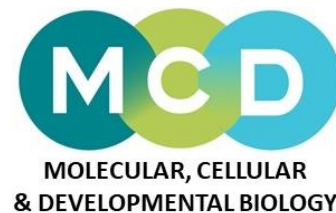


Modelling ants' visuo-motor circuits

Océane Dauzere-Peres

Filipe Pinto Teixeira

Antoine Wystrach

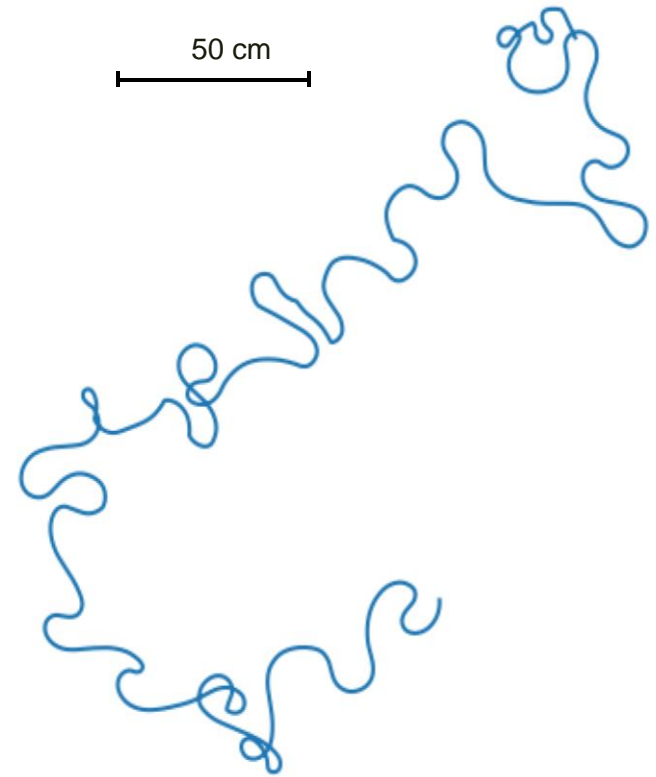


Ants oscillate while walking



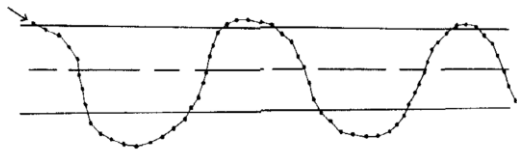
Cataglyphis velox

50 cm



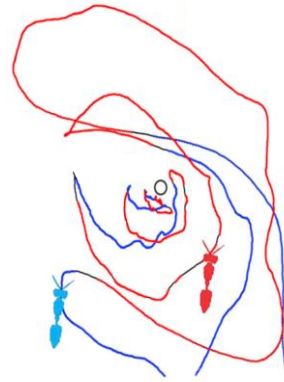
Oscillations are present in a lot of different species :

❖ Silkmoths



(L.P.S. Kuenen & T.C. Baker)

❖ Wasps



(Stürzl et al., 2016)

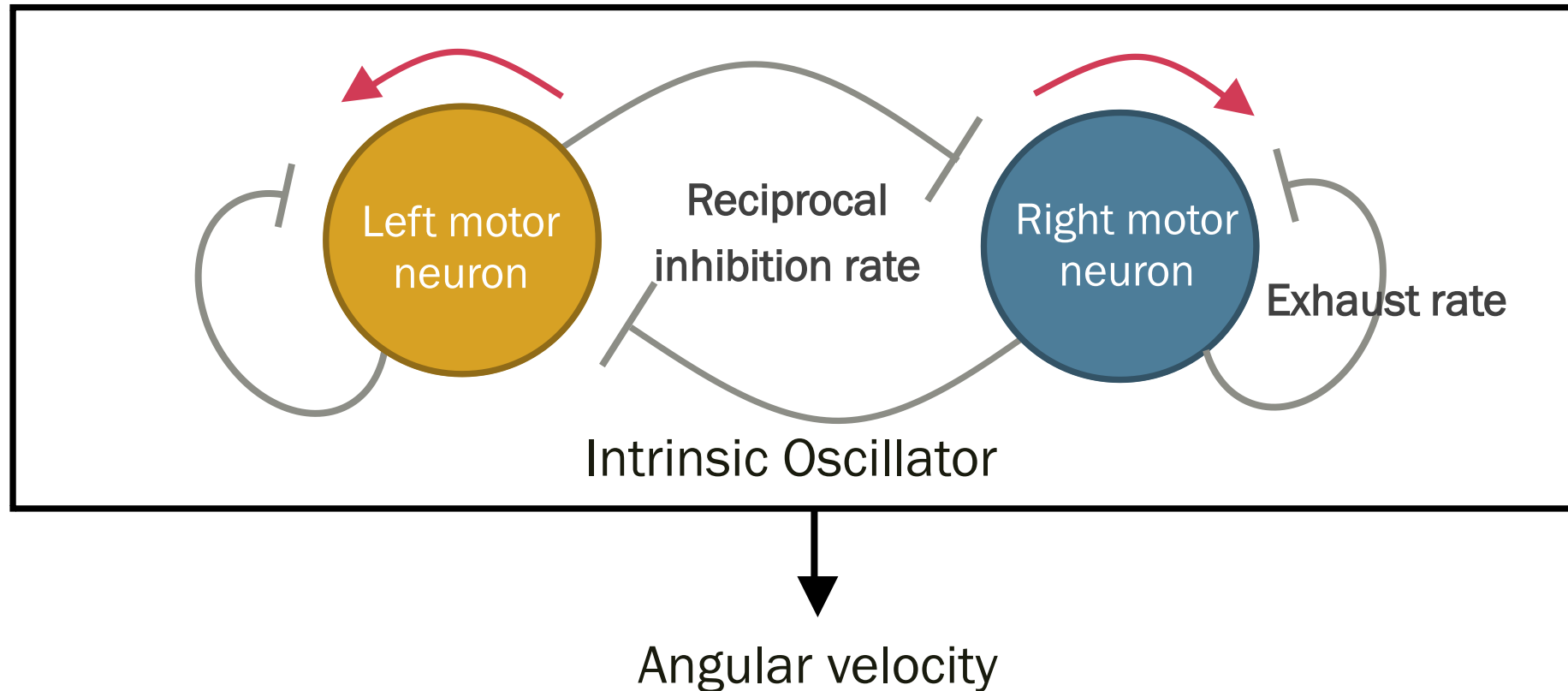
❖ Fruit flies larvae

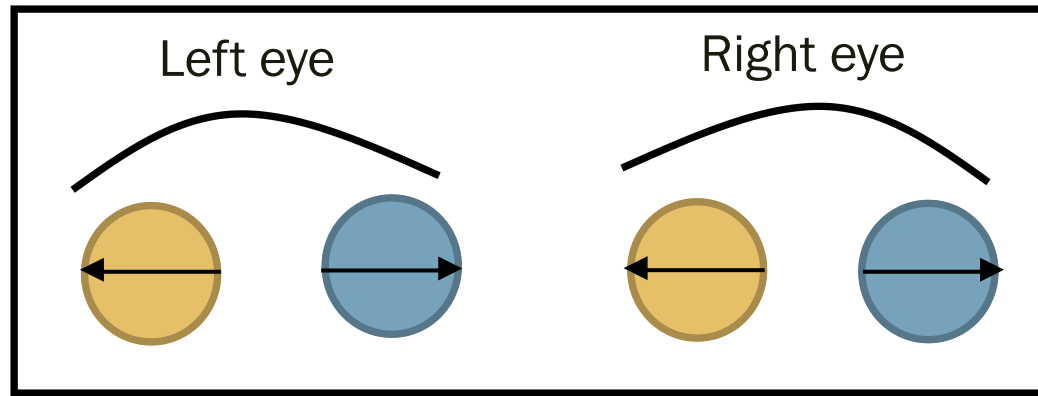


(Wystrach et al., 2016)

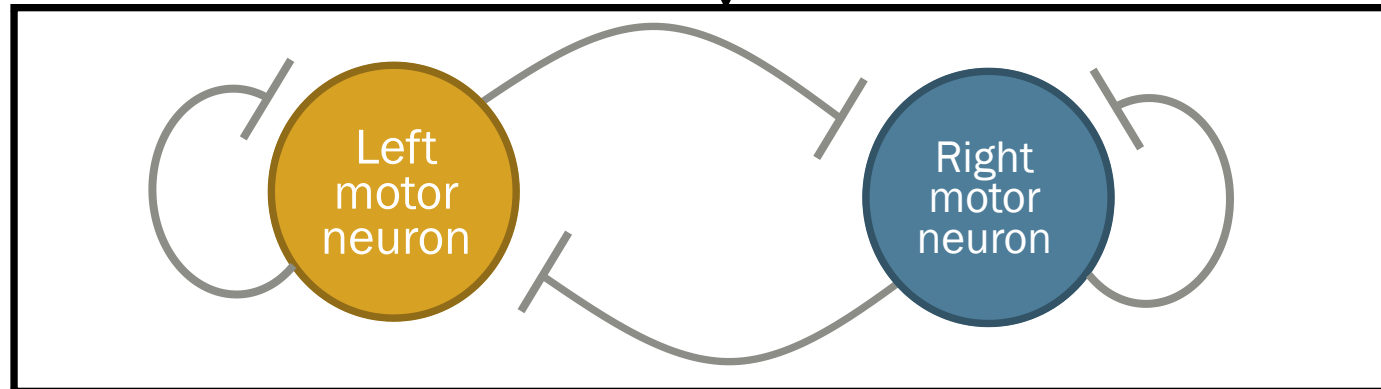
Intrinsic oscillator in the **lateral accessory lobe (LAL)** of insects' brain

(Iwano et al., 2010, Namiki & Kanzaki, 2016, Namiki et al., 2014, Steinbeck et al., 2020)



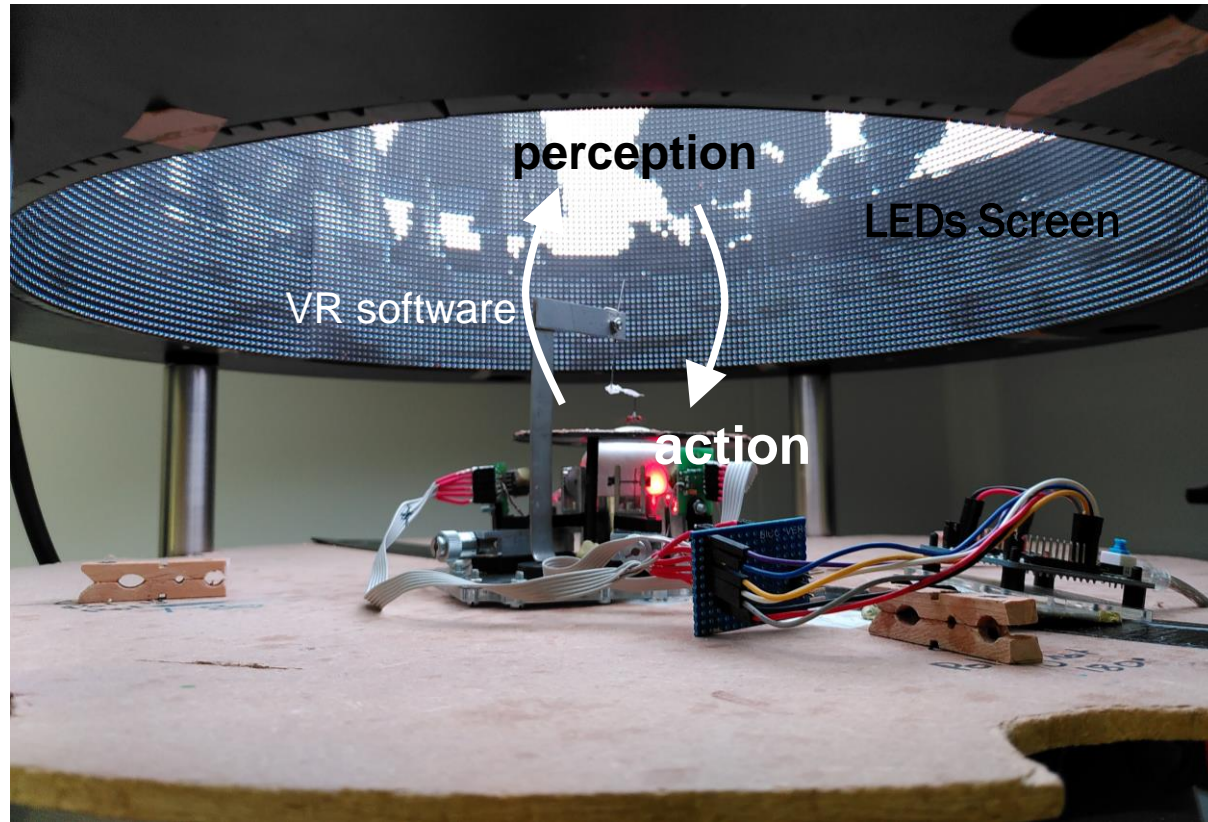


?

