1 Results

The Yan model clearly shows a bias towards greater excitement with shorter interburst intervals, longer burst duration Comparing time series Figures 1 and 2, we can see that generally, the Yan model exhibits longer bursts with more leading-edge spikes and that around eL=-50, bursting becomes tonic spiking, while the TB model has shorter, tighter bursts and continues to exhibit bursting even into eL=-50.

Additionally, while the TB model exhibits bursting at eL=-50 when g_{NaP}=1.8 or 2.4, the Yan model exhibits only tonic spiking when eL=-50. Note, however, that even in time series containing only tonic spiking, spike density does increase and decrease periodically and the effect is more noticeable when g_{NaP} is small.

The most interesting feature visible in the time series occurs at $gnap$ = 4.2, eL=-55. In the Yan model, spike frequency at the start and end of a burst is visibly higher than spike frequency at the burst center, while in the TB model we see bi-modal bursting behavior: the single bursts in he Yan model become two separate bursts in the TB model, each with a different duration and followed by a different interburst interval.

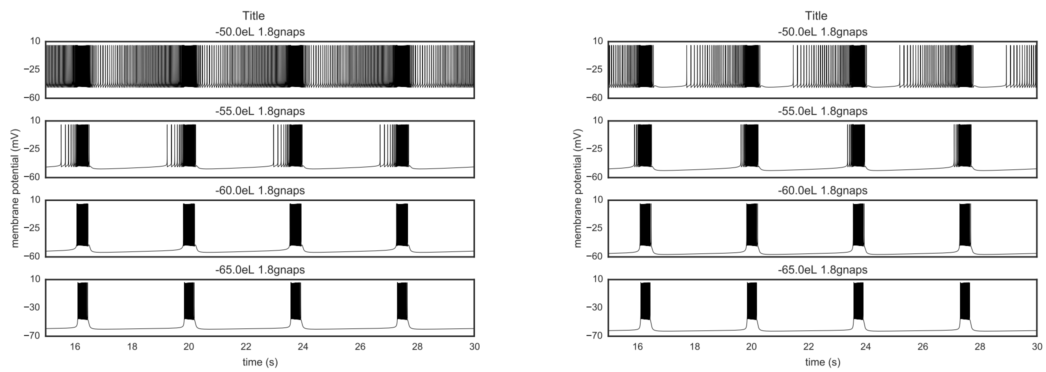


Figure 1: Time series generated from Yan and TB models at all values of eL for g_{NaP} = 1.8 nS.

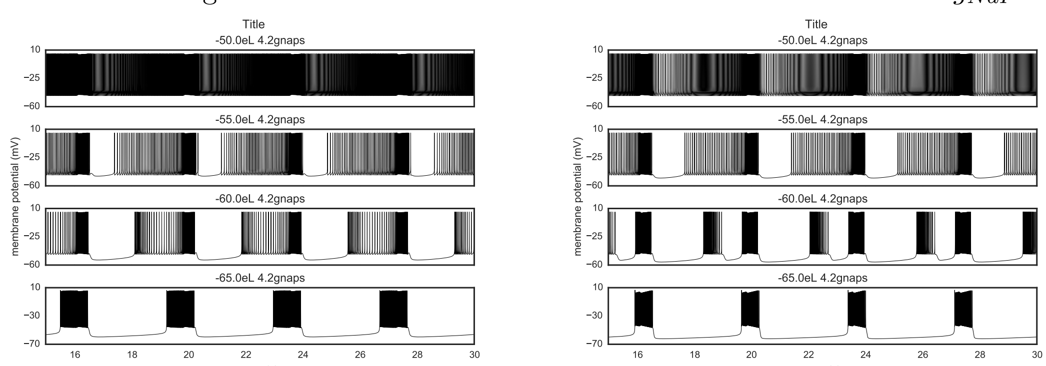


Figure 2: Time series generated from Yan and TB models at all values of eL for g_{NaP} = 4.2 nS.

