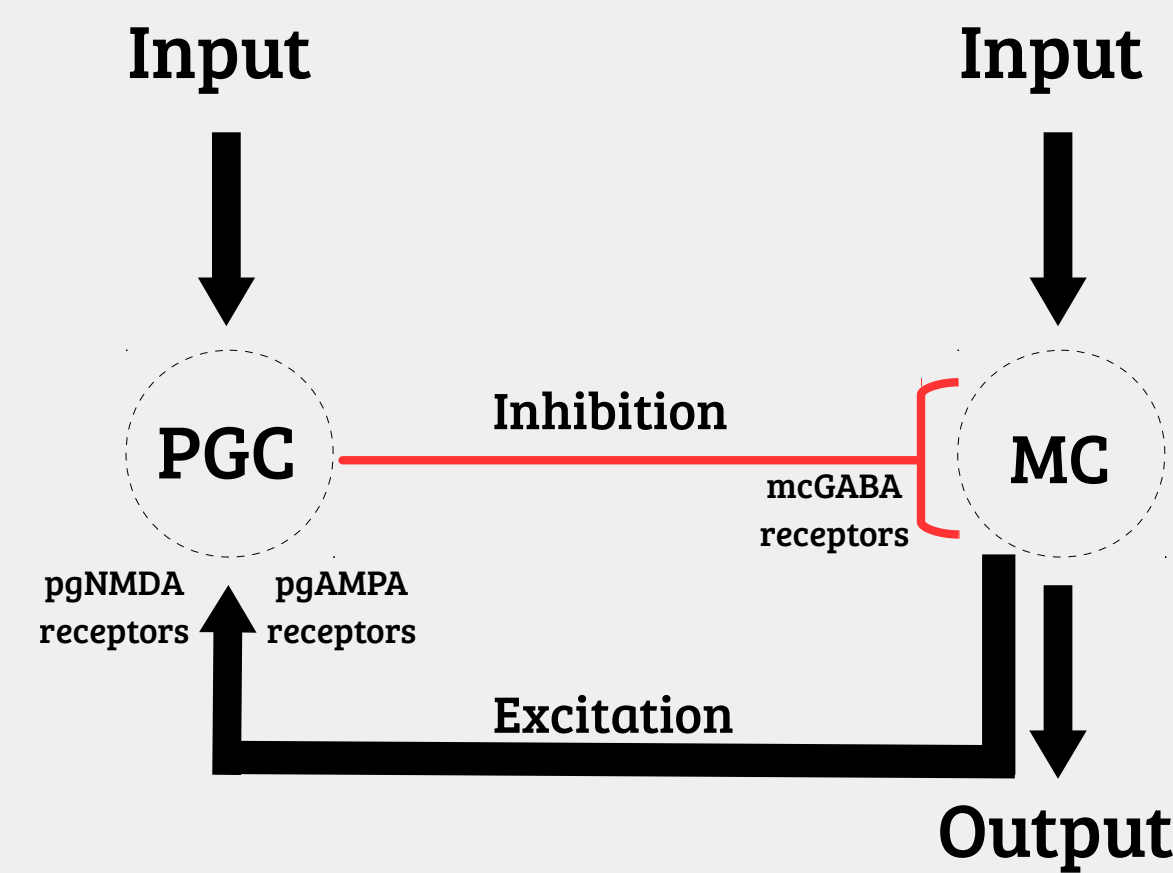


Introduction

- Recent studies show that the structure of odour stimuli contains information about the olfactory scene [2, 4].
- We investigated whether mitral cells (MCs) in the OB show frequency tuning and, if they do, how different components of the glomerular layer circuitry shape and determine the tuning.