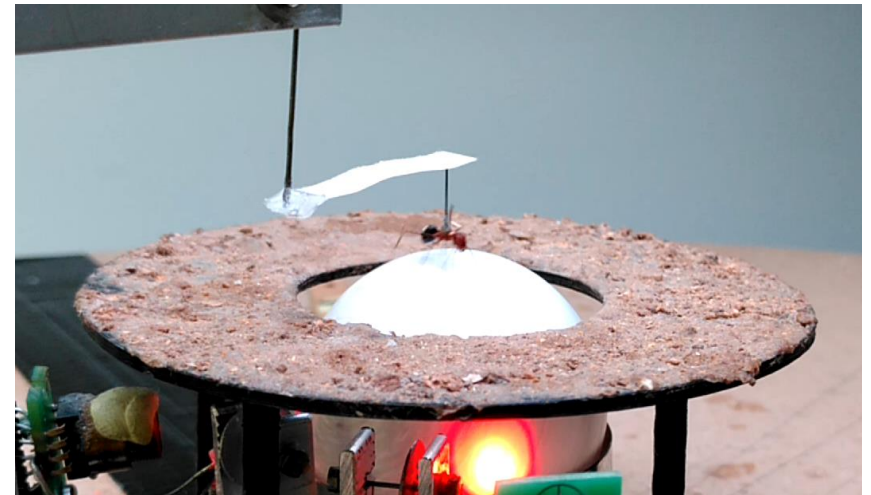


Angular velocity

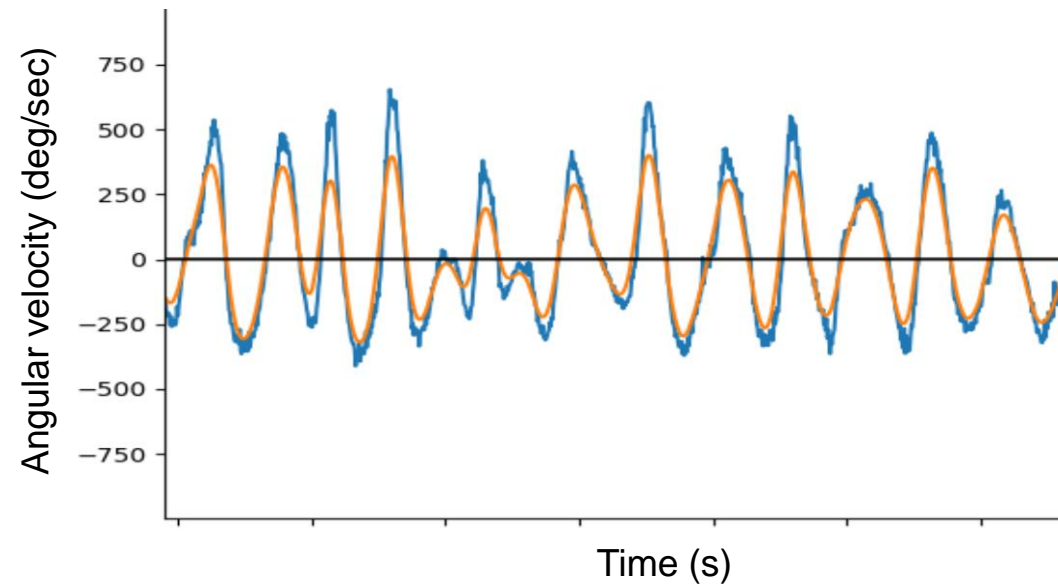
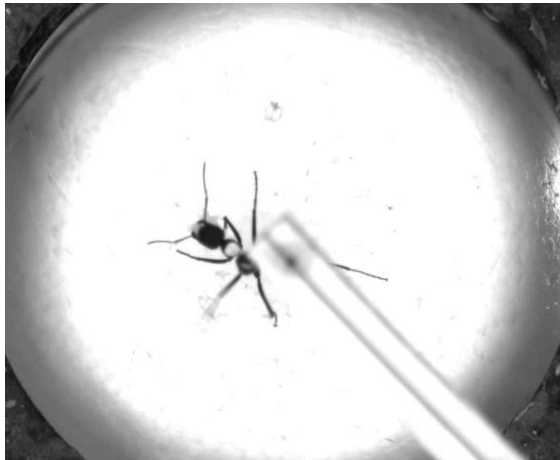
Virtual Reality set-up



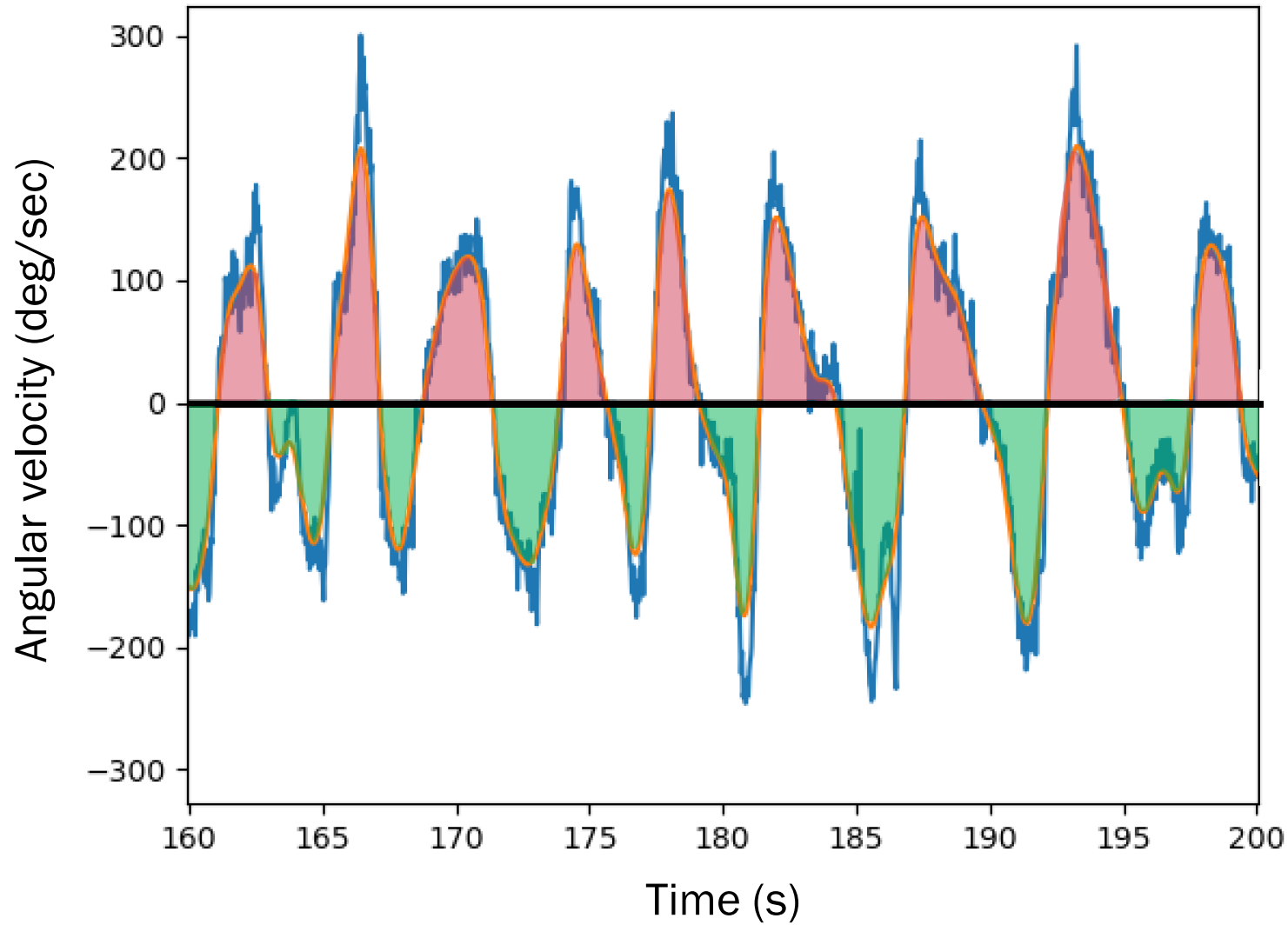
Trackball



Virtual Reality set-up

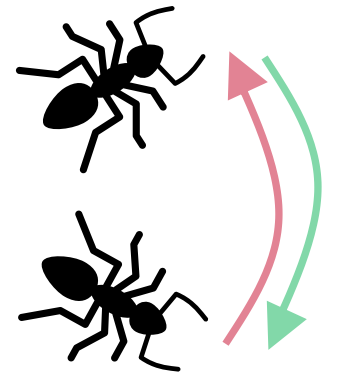


Angular velocity signals

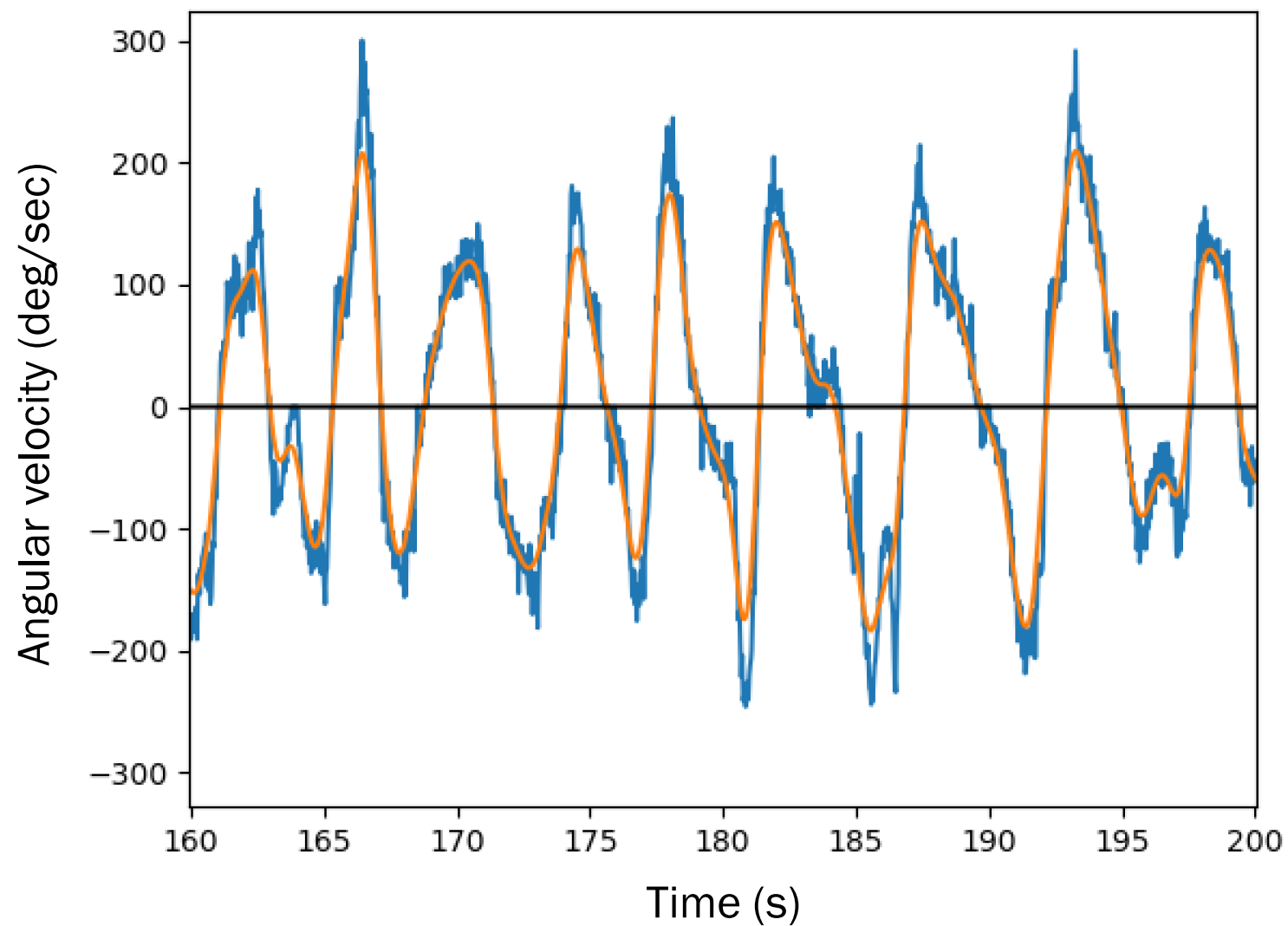


Left turn

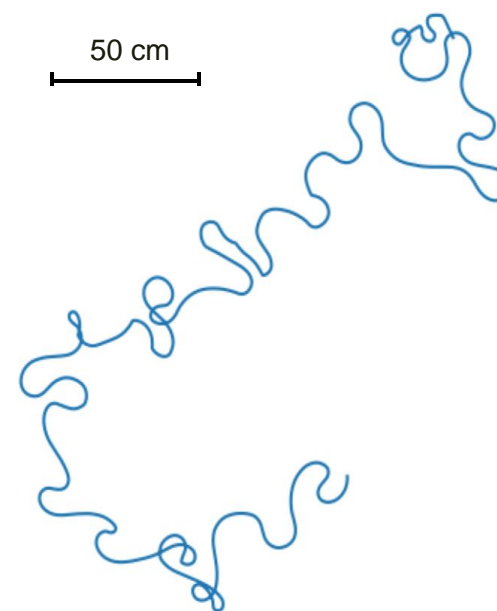
Right turn



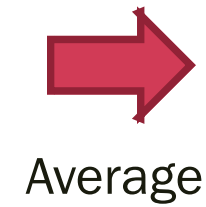
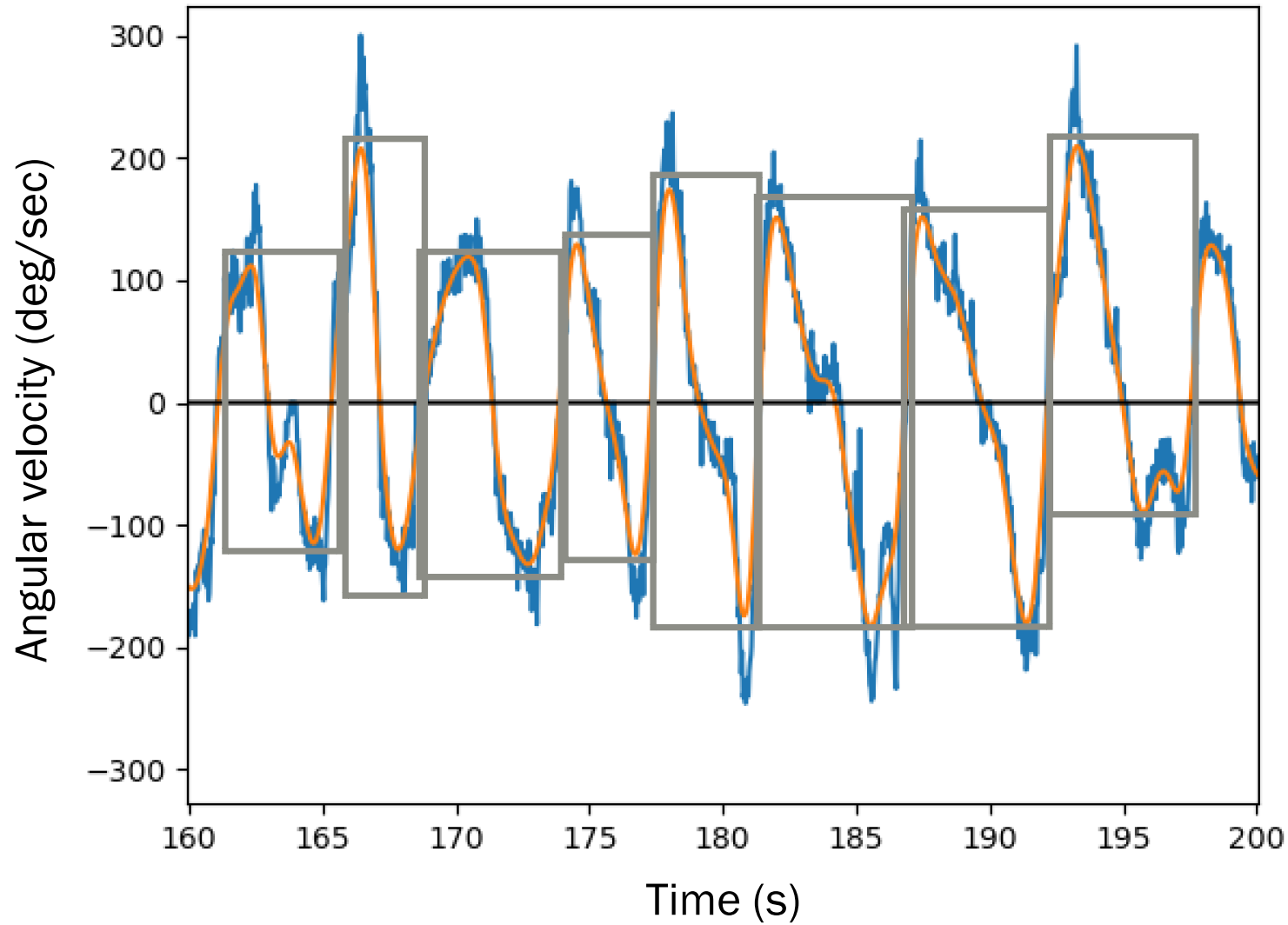
Angular velocity signals



