Crayfish lab report

A. Avril Crayfish Lab Report November 9, 2012 Dr. Marvin Results: Figure 1. Firing Rate of Tonic Receptor in Response to Stretch. The correlation between Firing Rate and Stretch of the slow adapting crayfish receptor for four different sets of data is represented in this figure. The recordings are taken at stretches of 2, 4, 6, 8, and 10 mm of the crayfish tail.

The best fit lines for the different sets of data are as follows: Ali and Emily-Linear best fit line, Dave and Laura- Exponential best fit line, Jimmy and Amina-Exponential best fit line, Tala and Jen-Linear best fit line).

Figure 2. Class Average for Firing Rate of Tonic Receptor in Response to Stretch. The firing rate of the slow-adapting receptor neuron in response to stimulus, which in this experiment is the stretching of the Crayfish tail at 2, 4, 6, 8 and 10 mm. Figure 3.

Rate of Adaptation of Tonic Receptor held at Constant Length (6mm). The best fit line for the rate of adaptation of the Tonic receptor is Logarithmic. At a constant stimulus, the initial firing rat drops and levels off at a constant firing rate representing the presence of a stimulus.

R2 Values for Linear, Exponential and Logarithmic Lines for each Data Set | Curve Type| R^2| Tala, Jen| Linear| 0. 982| | Exponential| 0.

982| | Logarithmic| 0. 982| Dave, Laura| Linear| 0. 982| | Exponential| 0. 982| | Logarithmic| 0. 746| Jimmy, Amina| Linear| 0.

950| | Exponential| 0. 976| | Logarithmic| 0. 824| Ali, Emily| Linear| 0. 988| | Exponential| 0. 934| | Logarithmic| 0. 965| Class Average| Linear| 0.

995| | Exponential| 0. 966| | Logarithmic| 0. 920| Discussion: 3. Frequency vs Stretch) In our classroom experiment, after dissecting and preparing our crayfish tail, we sucked up a MRO receptor neuron with our electrode to record firing of the nerve as we adjusted the length of the crayfish tail using a string attached to both the micromanipulator and the end of the tail. Unlike our classroom experiment, the methods for Delcomyn and Krnjevic and Van Gelder's experiment dealt directly with the MRO strand, to be more specific – the isolated abdominal stretch receptors of the crayfish.

In Delcomyn's experiment, the MRO strand was held at each end by forceps and a microelectrode was inserted into the cell body of the sensory neuron.

Gentle manipulations of the forceps caused a stretch in the MRO generating a generator potential in the strand that caused a spike potential in the sensory neuron. As stated earlier, methodically, Krnjevic and Van Gelder's experiment didn't differ significantly because they too interacted directly with the MRO receptor neuron. The independent variable in each experiment was the stretch applied to the neuron.

The dependent variable for our classroom experiment and Delcomyn's experiment was the firing rate, but Krnjevic and Van Gelder's experiment contained an additional dependent variable—tension (which is linearly related to the firing rate). b) According to Krnjevic and Van Gelder's Figure 7, stretch and tension are linearly related.

The graphs reveal that with increasing tension, firing rate and tension increase progressively faster. The relationship of both tension and firing rate to stretch are exponential (Krnjevic and van Gelder, 1961).

Because of the differences in our methodical approaches, our classroom experiment is not directly comparable to Delcomyn or Krnjevic and van Gelder's. The author's data is much more comparable because Delcomyn and Krnjevic applied stretch directly to the MRO strand, so the stretch in mm is directly comparable for the two. In our classroom experiment, we have a much bigger range because we dealt with the entire crayfish tail, so much of the movement in millimeters goes into lifting the tail itself.

c) The best-fit curve for my results of firing rate vs. tretch applied is exponential. Similarly to Delcomyn's results, my stretch is linearly related to the firing for the first three data points. For the last two values, my scale begins to increase exponentially and starts to resemble Krnjevic and van Gelder's results. Operational errors that could account for differences in the class data would be recordings incorrectly taken before the neuron has adapted (values would be higher).