Model



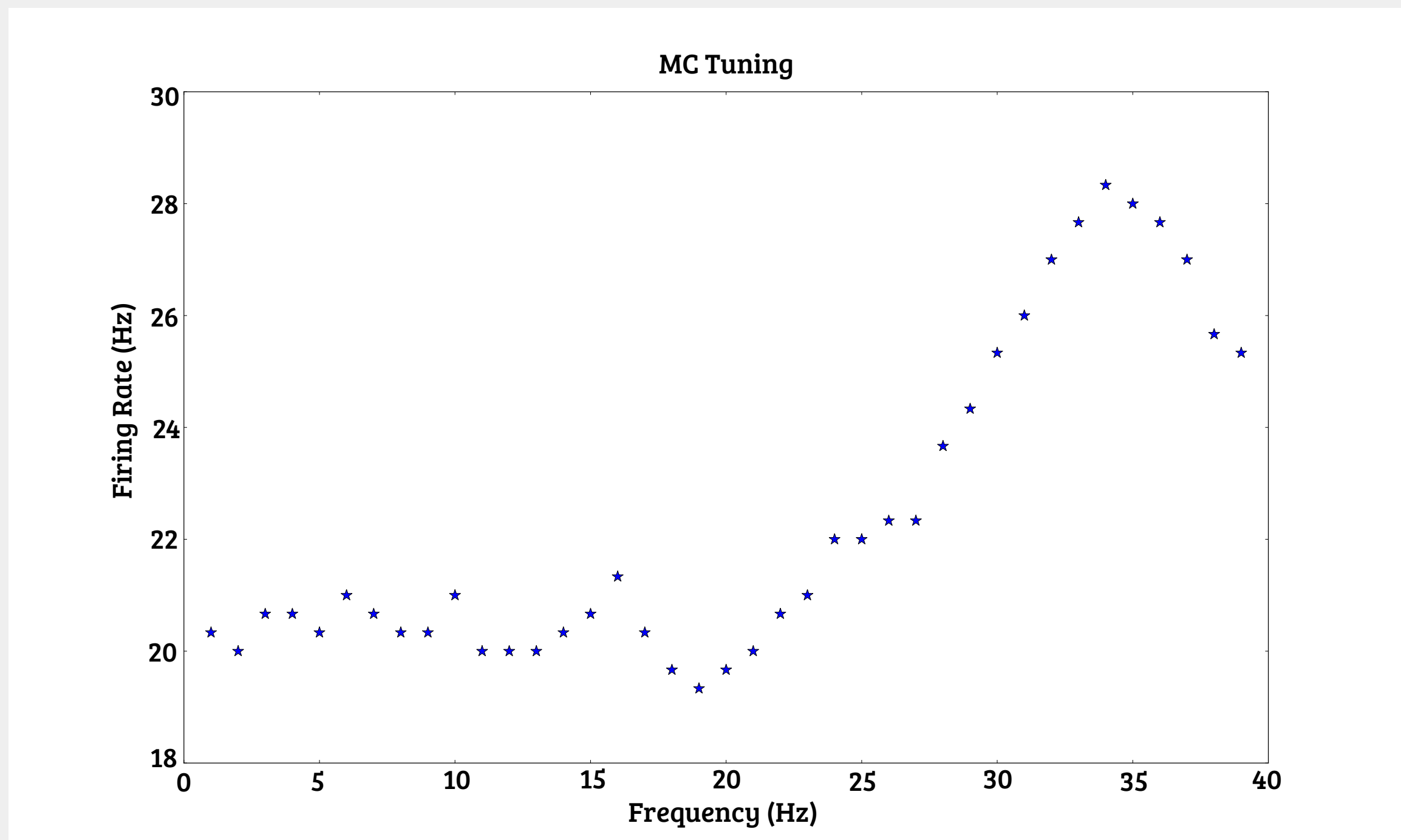
- We used a model of the OB (modified from [3]).
- Modeled MC - PGC (periglomerular cells), focusing on recurrent and feed - forward inhibition in the glomerular layer.

Method

- Parameter combinations: PGC input strength, MC - PGC excitation strength and PGC - MC inhibition strength.
- We used sinusoidal currents of varying frequencies as input, using the equation:
$$y(t) = c \cdot \sin(2 \cdot \pi \cdot f t + \varphi) + 0.18$$
- Where strength of input to MC (c) = 0.45nA and phase (φ) = 0.
- PGC input is defined as $i \cdot c$, where i is the PGC input factor.

Parameter	Iteration Values				
PGC Input Factor (i)	0.2	0.3	0.4	0.5	0.6
MC - PGC excitation strength (W_{exc})	2.0	4.0	6.0	8.0	10.0
PGC - MC inhibition strength (W_{inh})	1.0	2.0	3.0	4.0	5.0
Frequency (f)	1.0, 2.0, 3.0, ... , 40.0				

- Constructed frequency tuning curves (fig2) and then extracted the peak resonance frequency (fig 3).