Virtual trajectory

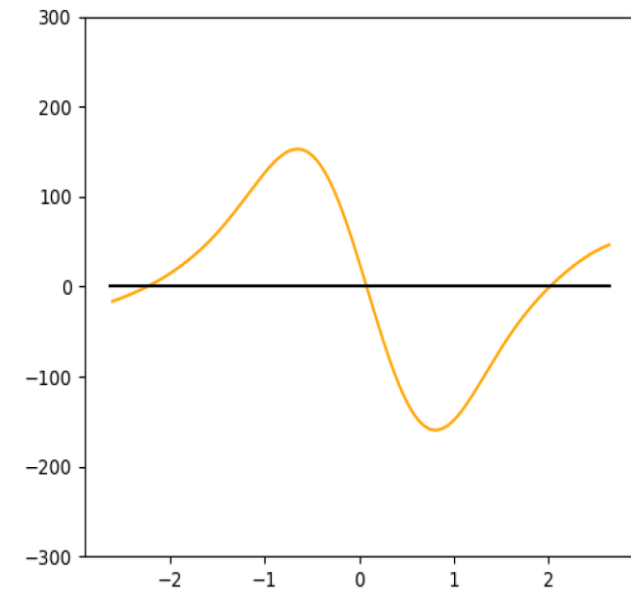


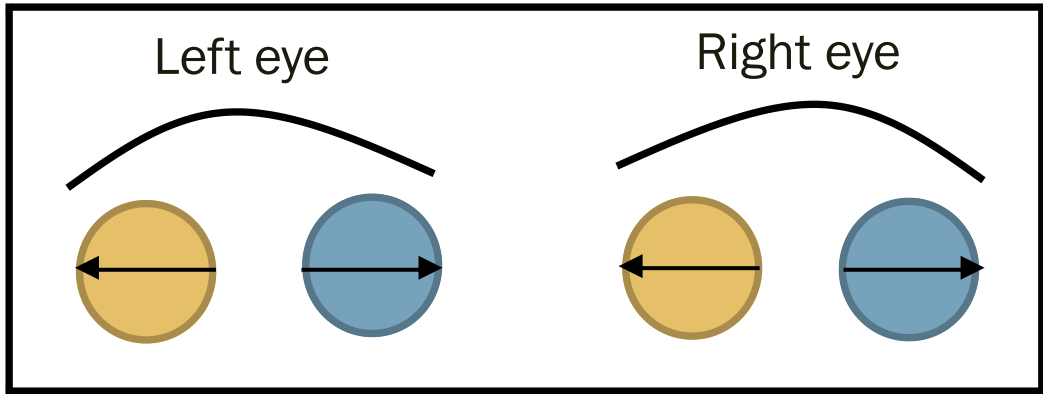
Angular velocity signals



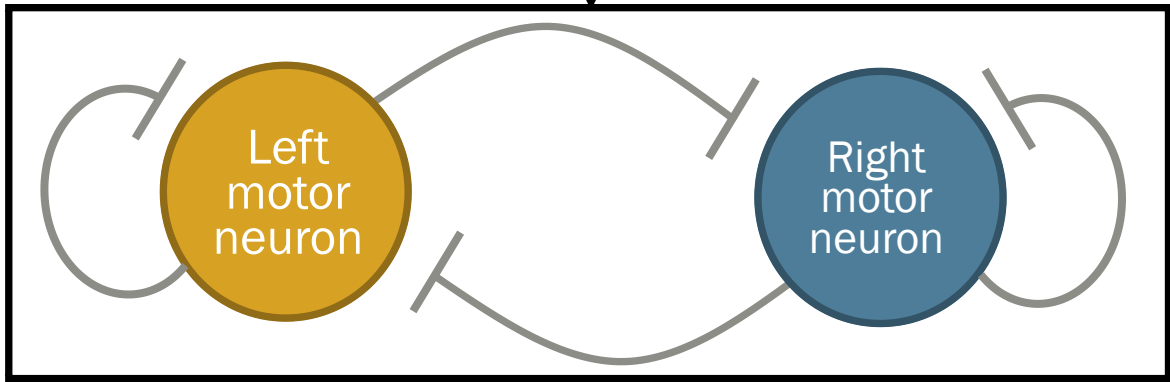
Average

Mean oscillation cycle

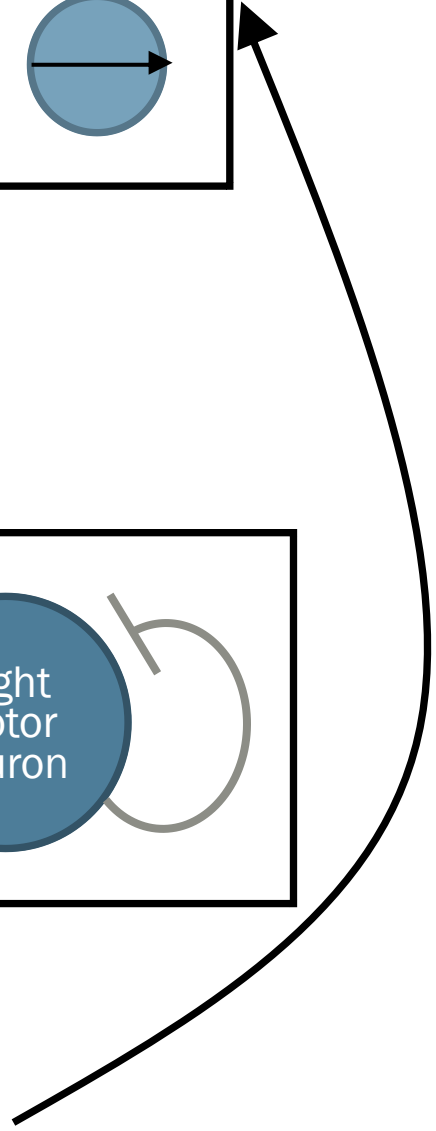


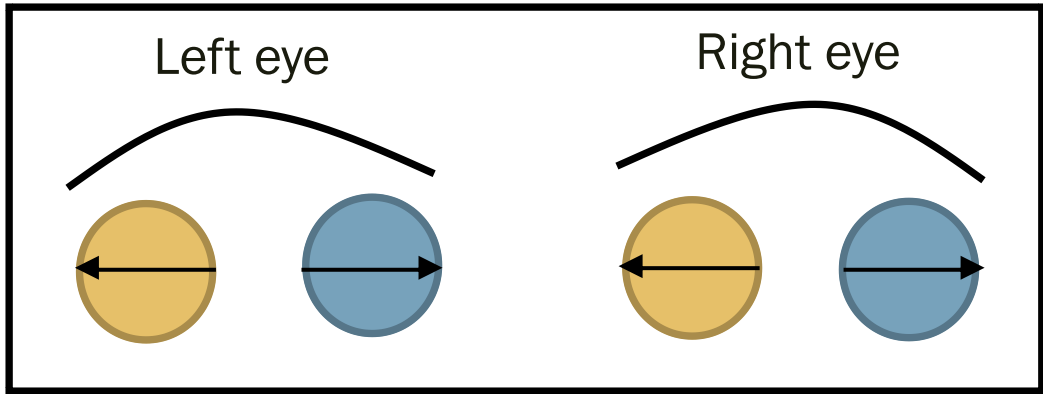


?

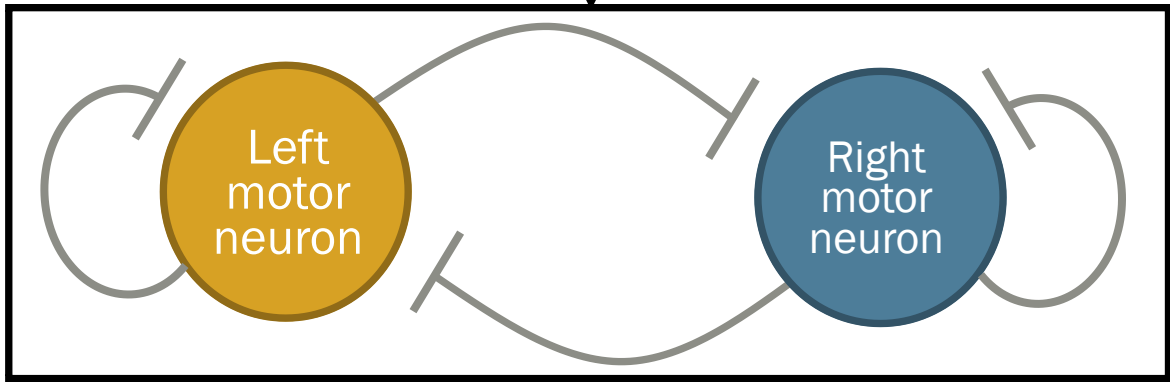


Angular velocity





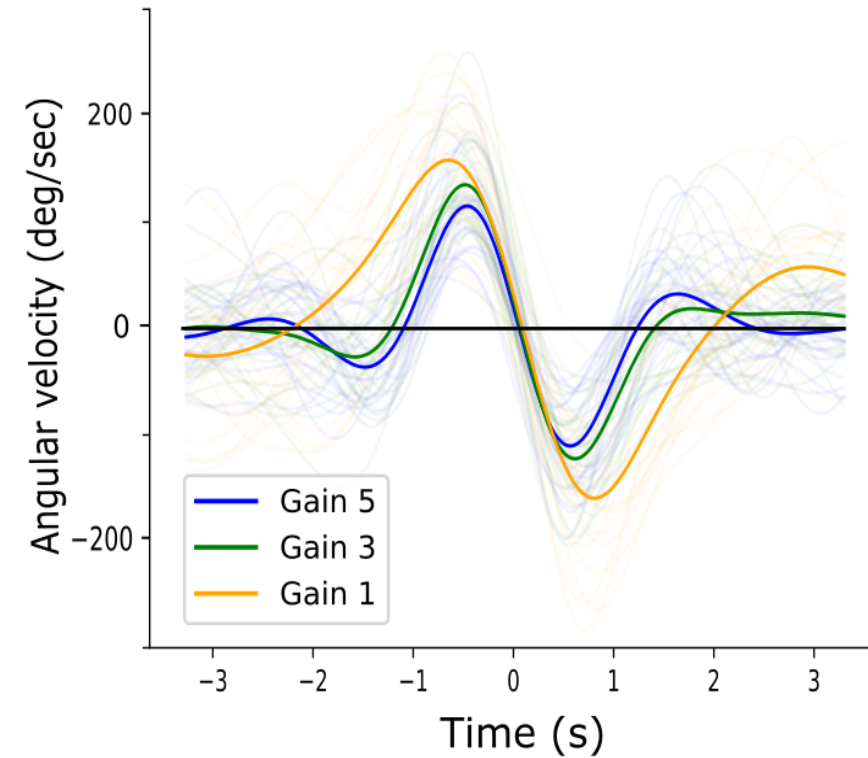
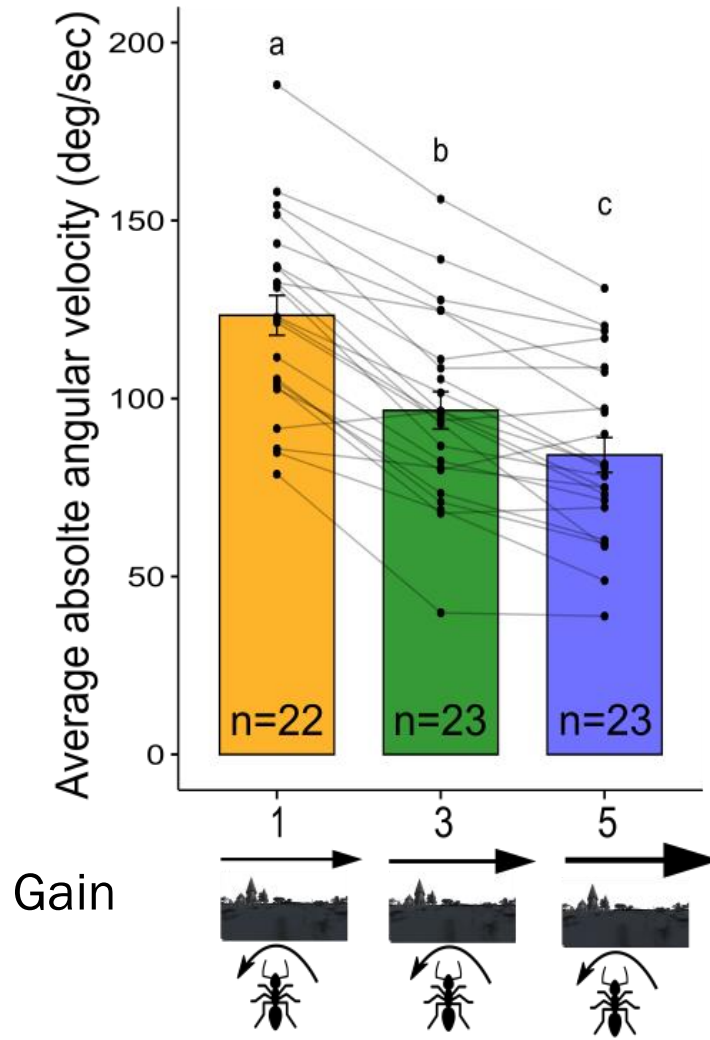
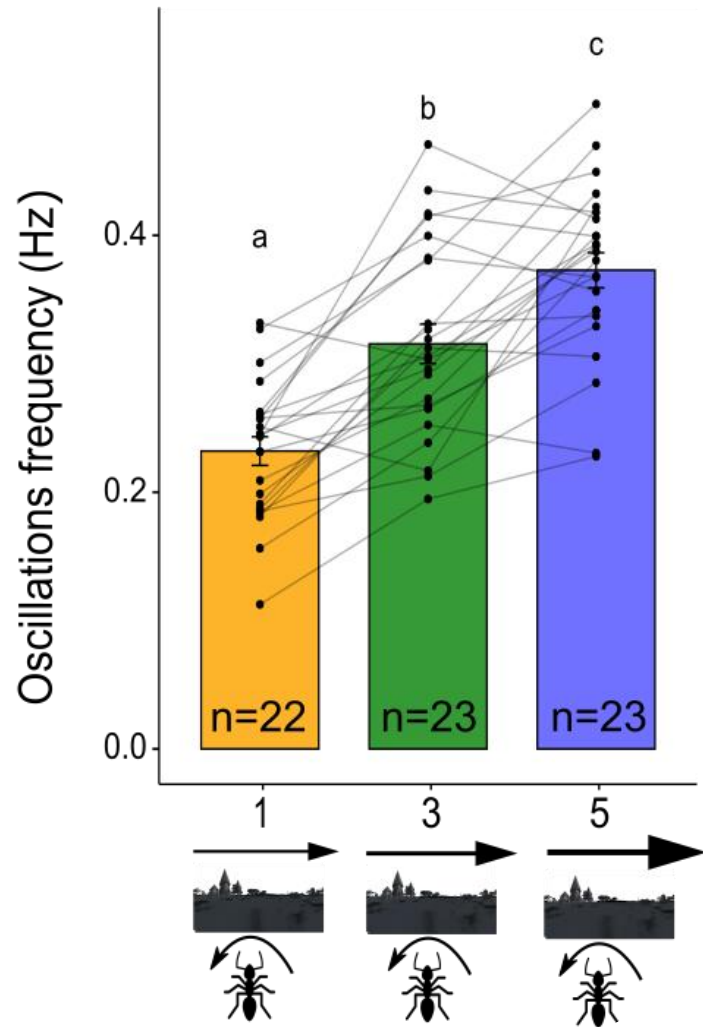
?



