Information transfer between neurons is at least partly encoded in the frequency of spikes or burst discharges as well as in the temporal spike patterns. It is known that mammalian cold receptors exhibit a variety of different spike patterns depending on temperature, which is one of the possible stimuli of these cells. The characteristic changes of spike patterns with respect to the variation of temperature can be described by the Huber/Braun model, which mimics the neuron dynamics as an interplay of fast and slow ion currents. While the slow currents yield subthreshold oscillations, the fast subsystem seems to be responsible for the spiking mechanism.

The amplitude of subthreshold oscillations in this model neuron might be altered by external stimuli like hormones or neurotransmitters. To study the role of the subthreshold oscillations we have introduced a parameter which manipulates the impact of the subthreshold currents on the dynamics of the membrane potential. The neuron then undergoes a series of systematic changes in the course of scaling down the amplitude of subthreshold oscillations until it settles at a fixed point. It can be concluded from the analysis of the emerging dynamics that amplitude scaling serves as an important ingredient in the perception of temperature in mammals.

Furthermore, our study shows that the key feature for non-trivial dynamics is the highly nonlinear coupling of the slow, subthreshold currents to the fast, spike-generating currents in the model. If the fast subsystem is subjected to a periodic external forcing current of the same amplitude and frequency as supplied by the subthreshold currents, the dynamic behaviour becomes merely trivial.

In the light of these results, it seems likely that an extension of the common interpretation of the mechanism of spike generation and the spiking patterns is necessary. The highly nonlinear feedbacks between the slow and fast subsystems of the cold receptor model should be emphasized more. The explanation for the spiking mechanism can not be based solely on the idea of spikes being triggered by the amplitude of slow oscillations alone.