- Extracted the resonance strength of the tuning Q (fig 4), measured as:

$$Q = \frac{(F_{max} - F_{min})}{\langle F \rangle}$$

- F_{max} and F_{min} are maximum and minimum firing rate.
- $\langle F \rangle$ is mean firing rate over all measured frequencies.

Acknowledgements

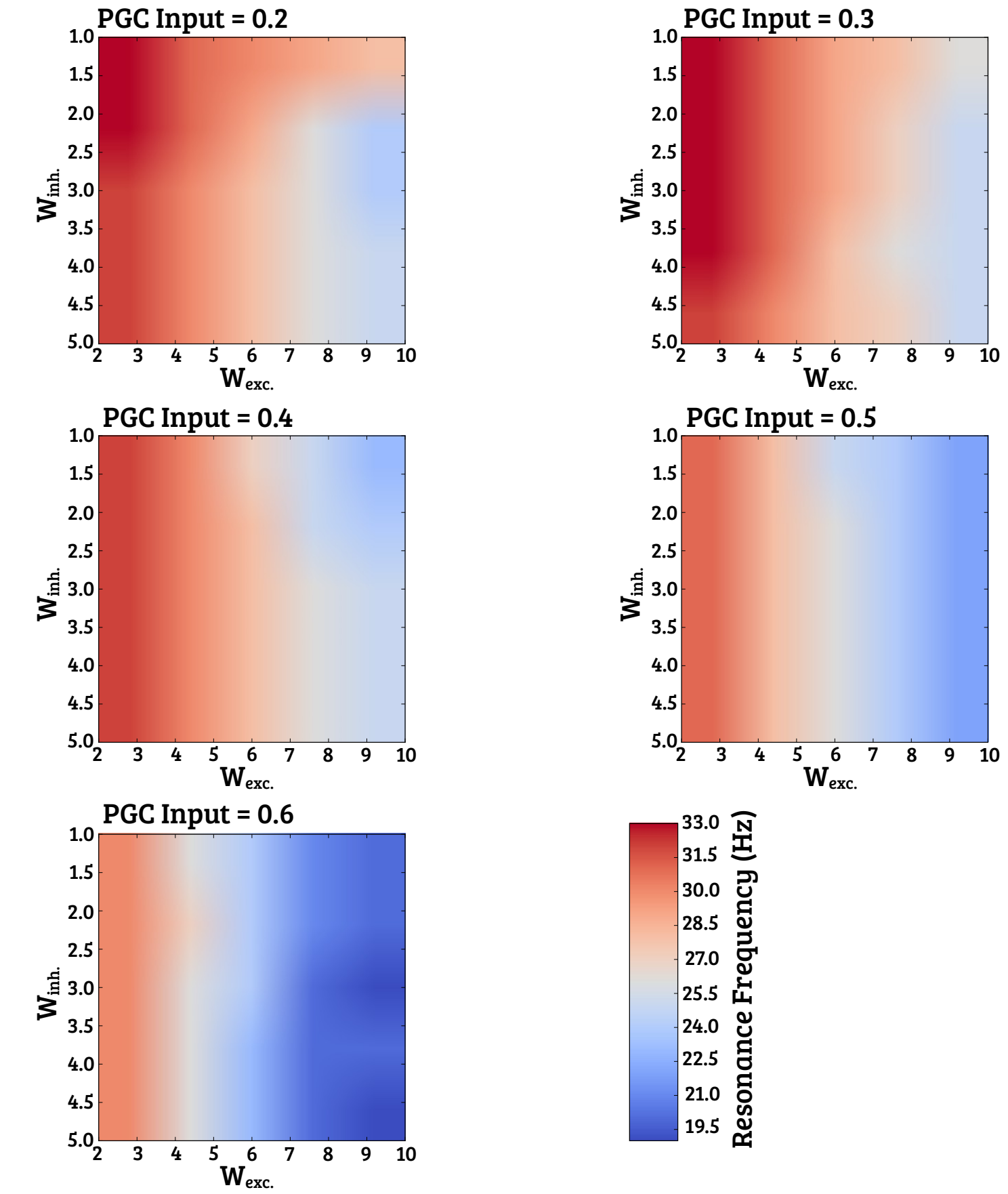
We thank Michael Schmuker for comments and support.