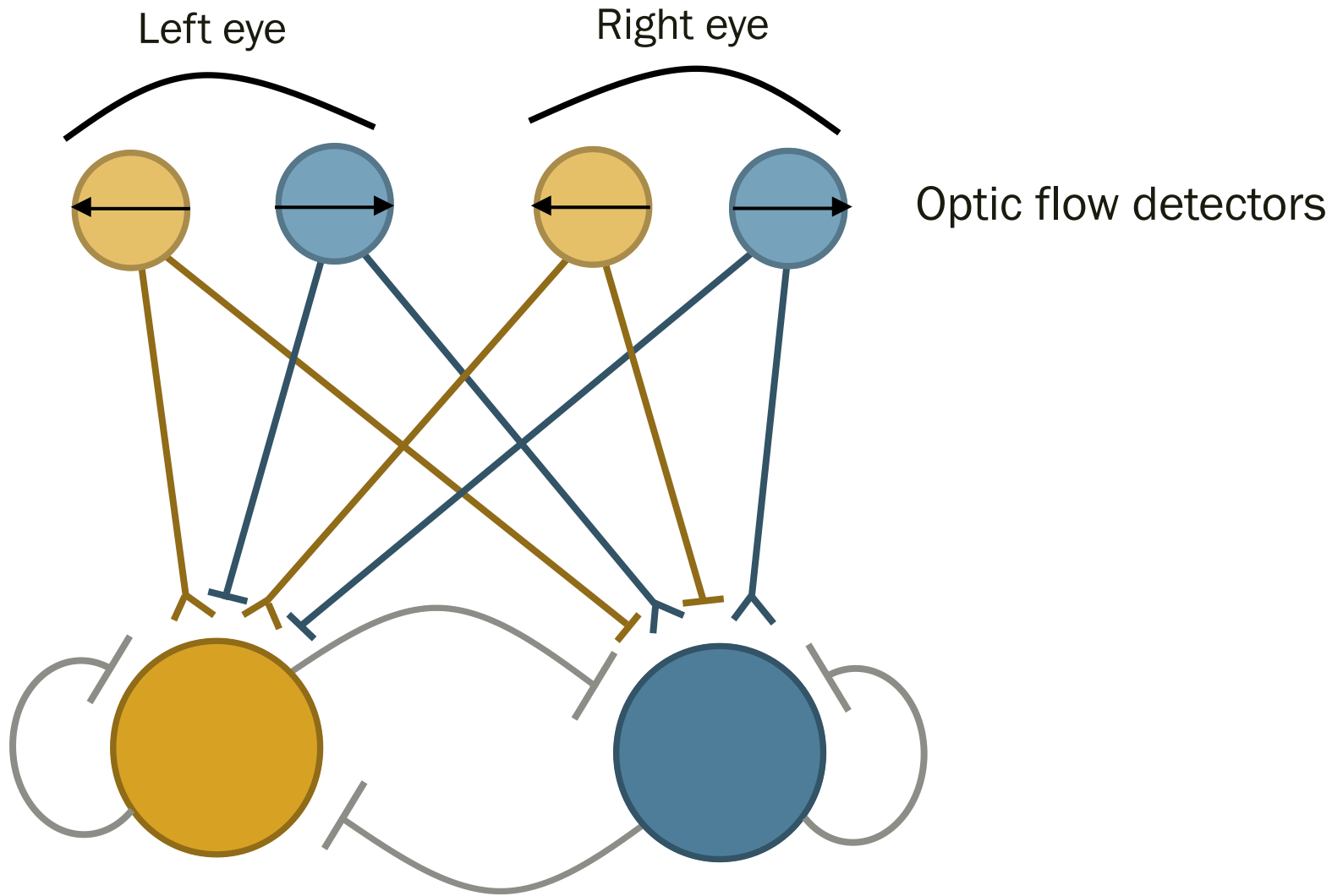
Angular velocity

x GAIN

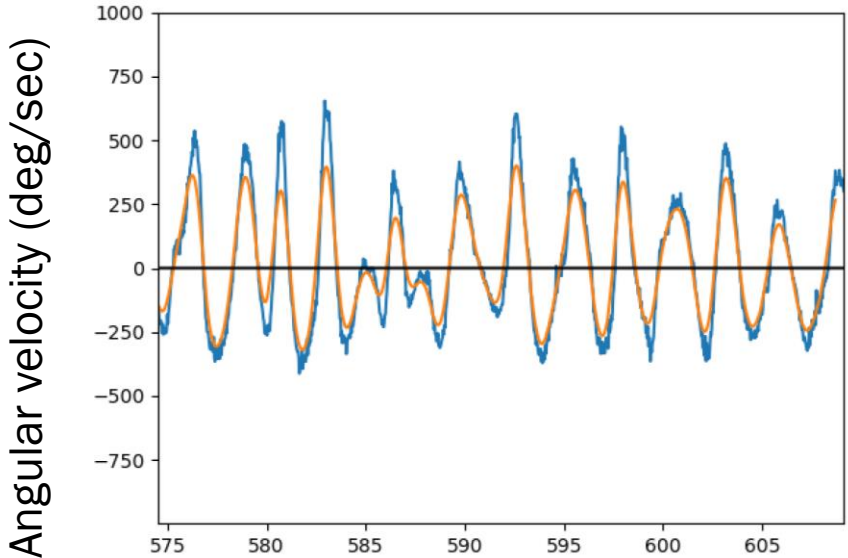
Oscillations are affected by optic flow



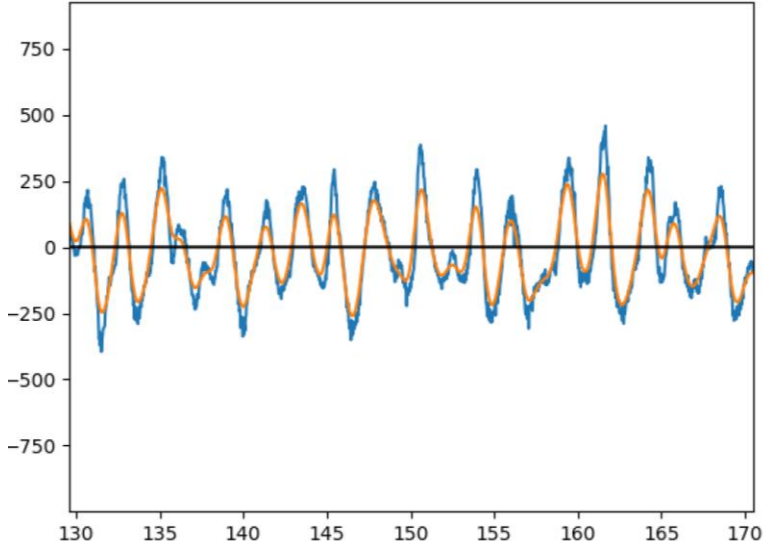
More optic flow = smaller turns



Ants' signals

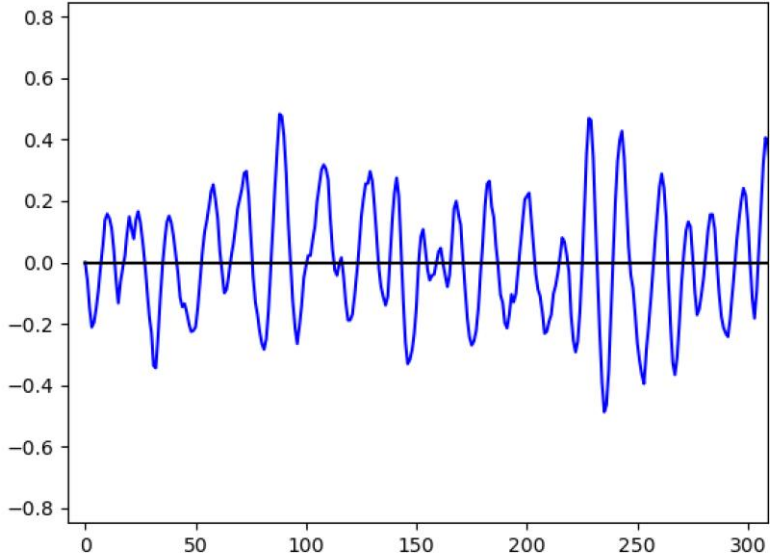
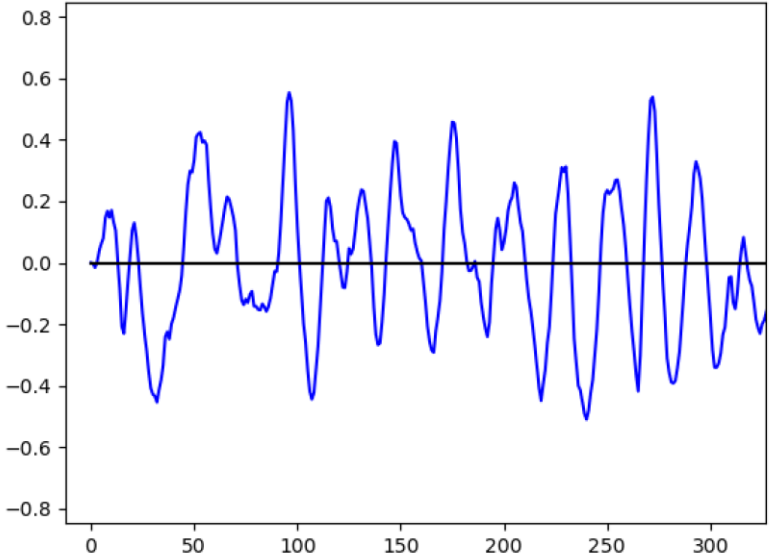


