# SENSORY TRANSDUCTION IN AN ARTHROPOD MECHANORECEPTOR SYSTEM

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## INTRODUCTION

Arthropods (insects, spiders and crustaceans) have provided a variety of model systems for studying fundamental mechanisms of sensory transduction and processing of sensory information. In addition to their ready availability and relatively simple nervous systems, the arthropods possesss a class of sensory receptors, the Type I or cuticular receptors, that have their sensory neuron cell bodies located in close proximity to the sensory endings in the external cuticle. These receptors allow experiments to be performed that are currently impossible with most vertebrate mechanoreceptors.

Slit sensilla are specialized mechanorecptors that detect mechanical strain in the spider cuticle. They occur singly and in groups, called slit-sense organs. We developed a preparation of the VS-3 slit-sense organ (Barth and Libera, 1970) in the tropical wandering spider, *Cuppienius salei*, that has allowed us to make intracellular recordings from primary mechanosensory neurons and to voltage-clamp the receptor current during sensory transduction.

## METHODS

Figure 1 shows the experimental arrangement used for most of our studies on the VS-3 slit-sense organ. The organ consists of 7-8 slits in the cuticle, with each slit innervated by a pair of sensory neurons. Both the neurons of each pair are mechanoreceptors but they have different adaptation properties. Glass microelectrodes of about 60 MΩ resistance were inserted into the sensory neurons allowing measurement of the membrane potential or the receptor current by the switching single electrode voltage clamp technique (Juusola et al., 1994).

## RESULTS AND DISCUSSION

Tansduction occurs in the tips of the sensory dendrites that terminate in the slits. The tips are surrounded by a sodium-rich lymph, and recordings of the receptor current, including its current-voltage relationship and ion substitution experiments showed that mechanical stimulation opens sodium selective ion channels in the tips (Höger et al., 1997). Noise analysis of the receptor current indicated that there are probably a few hundred mechanoreceptor channels with comparatively small single-channel conductance (Höger and French, 1999).

The receptor current adapts with time after a step stimulus to the slits, but the adaptation is much slower than the rapid adaptation of the action potential discharge, indicating that other membrane currents control the rapid adpatation

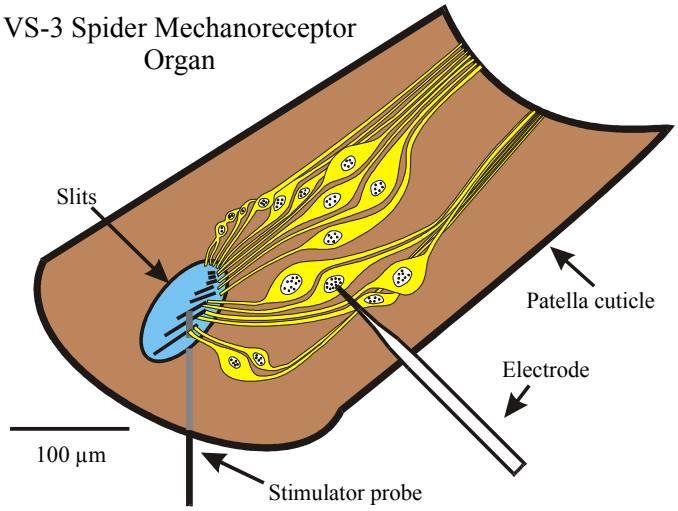


**Figure 1**: Mechanotransduction in the spider VS-3 slit-sense organ. The patella cuticle was dissected and the tissues removed to expose the sensory organ. Microelectrodes were inserted into neuron cell bodies while a mechanical stimulator pushed on the appropriate slit from below.

## SUMMARY

The spider VS-3 organ has provided important new information about fundamental mechanisms of transduction in arthropod mechanoreceptors. Current experiments are aimed at further characterization of the receptor channels to allow comparison with families of mechanically-activated ion channels in other systems.

## REFERENCES

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