1.1 Total Cycle Time, Burst Duration, Interburst Interval

Average total cycle time, the time from the start of one burst to the start of another, was uniform between models and parameters sets for all time series that exhibited bursting (not pictured). The only point of significant difference was at $eL = -60 g_{nap} = 4.2$ where the value for the TB model was half that of all other TCTs measured, due to bi-modal bursting exhibited by the TB model at that parameter set (Fig [2]).

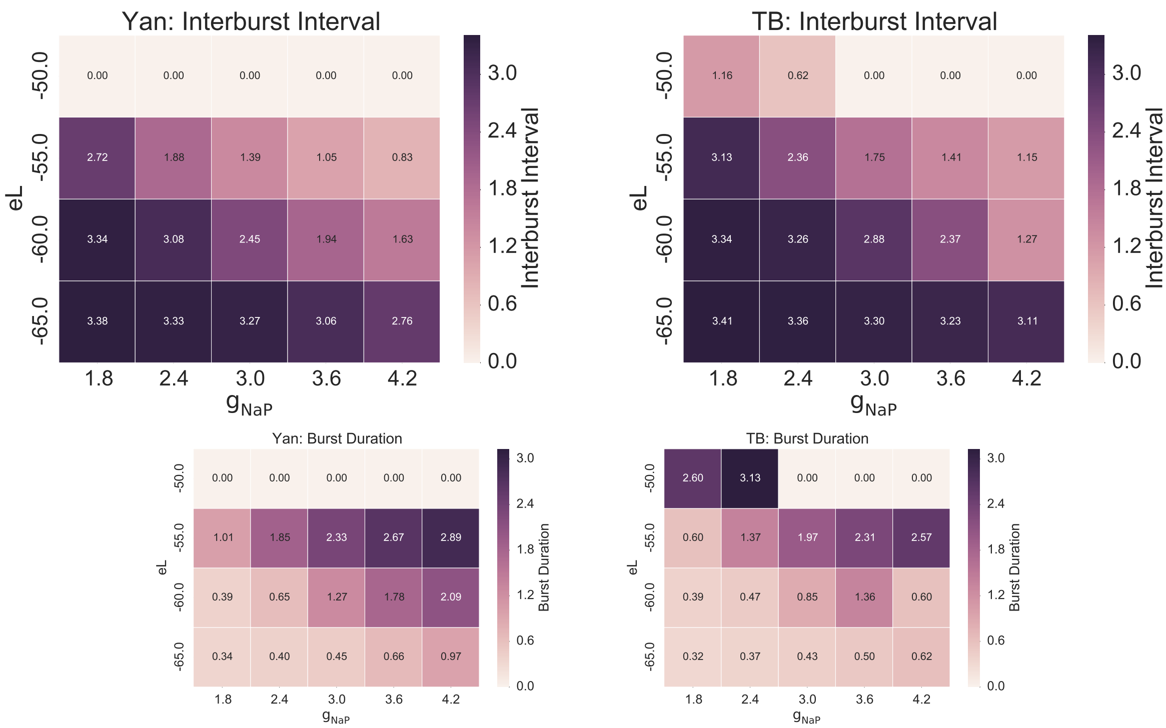
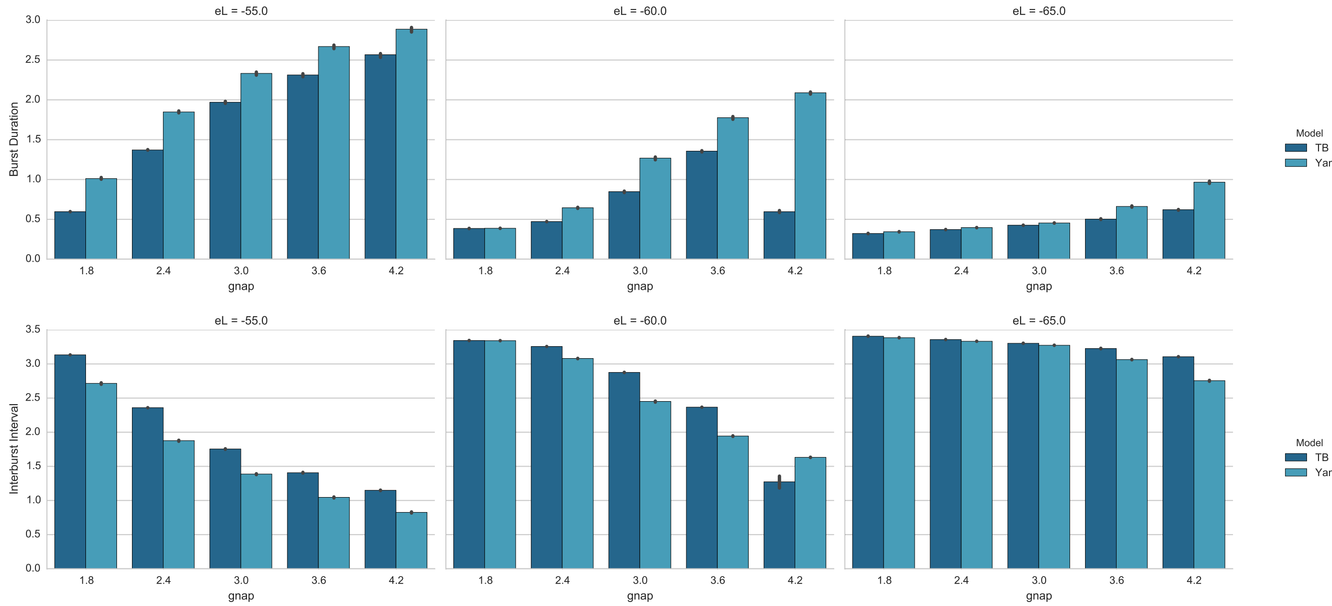