Gain 1

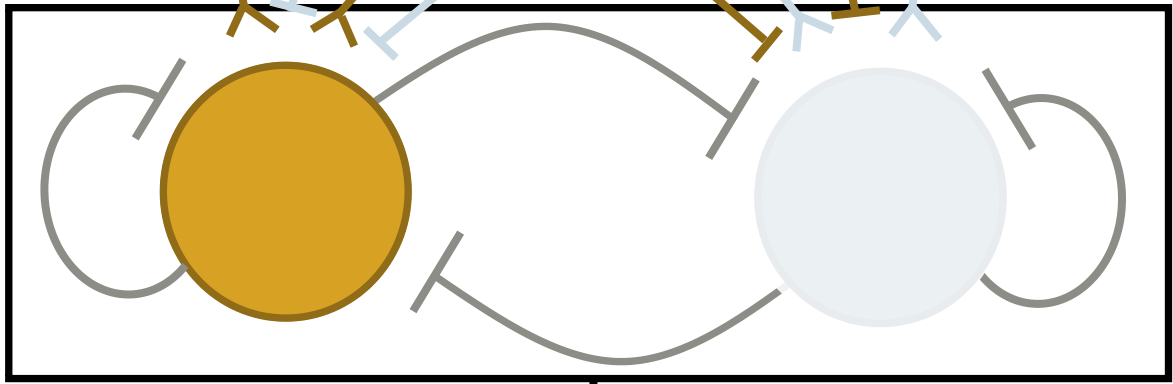
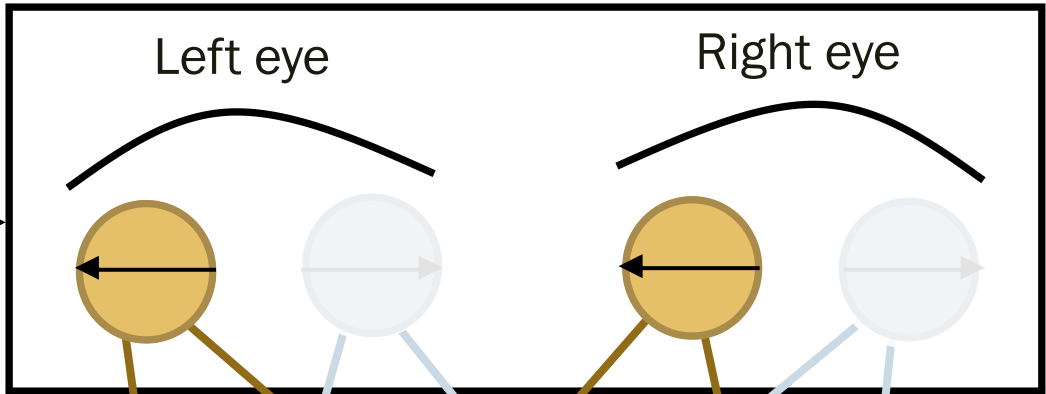


Gain 5

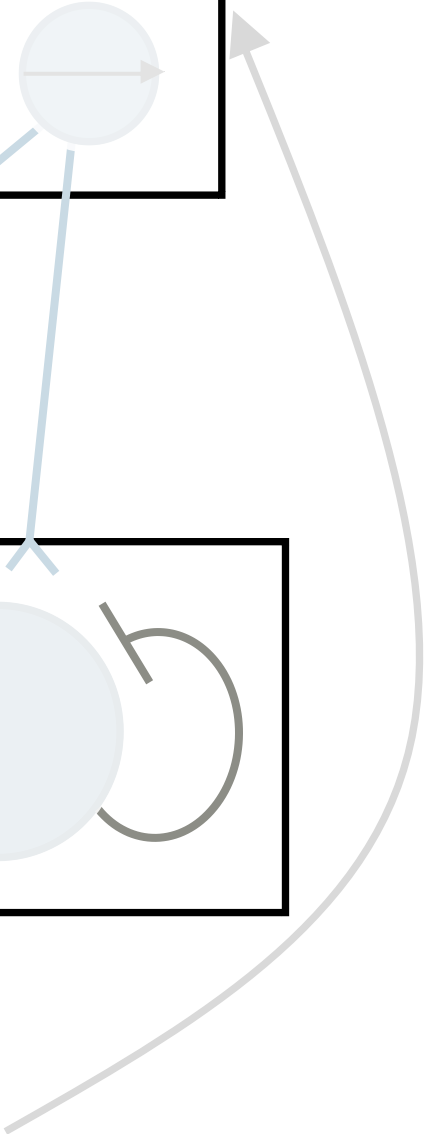
Model simulations



External rotation



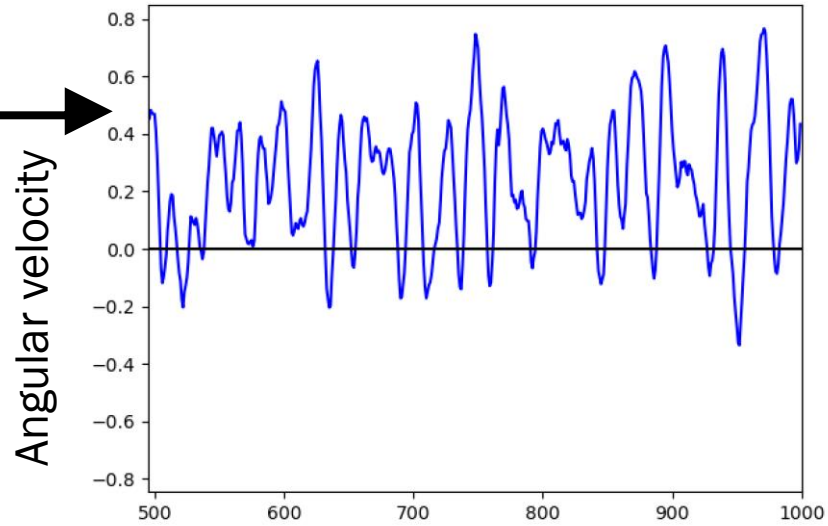
Angular velocity



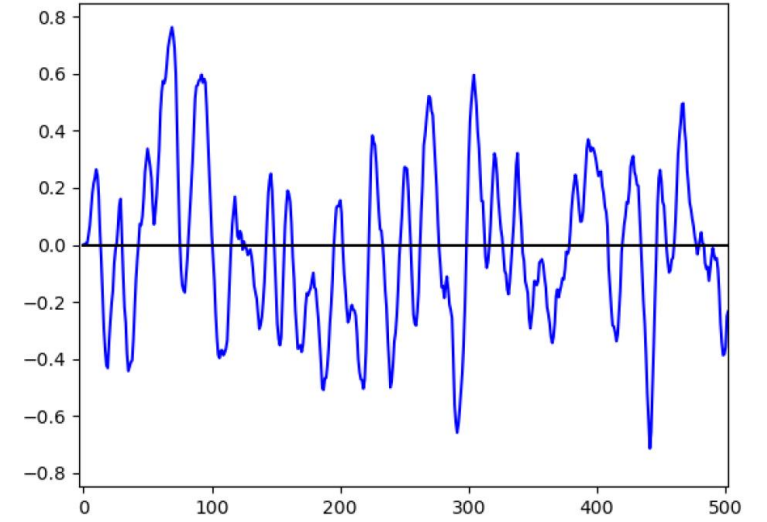
x GAIN

Model predictions

External rotation



Left external rotation
(Gain 0)

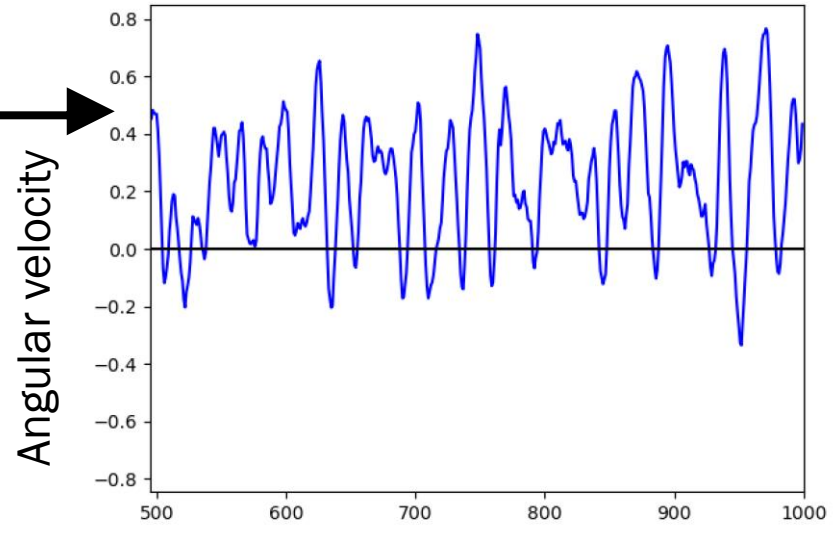


No rotation
(Gain 0)

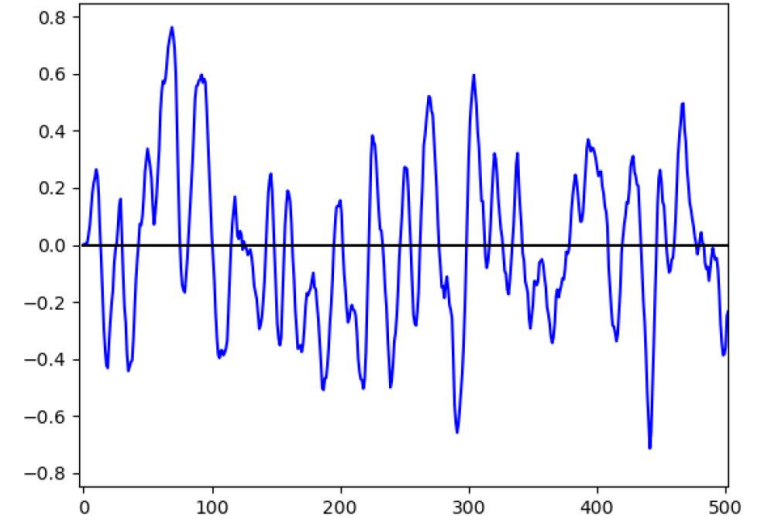
External rotation



Model predictions

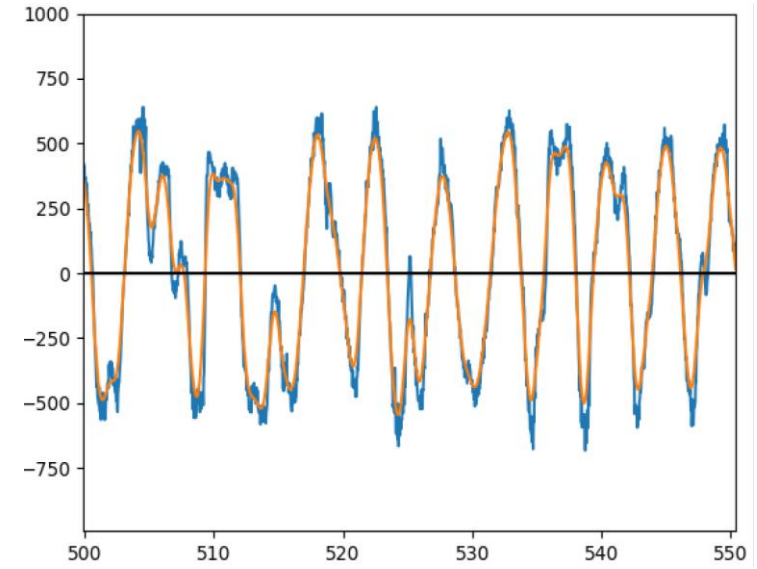
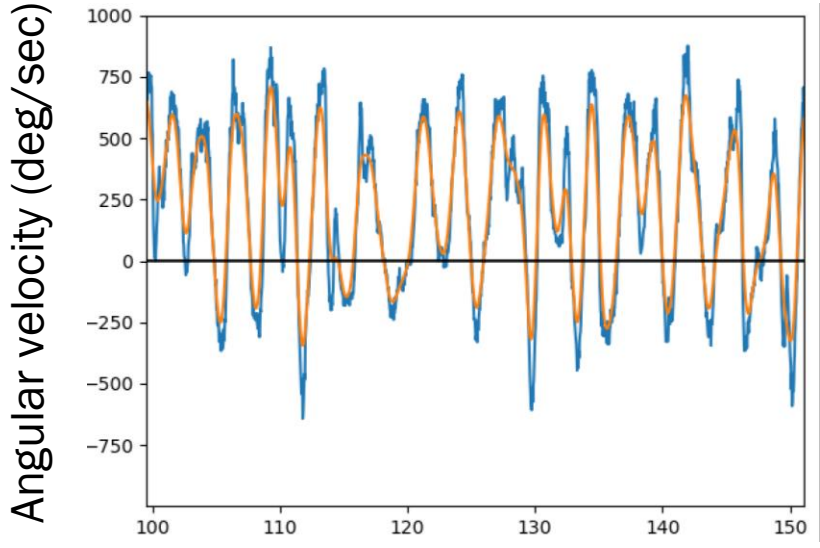


Left external rotation
(Gain 0)

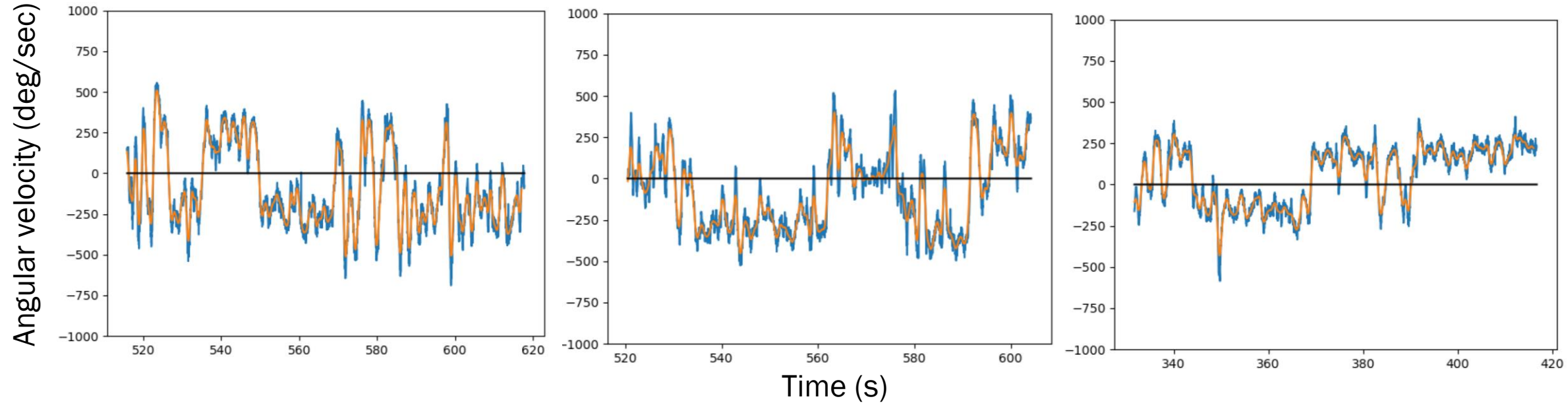


Ants' signals

No rotation
(Gain 0)

