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ability? Statistical theory indicates that a good measure of the discriminability of signals is the mean to standard-deviation ratio of response to the signals, with a higher ratio providing better discriminability. In this paper, the signal is electrical stimulation of the scala tympani with bipolar, biphasic current pulses, and the response is spike activity of individual auditory nerve fibres in the cat. We analyze experimental measurements of the mean, variance and standard-deviation of auditory nerve spike activity to a variety of electric stimulation conditions. In order to explain the mean to variance relationship, we apply a point process model of neural response. This model demonstrates that refractory properties of the neuron explain the experimental responses, and permits a prediction of neural response under arbitrary conditions. These results facilitate a prediction of the discriminability of variously coded sounds - permitting the design of new stimulation strategies which improve speech understanding.

A MATHEMATICAL MODEL OF ELECTRICAL STIMULATION OF THE AUDITORY NERVE

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Accurate models of Auditory Nerve (AN) response to electrical stimulation may assist with the development of speech processing strategies for cochlear implants. Until recently most models of AN response to electrical stimulation have utilized deterministic (non-random) descriptions, in spite of strong evidence for stochastic (random) components of behaviour in the neurophysiological data. Models of auditory performance using these deterministic descriptions have been unable to predict many important psychophysical phenomena. Can stochastic models improve these predictions?

To answer this question, we have developed a model of AN response which includes the stochastic behaviour, but which is also computationally efficient enough to be used in predicting simultaneously the individual response for each neurone in the auditory nerve, and subsequently in the prediction of psychophysical results. The model has been developed by adding membrane noise as measured in neurophysiological studies to a classical deterministic model. Comparison of the deterministic and stochastic models highlights aspects of neuronal response which cannot be explained in a deterministic model. Furthermore, the stochastic model is shown to be more accurate in predicting psychophysical performance in a classical deterministic model. This model can consequently help with optimising the configuration of current speech processing strategies and with developing new strategies.

THE INTERACTION BETWEEN THE CYTOKINE LIF AND NEUROTROPHINS ON SPIRAL GANGLION CELLS

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Survival of auditory neurones depends on the continuous supply of growth factors. Hair cells within the cochlea are known to produce supply growth factors responsible for the survival and growth of vestibular neurones. As a result of trauma, disease or ageing, these hair cells are lost, and consequently, the supply of growth factors is reduced, leading to a secondary wave of auditory nerve degeneration.

Neurotrophins and cytokines are two families of growth factors reported to have activity in the cochlea. Moreover, it is suggested that neurotrophins and cytokines act synergistically upon sensory nerve cells, although the mechanism of this synergistic effect is unknown. It has, however, been suggested that one of the growth factors could be involved in the maintenance of basic cellular metabolic function, while the other could be involved in differentiation events.

The current study involves a primary cell culture of cochlear neurones (spiral ganglia neurones) in vitro. These cultures are being used to investigate the action of exogenous growth factors on the process of outgrowth and survival of auditory nerve cells, in order to find combinations of growth factors that could be applied to maintain and/or repair auditory neurones in vivo.

Preliminary findings suggest that the cytokine Leukaemia Inhibitory Factor (LIF) displays trophic activity of spiral ganglion neurone cultures. The more definitive findings and interaction between LIF and the neurotrophines will be reported.
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To answer this question, we have developed a model of AN response which includes the stochastic behaviour, but which is also computationally efficient enough to be used in predicting simultaneously the individual response for each neurone in the auditory nerve, and subsequently in the prediction of psychophysical results. The model has been developed by adding membrane noise as measured in neurophysiological studies to a classical deterministic model. Comparison of the deterministic and stochastic models highlights aspects of neuronal response which cannot be explained with a deterministic model. Furthermore, the stochastic model is shown to be more accurate in predicting psychophysical performance than a classical deterministic model. This model can consequently help with optimizing the configuration of current speech processing strategies and with developing new strategies.

THE INTERACTION BETWEEN THE CYTOKINE LIF AND NEUROTROPHINS ON SPINAL GANGLION CELLS

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Survival of auditory neurones depends on the continuous supply of growth factors. Hair cells within the cochlea are known to produce growth factors responsible for the survival and growth of neurones. As a result of trauma, disease or ageing, hair cells are lost, and consequently, the supply of growth factors is reduced, leading to a secondary wave of auditory nerve degeneration.

Neurotrophins and cytokines are two families of growth factors reported to have activity in the cochlea. Moreover, it is suggested that neurotrophins and cytokines act synergistically upon sensory nerve cells, although the mechanism of this synergistic effect is unknown. It has, however, been suggested that one of the growth factors could be involved in the maintenance of basic cellular metabolic function, while the other could be involved in differentiation events.

The current study involves a primary cell culture of cochlear neurones (spiral ganglion neurones) in vitro. These cultures are being used to investigate the action of exogenous growth factors on the process of outgrowth and survival of auditory nerve cells, in order to find combinations of growth factors that could be applied to maintain and/or repair auditory neurones in vivo. Preliminary findings suggest that the cytokine Leukaemia Inhibitory Factor (LIF) displays trophic activity of spiral ganglion neurone cultures. The more definitive findings and interaction between LIF and the neurotrophines will be reported.

NORMAL NEURONAL PATTERN AND CHANGES AFTER DEAFFERENTIZATION OF COCHLEAR NUCLEUS IN MONKEYS

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INTRODUCTION: In order to improve the current design of the Auditory Brainstem Implant (ABI), we are carrying out a research project on monkeys (macaca fascicularis) with these two goals: 1) Study of the normal neuronal pattern of the Cochlear Nucleus (CN) and the changes after deafferentization; and 2) analyse the effects of the ABI implantation in the CN of the monkey. We present the general schedule of the project and the results concerning the first objective.

METHOD: The study of the normal architecture of the CN and its topographic relations at the brainstem was carried out in a control group of 5 monkeys. Group A. In 7 monkeys, Group B, a bilateral translabyrinthic section of the acoustic nerves was performed to analyse the effects of deafferentization three months after the surgical section. After examination of the effectiveness of the auditory nerve section, the brainstem was dissected and serially sectioned orthogonal to its long axis in a freezing microtome at 30 µm. Control cases were: 1) injected with WGA-HRP to study the primary afferent projection of the acoustic nerve; 2) transcardially perfused with 4% paraformaldehyde and sections incubated with antisera against nonphosphorilated neurofilaments (SMI-32) to show immunoreactivity in neurons, glial fibrillary acid protein (GFAP) as an astrocytic marker, and other histochemical and immunohistochemical markers (Synaptophysin, Calretinin, Parvalbumin and Calbindin). Experimental cases with bilateral section of the acoustic nerve were perfused three months later and the immunohistochemical series compared to controls.

RESULTS: There is an increase in the overall astrocytic population affecting all levels of the cochlear nuclei. There is a profound reorganization of the glia shown as a loss of the discrete surrounding of astrocytic processes of the CN neurons. At the neuronal level, the cochlear nuclei show a decrease in volume with no apparent loss of neurons. The SMI-32 pattern of immunoreactivity in control cases labeled selectively the large population of neurons, mostly spherical bushy, multipolar and giant cells. The immunoreactivity, labeled the soma as well as the proximal part of dendrites, fibers and weakly labeled bundles of woolly fibers. The experimental cases showed a decrease in multipolar and giant cells number, a loss of the immunoreactivity in the proximal processes of the stained neurons, a