Figure 3: Heat map showing variations in burst duration and interburst interval with changes in eL, g_{NaP}, and the model. Zeroes indicate no bursting (i.e. tonic spiking).

By contrast, BD and IBI were both model and parameter sensitive. BD increased with increasing g_{nap} and decrease with decreasing eL, while IBI did the opposite. Sensitivity to changes in eL and g_{NaP} decreased at the lower edge of the test ranges, so that when eL was -65, BD was not sensitive to small changes in g_{NaP} at the smaller end of the g_{NaP} range. This effect was most apparent for the TB model than it was for the Yan model. Similarly for IBI, as eL decreased IBI became less sensitive to g_{NaP}, and the trend was more noticeable in the TB model. Burst duration for Yan increases with eL more rapidly than does TB. Differences in burst duration between the two models does not change significantly with change in g_{NaP}*. For Yan, bursting does not occur while $eL = -50mV$, while bursting occurs at $eL = -50,\ g_{NaP} = 1.8, 2.4$. *dbl check this

1.2 Peak Variation

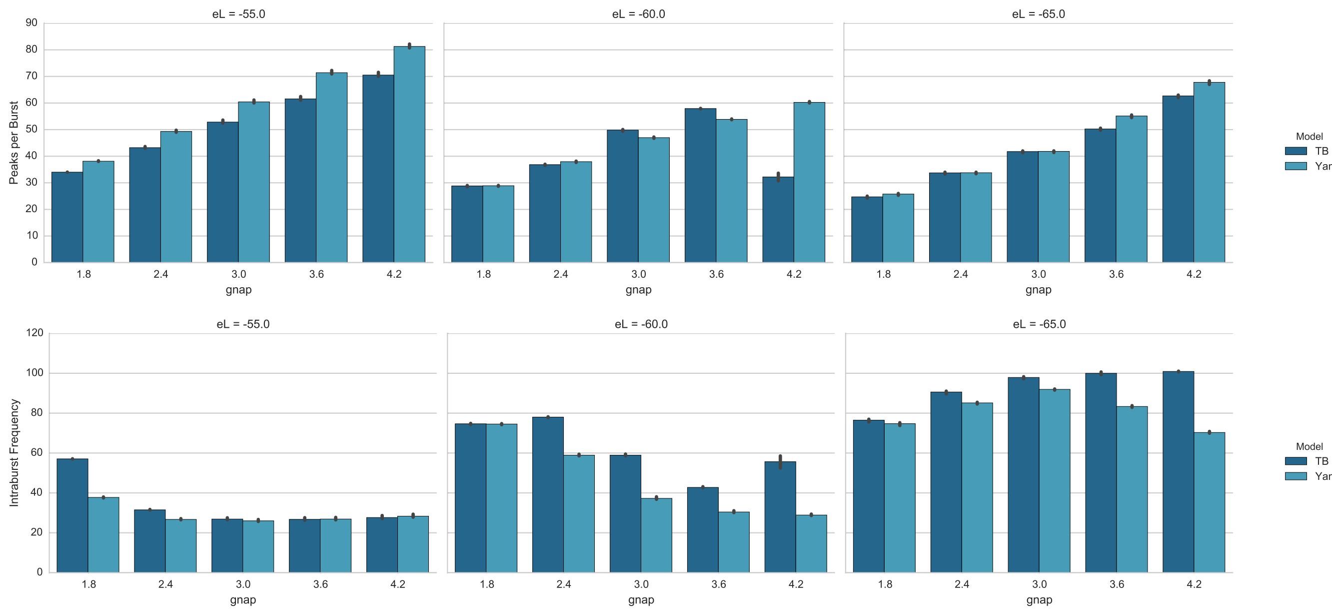
Peak variations can be described by several measures, peaks per burst, intraburst frequency (the frequency of peaks within a burst), interpeak interval, and peak amplitude. The number of peaks per burst were increasingly model sensitive with increasing eL and g_{NaP}. The Yan model consistently shows higher Peaks per Burst, except for eL=-60, where the TB model is significantly larger at g_{NaP}=3.0 and 3.6. Most comparisons between time series from the same model with different parameters show significant difference. Generally, PpB increased significantly with eL and g_{NaP}, but PpB dropped significantly at eL = -60 for TB when g_{NaP} = 4.2 and for Yan at g_{NaP}=3.6 and 4.2.