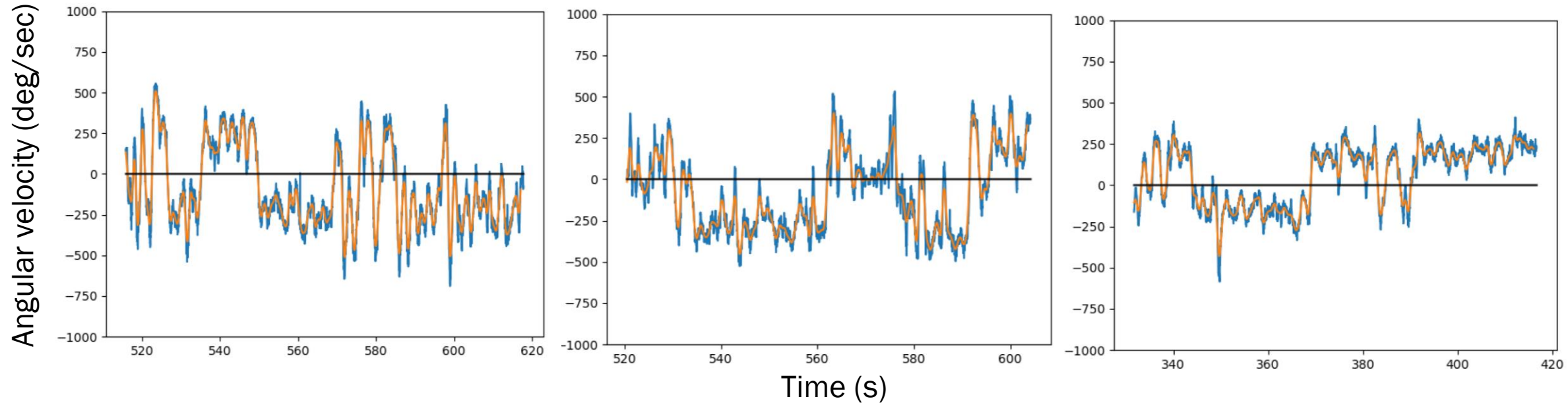


Gain 0

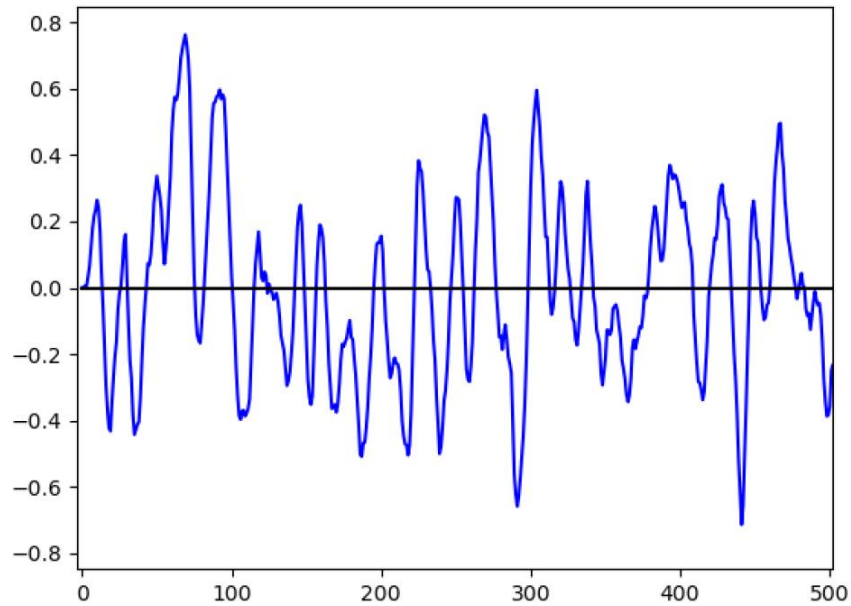


→ Ants can get stuck turning on the same side

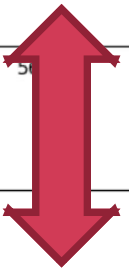
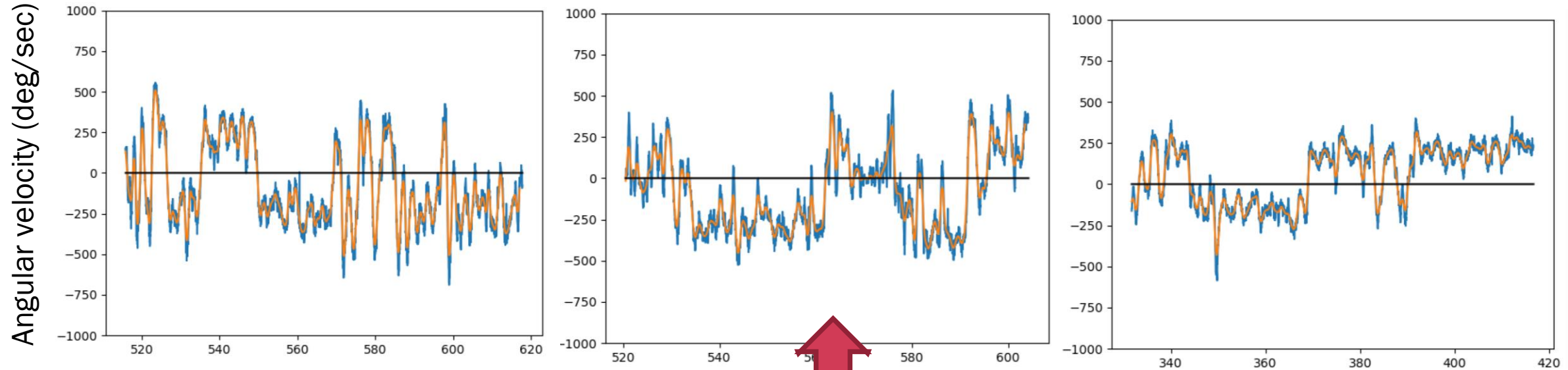
Gain 0



Model's prediction

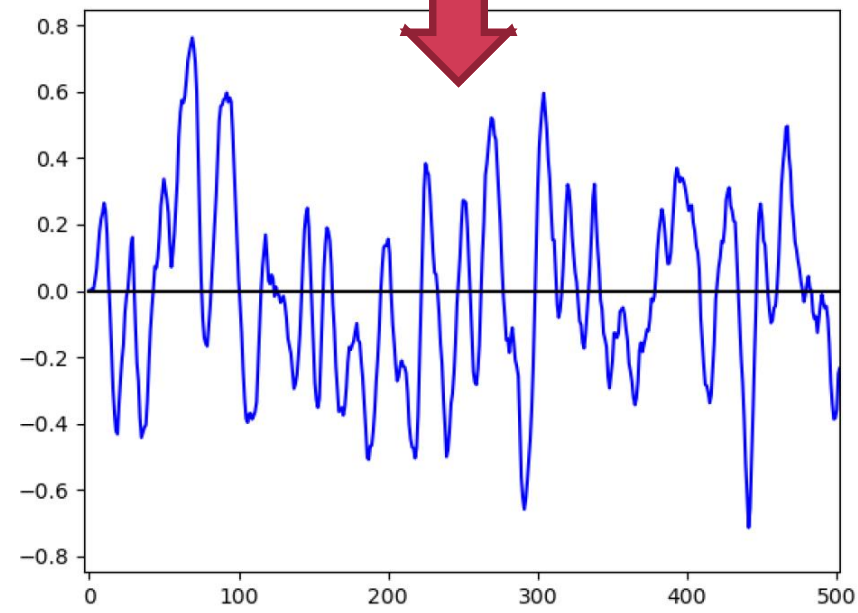


Gain 0

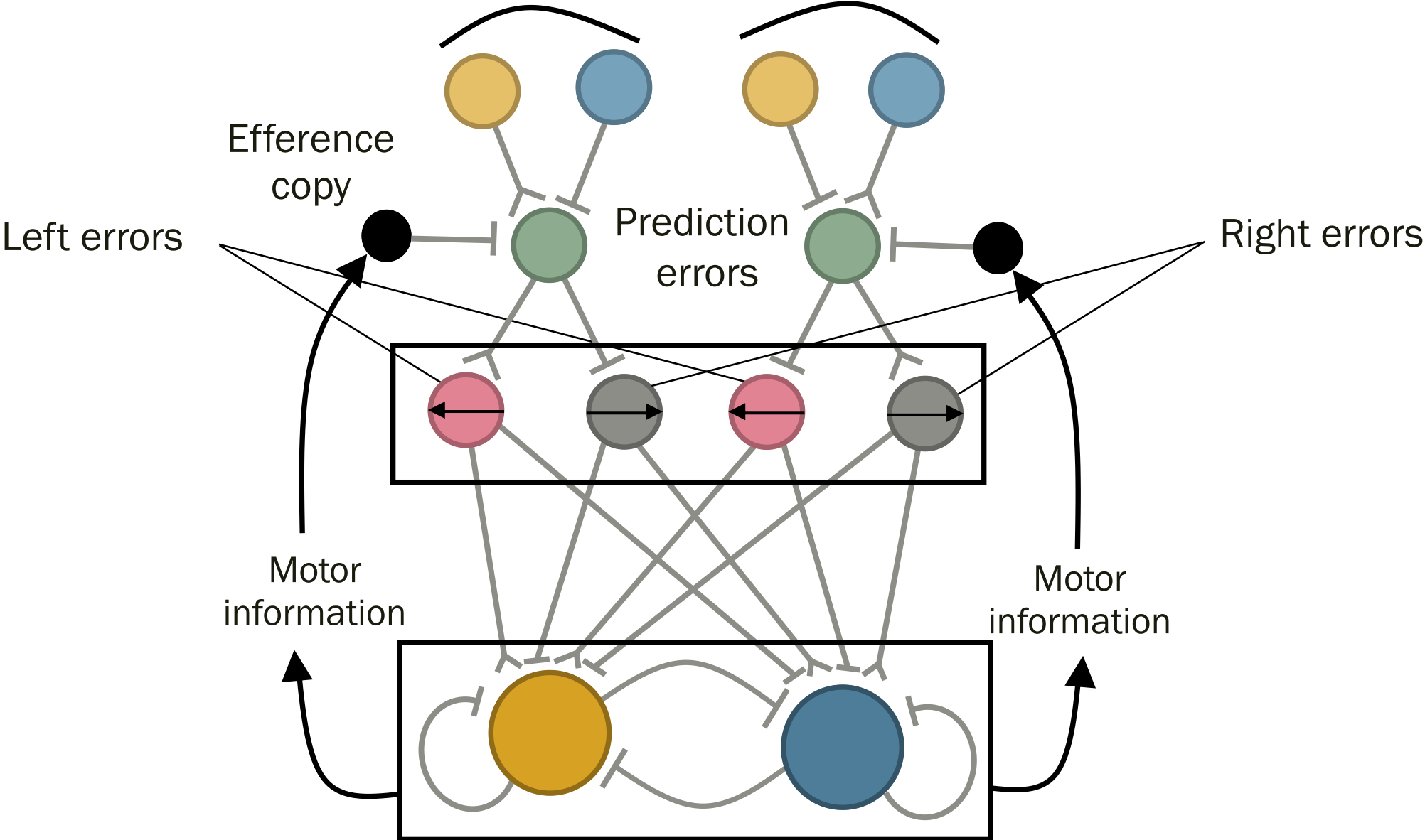


Mismatch !

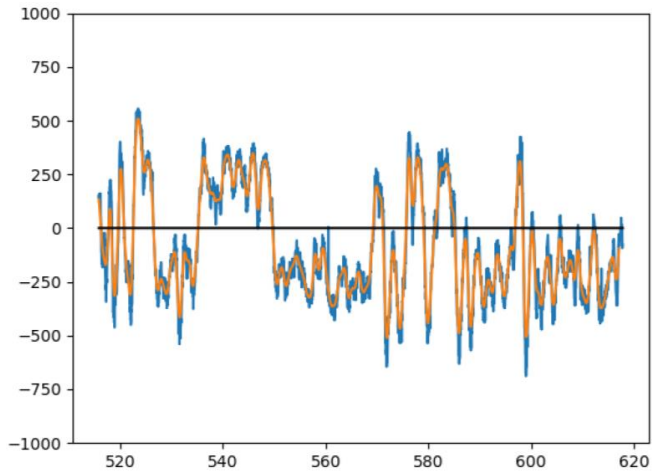
Model's prediction



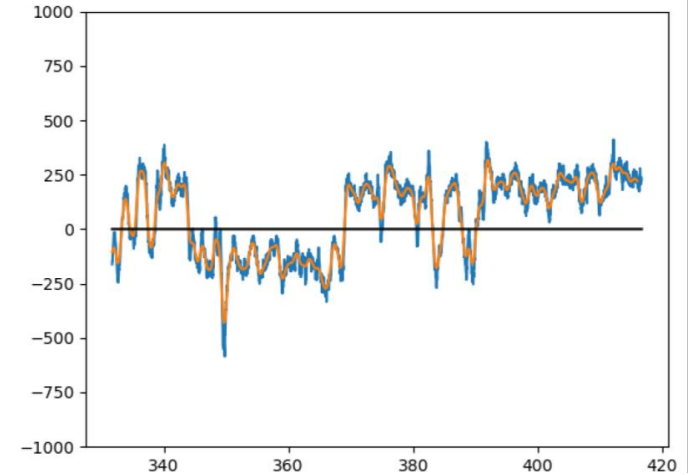
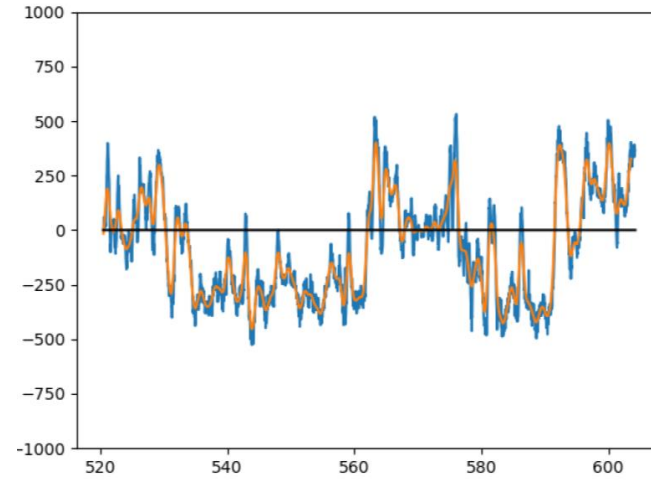
Neural model



