

# Electric Currents Modulate the Growth Cone To Focal

Patel, NB; Xie, Z; Young, Sh; Poo, M

## Abstract:

Monopolar Electric Current Pulses Were Focally Applied Through A Micropipette To The Growth Cone Of *Xenopus* Embryonic Neurons In Culture. Application Of The Current Directly In Front Of The Growth Cone Modulated The Rate Of Growth Cone Extension: Negative (sink) Currents Increased The Growth Rate, While Positive (source) Currents Reduced The Growth Rate. When The Currents Were Applied In A Direction Perpendicular To The Direction Of The Neurite Growth, Both Negative And Positive Currents Produced Inhibitory Effects. Application Of A Negative Focal Current At A 45 Degree Angle With Respect To The Direction Of Neurite Growth Resulted In An Oriented Growth Of The Neurite Toward The Current Sink. However, After The Growth Cone Had Been Attracted To The Vicinity Of A Current Sink, Further Extension Of The Neurite Was Inhibited. These Current Effects Occur Rapidly After The Onset Of The Current Application, And Are At Least Partially Reversible Within 1 Hr After The Termination Of The Current. The Magnitude Of Current Density Required To Induce A Growth Cone Response Was Found To Be In The Order Of A Few Pa Per Micron<sup>2</sup>. Such Current Density Is Close To That Which May Be Generated At The Muscle Cell Surface By The Acetylcholine Molecules Released From The Growth Cone During The Early Phase Of Nerve-muscle Contact.