausdoctors.net

ABSTRACT

The recently published Chapter 145, "Hearing and the perception of sound", in the Thomson Reuters series on expert evidence, (Editors Ian Freckelton and Hugh Selby), was prepared to acquaint expert witnesses, litigators and the legal profession about science and practice directed to hearing and the perception of sound. Sounds such as speech in various acoustic environments, warning signals, background noise, and listeners with hearing impairments, can assume significance in civil disputes or criminal matters. A synopsis of the chapter, authored by David Alais, Virginia Best, Paul Niall, Carolyn Semmler and Donald Woolford will be presented by Donald Woolford. The presentation will conclude with a brief examination of a lay witness followed by an expert witness to illustrate acoustic forensics.

THE DIRECTION OF THIS PAPER

This paper will introduce Chapter 145, "Hearing and the perception of sound", in its application to mediation or the court system in providing expert evidence. The practice of acoustics in its branches has basis in the hearing and perception of sound. Indeed the design criteria for sound measuring equipment and for the measurement of hearing, are for many applications, tailored to the characteristics and physical limitations of human hearing and perception. In the acoustic branch of applied science, specialised measurements are required to specify the design of structures to reduce noise; the design of enclosures for music or speech; the design of concert halls and recording studios; the design of electro-acoustic equipment for hearing aids and audio equipment; hearing conservation; medical acoustics and hearing and research. Often in civil and criminal disputes, matters such as speech wrongly interpreted in various acoustic environments, warning signals unidentified in high background noise, and listeners with impaired hearing, may be significant. However, not all disputes can be solved using the application of scientific measurement, but sometimes in the application of experiential knowledge. The material in the Chapter is thus designed to provide a background and reference to increase scientific understanding of hearing and sound perception. It will help bridge the gap between science and practice, and aid expert witnesses, advocates and litigators apply this knowledge in mediation or the court system, to help resolve disputes in civil or criminal matters. Each submitted paper will be refereed by at least two reviewers. Only papers being presented at the conference will be published in the conference proceedings. Authors are fully responsible for their papers, which should not have been published elsewhere. They must have taken necessary steps to obtain permission to use any material that might be protected by copyright.

BRIEFLY COVERED IN CHAPTER 145

The Chapter introduces the following topics, viz. the gross anatomy and physiology of the auditory system; auditory perception and its limitations; the nature of thresholds; the perception of direction and distance of sound sources; binaural and monaural hearing; the loudness, intensity and masking of sounds; cognitive psychology, memory for sounds and speech; audition in the multisensory brain; individual differences and ambiguity in perception; abnormal hearing and deafness; types of hearing impairment and diseases of hearing; and the ageing of human hearing. The compensation of assessments for noise-induced hearing loss and related measurement is covered in depth. Brief appendices include information about the nature of sound and some of its physical characteristics, as well as Signal Detection Theory.

THE APPLICATIONS FOR CHAPTER 145

The Introduction to Chapter 145 postulates many examples where the presented material can be applied. The disciplines where hearing and the perception of sound are applicable are wide-ranging, and thus several authors contributed to give a broad coverage.

Expert witnesses in the acoustics disciplines often provide data about the physics and measurement of sound, where there may be a dispute about complying with statutes and regulations that define allowable noise levels, whether a particular sound is annoying, or whether hearing conservation criteria have been exceeded. Sometimes they may be asked whether a particular sound can be heard in a certain context. The acoustic consultant is mainly dependent upon his instrumentation and recorded material to help resolve cases dependent upon his expertise. This is in contrast to the audiologist, whose primary concern is the health of the hearing system and speech communication.

NON-EXPERT OR LAYMAN WITNESSES AND EXPERT WITNESSES HELP DEVELOP THE FACTS OF A CASE

The competence of laymen witnesses who testify in matters of hearing and perception may require checks as to the integrity of their listening abilities in quiet, or in less favourable situations, such as noisy or reverberant backgrounds. It may be that the discrimination of speech or other sounds, such as warning signals are critical to a particular case. For example, a witness may be required to report on words or conversations in which he/she participated whilst in an unfavourable acoustic environment such as a noisy restaurant, sporting venue, public transport, or an airport. This involves what was heard, possibly after a considerable time has passed. The presence or absence of visual information may be relevant to the overall perceptual recollection. The court must also be made aware of possible perceptual ambiguities at the time of a reported incident.

The evidence presented by witnesses can be challenged by advocates on either or both sides of a civil dispute or criminal case. Expert witnesses on each side of disputes help the courts establish the reliability of the facts presented.

COGNITIVE SKILLS

The importance of cognition must never be underestimated. Cognition is a comparatively new branch of the science of psychology. It attempts to quantify human thought and action for a particular time and sometimes place, and is dependent upon current culture. The identification and memory of environmental sounds has been found to be greatly affected by context and environmental cues. A large body of work has demonstrated that “remembering is not the re-excitation of many fixed, lifeless and fragmentary traces, but is an imaginative reconstruction or construction”, and as such factors affecting perception and memory in witnesses should be considered.

COMPENSATION ASSESSMENTS OF NOISE-INDUCED HEARING LOSS (NIHL)

This section sketches the economic and legislative influences on the incidence of noise induced hearing loss over the last generation. It explains the relationship between hazardous noise exposures, quantitative noise surveys and the association with the improvement in applicable Australian, New Zealand and International Standards. The use of pure tone audiometry and the causes of variations in compensation assessments are covered. The basis for the conversion of impairment assessments to ratings for monetary compensation is set out, as are the rules accounting for contributions from tinnitus and presbycusis. There is a succinct but important section on how non-occupational contributions to a hearing loss are separated from the compensable occupational components. An understanding of these materials is a necessary adjunct to other data in the Chapter.

SIGNAL DETECTION THEORY

A topic covered briefly in the Chapter is Signal Detection Theory. Signal Detection Theory is a descriptive model and mathematical tool that has been widely used to understand and explain the ability of humans to detect sensory stimuli. In the application of this technique, it is possible to separate purely sensory capabilities from factors relating to motivation, bias, and measurement criteria. The distinction is entirely necessary in light of the fact that human responses to a

particular sensory stimulus (such as a sound) can vary from instance to instance.

THE EXAMINATION OF A WITNESS TO ILLUSTRATE ACOUSTIC FORENSICS

A witness will be questioned as a lay person about an aspect of a recent criminal case, in the perception and identification of a particular sound. The witness, an acoustic consultant, will then discuss hearing, perception and the acoustics involved.

CONCLUSION

Chapter 145 was prepared as a bridge between physical acoustic measurements and the perceptual consequences of sounds detected by humans. It is multidisciplinary, and hopefully will provide a primer to the mystery often surrounding the unknown parts of the perception of sound.

This paper, an advance on the Chapter, is expected to help not only expert witnesses, but also litigants and advocates apply the presented material in mediation and court work.