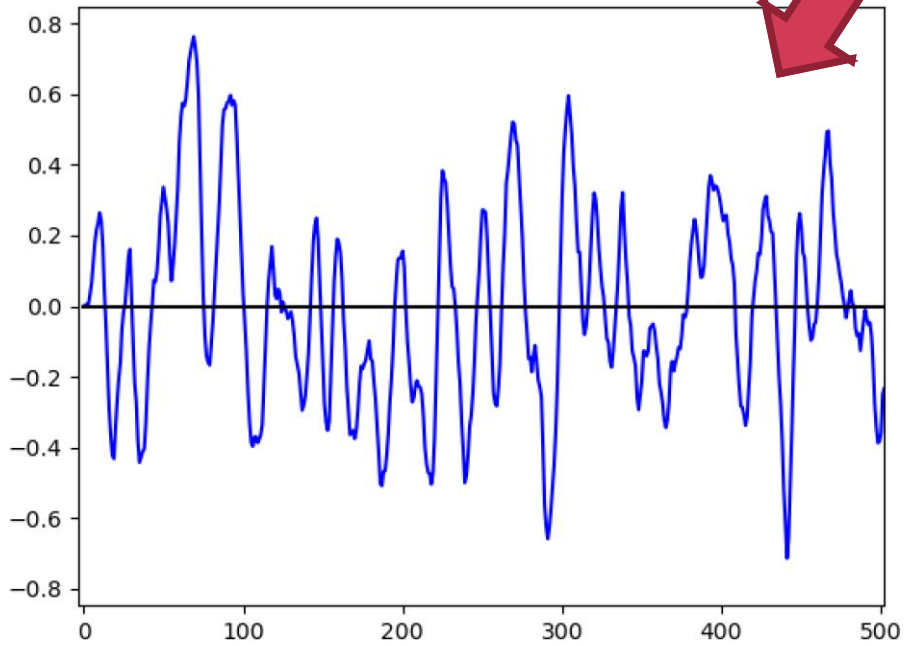
Angular velocity (deg/sec)



Gain 0



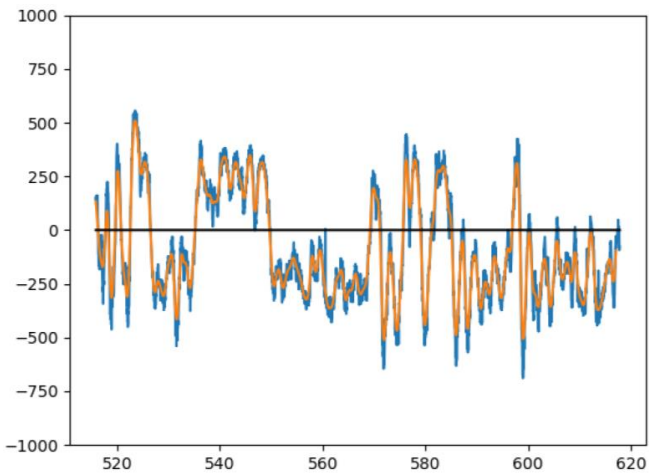
Old model



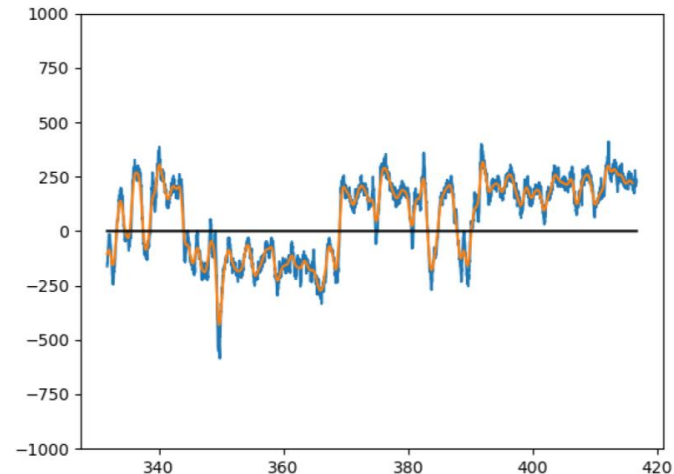
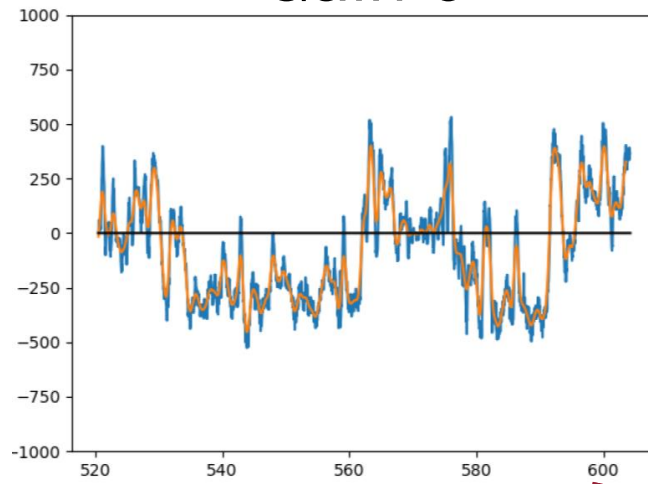
Mismatch !



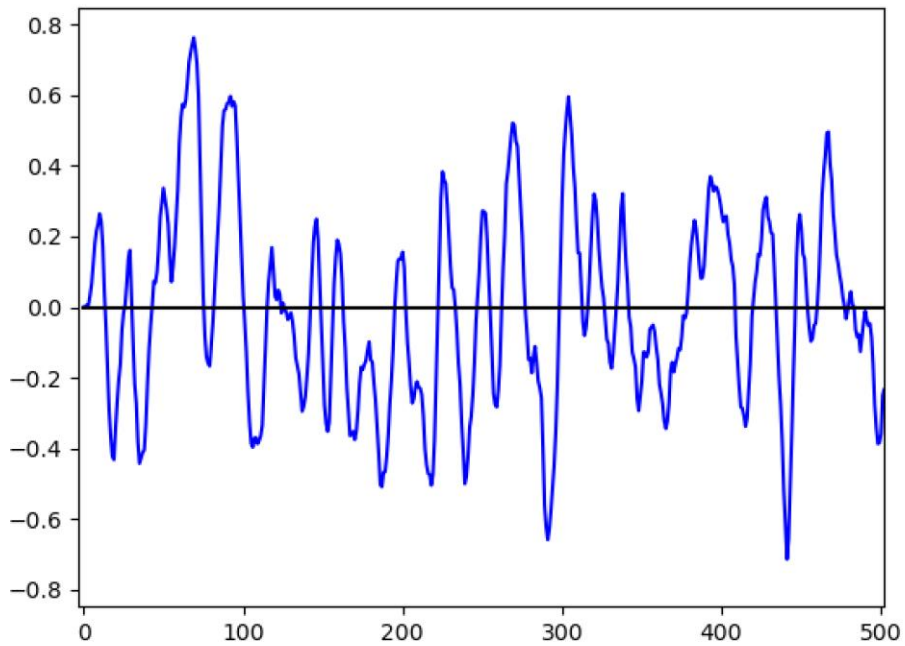
Angular velocity (deg/sec)



Gain 0

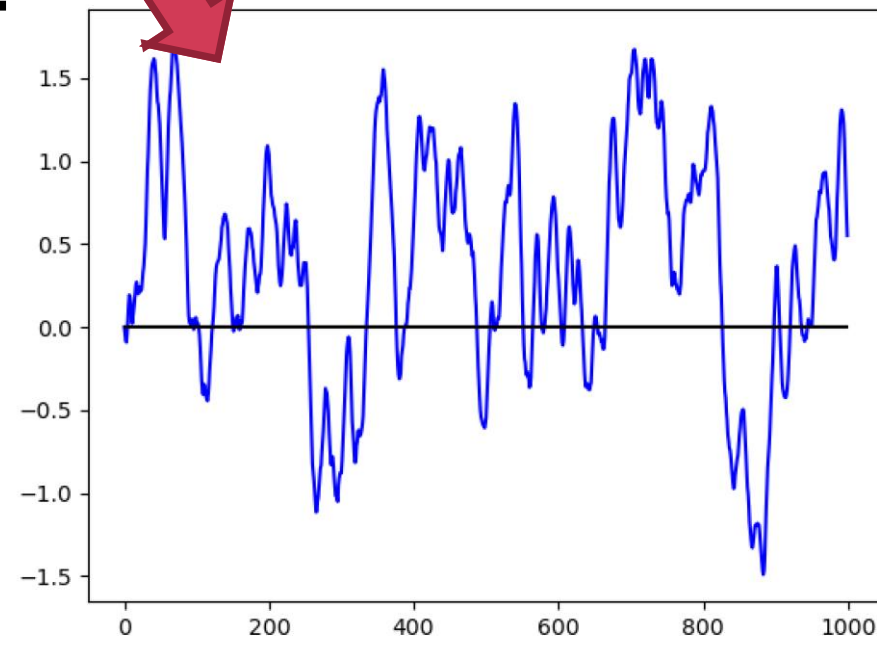


Old model

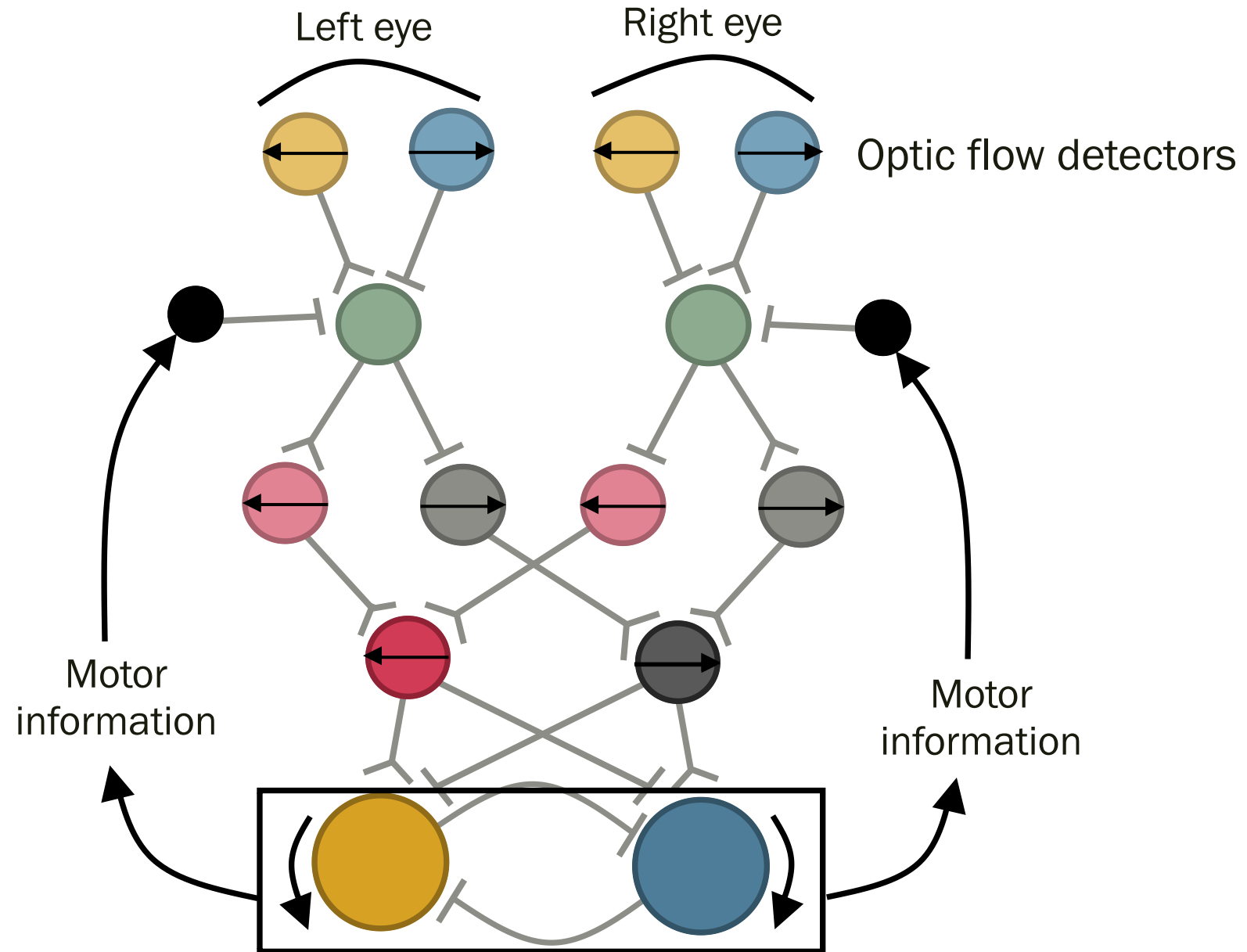


Match !