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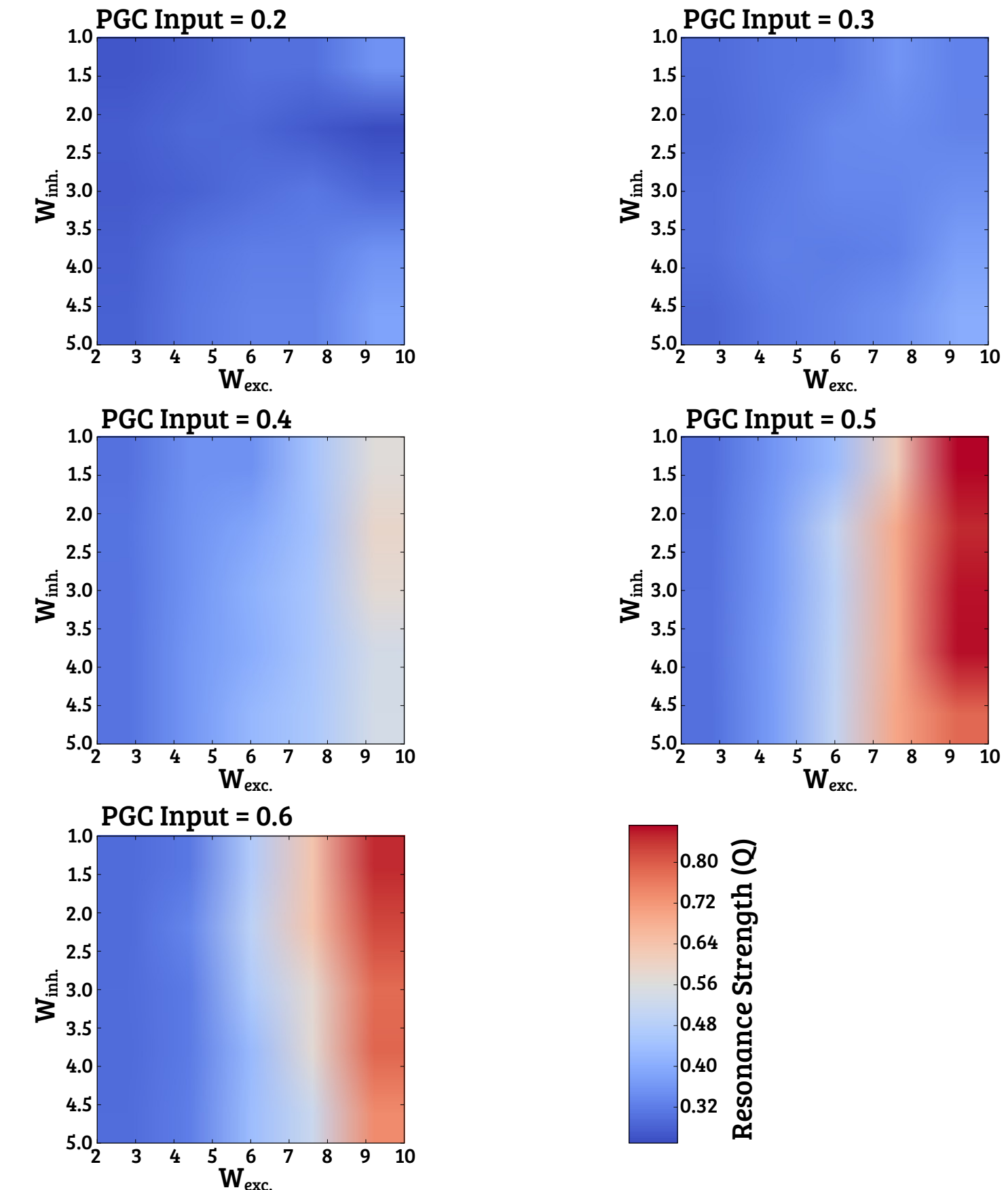
Results

Resonance Frequency of Tuning Curves



- Resonance frequency decreased as the excitation of the PGC increased (both from input and the MC).
- Strength of PGC inhibition onto the MC did not have a strong effect.

Resonance Strength (Q) of the Tuning Curves



- Resonance strength increased with the strength of the excitatory connection, when the PGC received sufficient external input.

Conclusion

- Our results suggest that MCs can show frequency tuning in the presence of sufficiently strong excitatory connections between MCs and PGCs, which provide feedback inhibition to the MCs.
- Therefore, the OB might be able to detect the frequency composition of signals.
- This could be used for olfactory scene analysis.
- However, we only see tuning in a narrow frequency range.