The class data supports Delcomyn's linear results, but it could be that our classroom experiment would have increased exponentially with increased stretch.

Delcomyn's data is linear in his experiment, but the range of stretch values is considerably smaller than Krnjevic's. Similarly to my experiment, Krnjevic's data also follows this linear trend until it reaches a level of stretch that causes an increase in tension and thereby and increase in the firing rate. In Figure 7 of Krnjevic and Van Gelder, it is at the two largest values for stretch that the firing rate increases from linear to exponential. The fact that

Krnjevic obtains values for firing rate at larger values of stretch could explain why his results showed exponential growth after a certain value.

) There is a huge amount of variance in the stress vs. frequency relation for the class. Simple biological factors like individual variance could account for the variance in the data. In Table 1 of Krnjevic's paper, he acknowledges that the differences in the receptor taken from the same cross section could have contributed to inaccuracies in his experiment (Krnjevic 1961). Another biological factor that might influence the slope of the stretch frequency curve could be tension.

For instance, a less flexible crayfish (i. . more tense) would have a faster firing rate for a given stretch than a more flexible crayfish would. 4. Frequency vs Time a.

In our particular experiment, a spike potential is the action potential of the sensory neuron that is driven by the generator potential. A generator potential in the MRO is driven by a net inward current of $Na+$ and $Ca++$ or an EPSP, after activation of the mechanoreceptor. This generator potential gets the membrane potential to threshold and thereby causes an Action Potential (spike potential).

The contributions of the generator adaptation and spike adaptation could be separated experimentally by application of a spike inhibitor, which in Krnjevic's experiment is represented by tetrodotoxin. b) In slowly adapting neurons, spike adaptation makes a greater contribution to overall adaptation. In Figure 1A, the spike potential has been isolated and according

to this experiment, the behavior of the neuron's spike potential is consistent with what we know about tonic receptors.

Under a constant current, the slow adapting neuron transitions from a rapid firing of action potentials to the slower fire represented by larger interspike intervals. In Figure 1B, the spike adaptation for the fast adapting receptor, too, is consistent with our knowledge of phasic receptors. There was an initial firing rate at the onset of the current, but while the current was still applied, we see a drop to zero for the phasic receptor's firing rate. (Nakajima 1964).

Conversely, in Figure 2A and B, where both phasic and tonic generator potentials are isolated, there is essentially no difference between the two potential's behavior(Nakajima 1964). This suggests that the generator potential has no effect on the behavior of the neurons and it's adaptation mechanism.

d) In both Figure 10 and my own, the adaptation over some duration to a constant stimulus is logarithmic. According to our overall adaptation result—the rate of firing of a slowly adapting neuron slows when exposed to a constant stimulus—Figure 10 of Nakajima follows the same form because our classroom experiments also follow a logarithmic curve. . i) In my analysis of whether the ion concentration model accounts for both adaptation and the immediate recovery from " overstretch", I conclude that this model only partially applies because of it's plausible explanation for spike adaptation. According to the Nernst equation (log NaIN/NaOUT), the Na concentration inside and outside of the cell could chemically equilibrate.

Based on where ENA is determines the depolarization of the action potential and if ENA were to drop below threshold (due to equilibration of Na concentrations and smaller influx of Na ions), we would not get firing.

Conversely, application of the ion concentration model to immediate recovery from " overstretch" doesn't directly apply because it can't explain how the ion concentrations would immediately become more available extracellularly to provide the ENA needed to cause firing of the action potential. The process of generating a concentration gradient could not logically occur that quickly. ii) In order to test the sensitivity of a particular ion channel, we could use the patch clamp method and analyze it's response to a constant stimulus and see whether or not we get a change in ion influx over time (that's not due to ion concentration).

Whether or not the channel's sensitivity to an ion changed over a certain time period could prove the validity of this mechanism.

References Nakajima, Shigehiro. " Adaptation in Stretch Receptor Neurons of Crayfish. " Science 1 (1964): n. pag. Delcomyn, Fred. " Encoding Stimulus Strength.

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