¡Intraburst Frequency¿ For smaller values of eL (-65, -60) and higher values of $gnap$ (3.0, 3.6, and 4.2), TB had a significantly larger intraburst frequency than did Yan. The same occurred for small values of $gNaP$ (1.8, 2.4) at higher values of eL (-55). Interestingly at eL = -65 mV, the difference between the TB and Yan values decrease with decreasing g_{NaP}, but at eL=-60 the difference increased with decreasing $gnap$. No significant difference occurred between the models for low values of eL at low values of $gnap$ or at high values of eL with high values of $gnap$.

Intraburst frequency is significantly larger for the TB model at lower values of eL and

Average peak amplitude showed strong model-dependent significant differences(Figure **??**). However, no clear and consistent pattern of increase or decrease occurred, making it difficult to tell if peak amplitude was model-dependent in a meaningful way. Interpeak interval (not pictured) was not model dependent, as no statistically significant difference appeared between time series generated by different models with the same eL and g_{NaP} parameters.



2 Discussion

We added the P2X7 model developed by Yan et al. to the somatic compartment of Toporikova and Butera's intrinsic bursting cell model and simulated the effects of changing eL and g_{NaP} on the activation (bursting?) patterns in the generated time series. This was the first attempt to model an intrinsically bursting preBC neuron with a P2X component.

The uniformity of TCT suggests model and parameter insensitivity. It may be a characteristic of the TB model, for which burst duration and interburst interval appeared to asymptotically approach a value when eL and nap were [unpublished results]. It is interesting to note that the addition of the P2X7 component doesn't significantly effect this trend. Determining if this uniformity is due to the TB model could be tested by adding the P2X7 component to BRS model.

Running BRS model singly and with the P2X7 component in the same parameter space would help further illuminate the effects of To locate the quiescent region, the parameter space needs to be extended. Primarily, the cell needs to be further depolarized by decreasing eL. Additionally, testing more values within current parameter space will help establish trends more securely.

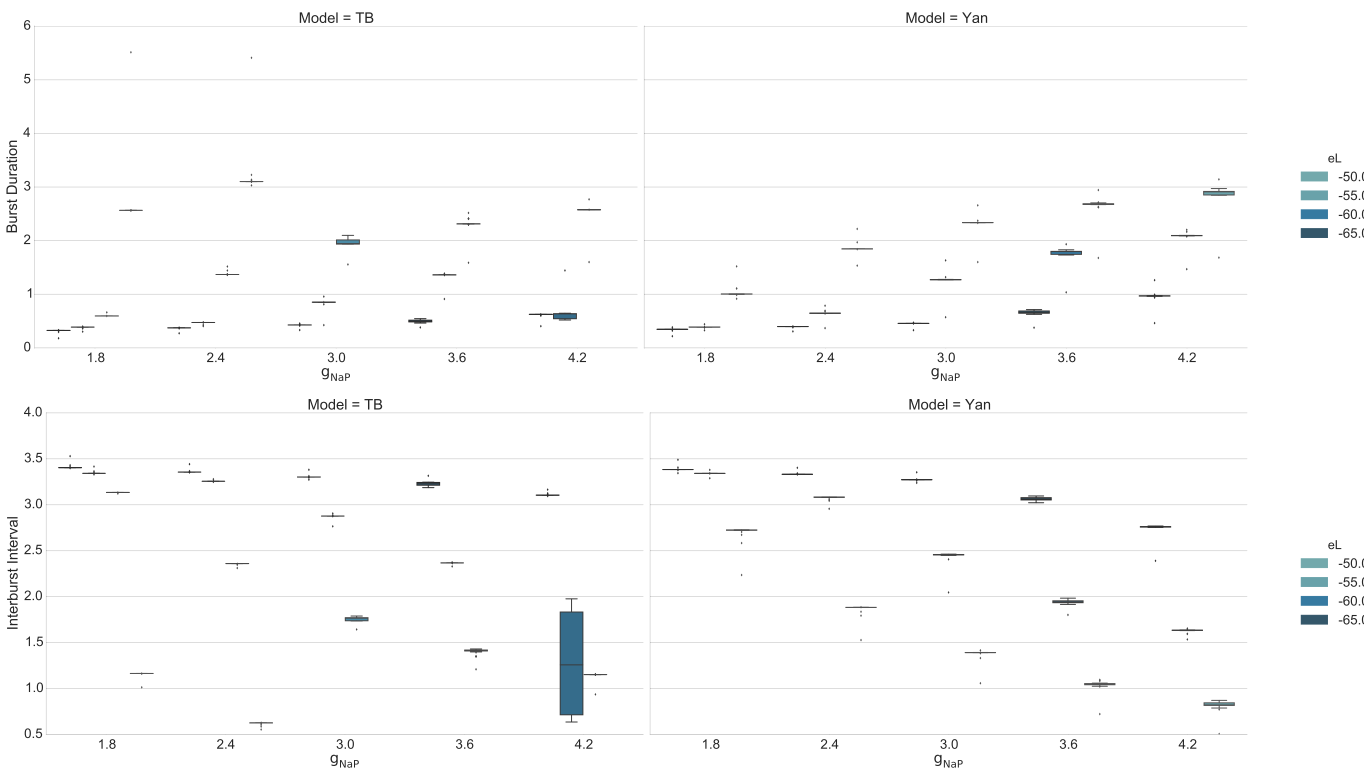
A valid critique of the current set of time series is that each run contains little more than 80 bursts, however, burst structure changes little with time, so this may be unnecessary.

Also, P2X7 causes an influx of Ca_{+2} which was not included in the TB+Yan model

PpB were probably parameter dependent within a model,

3 Abstract

We extend the Toporikova-Butera model with a P2X7 model from [Yan] and compare their response to changes in eL () and g_{NaP} (). We expect..... We find... Total cycle time was insensitive to changes in eL and g_{NaP} and model, while burst duration and interburst interval was sensitive to changes in all 3.


Model = TB
Model = Yan
Burst Duration
g_{NaP}
Model = TB
Model = Yan
Interburst Interval
g_{NaP}
eL
-50.0
-55.0
-60.0
-65.0