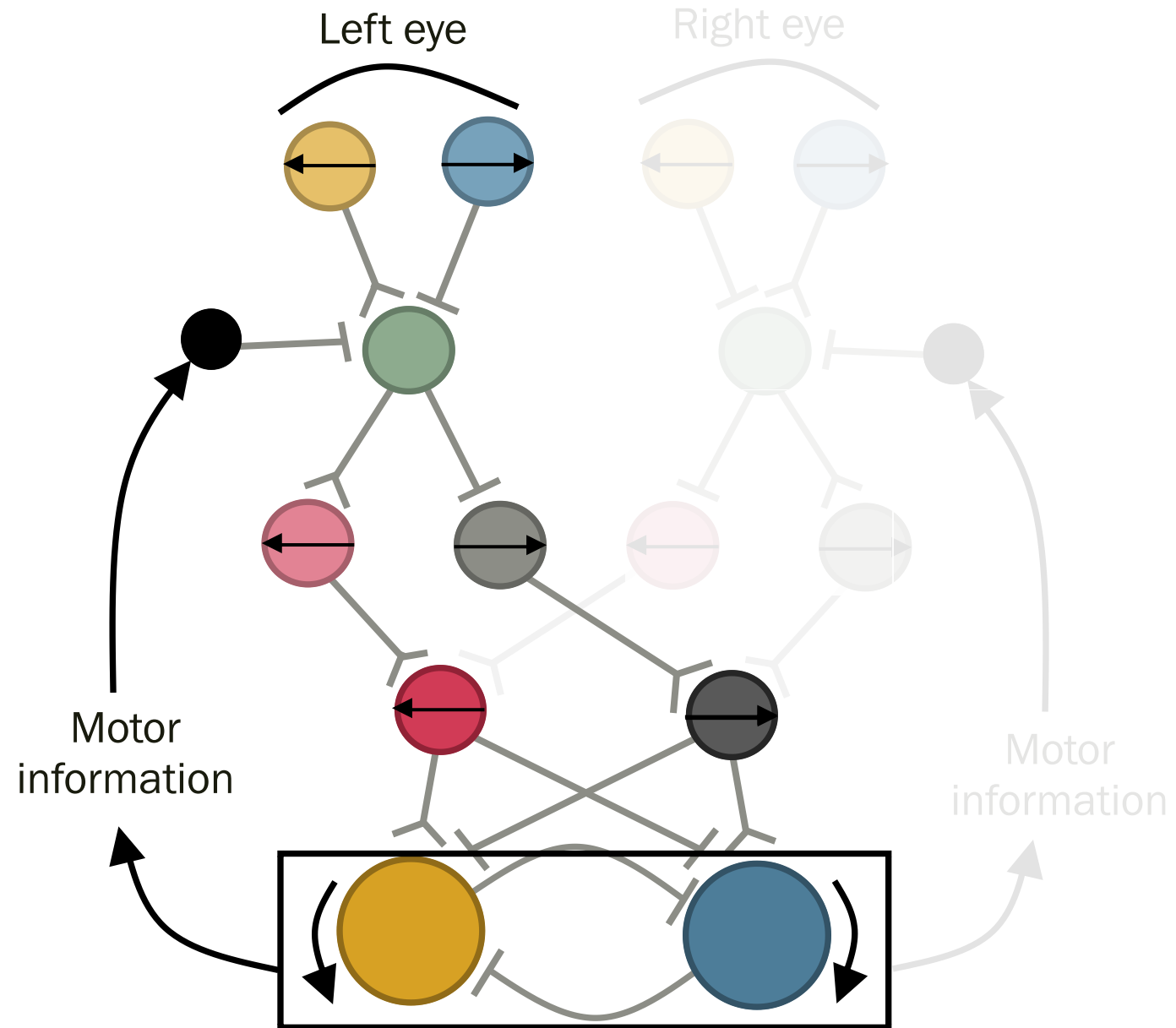
New model



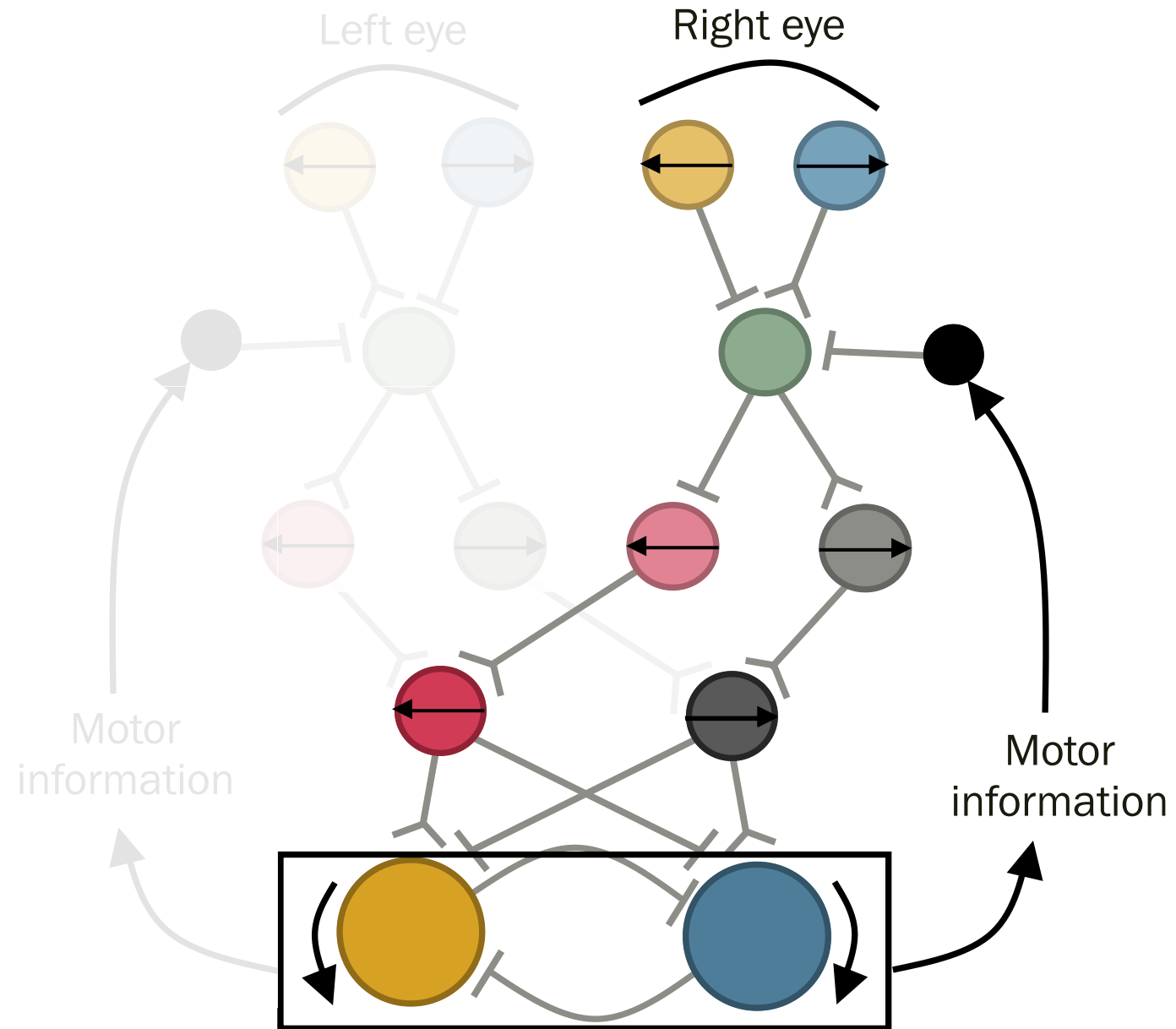
Neural model

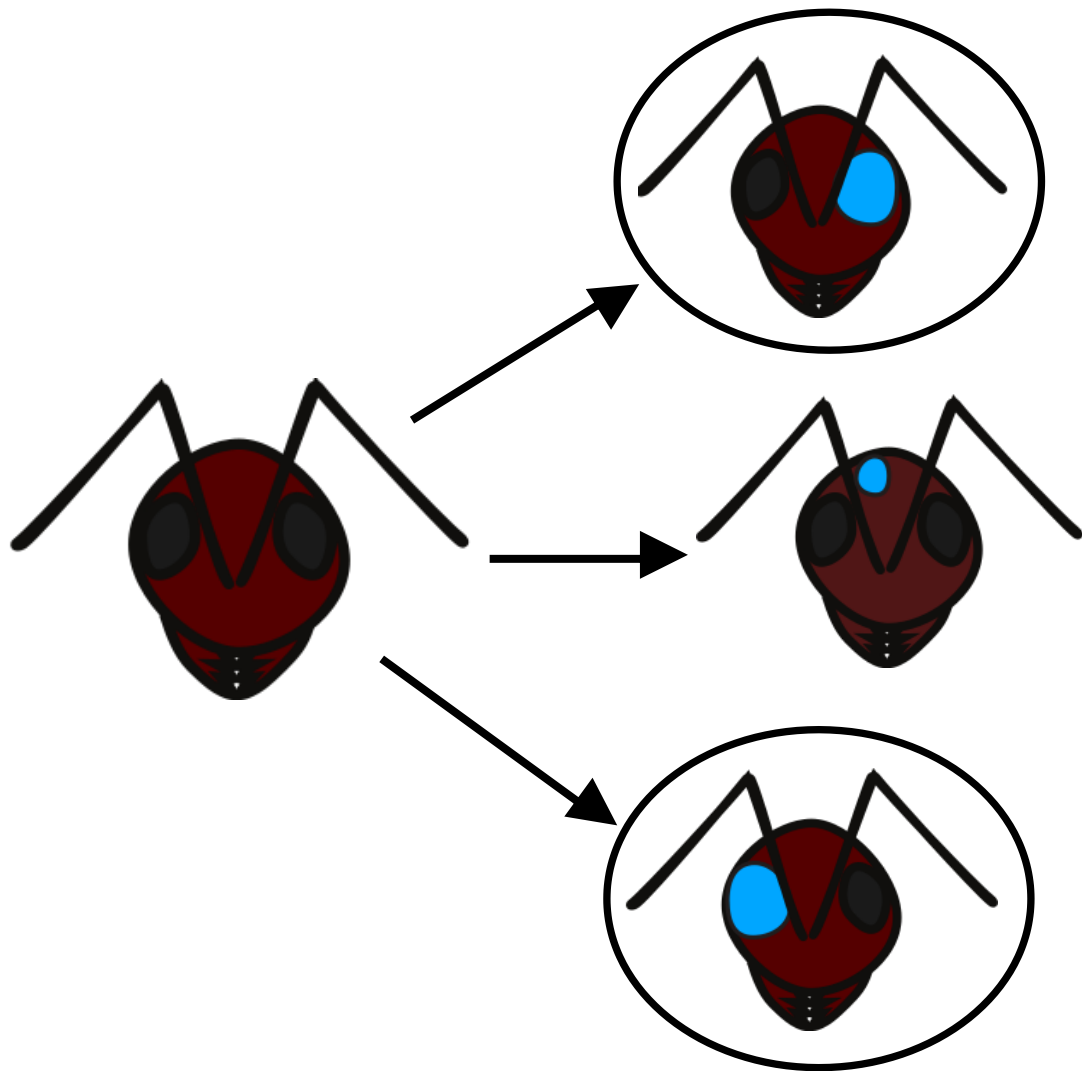


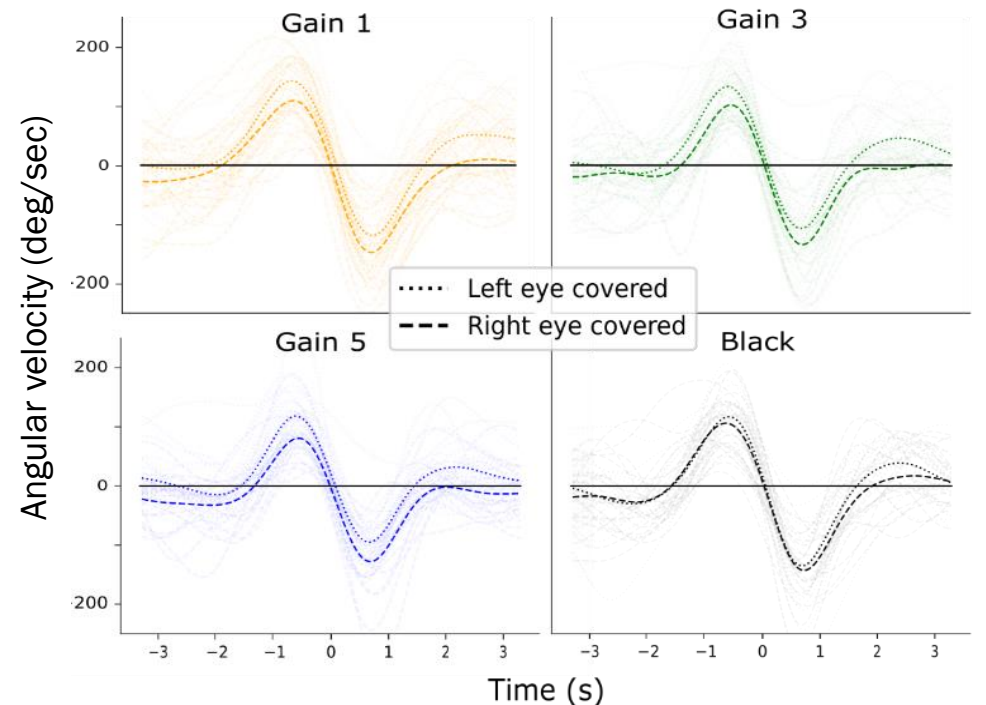
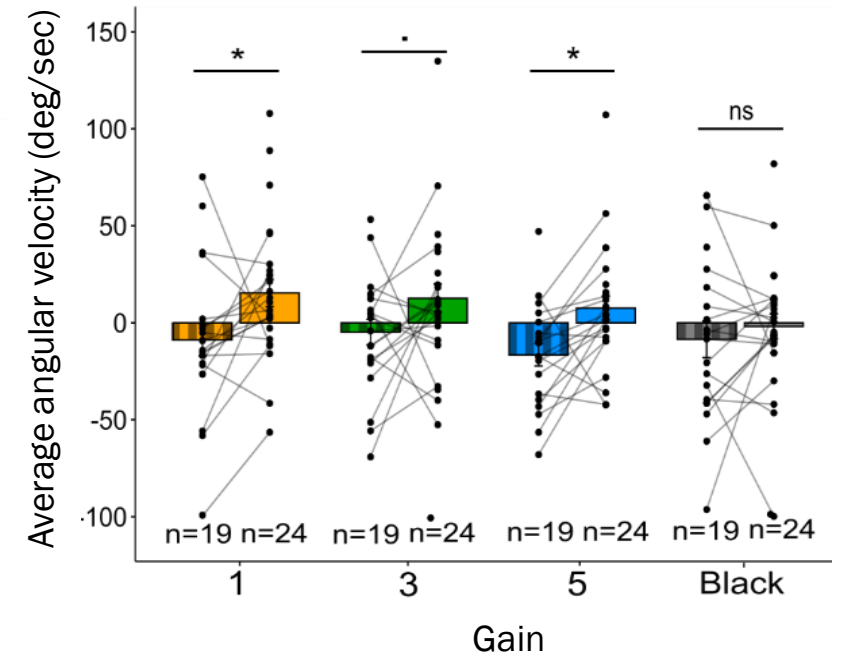
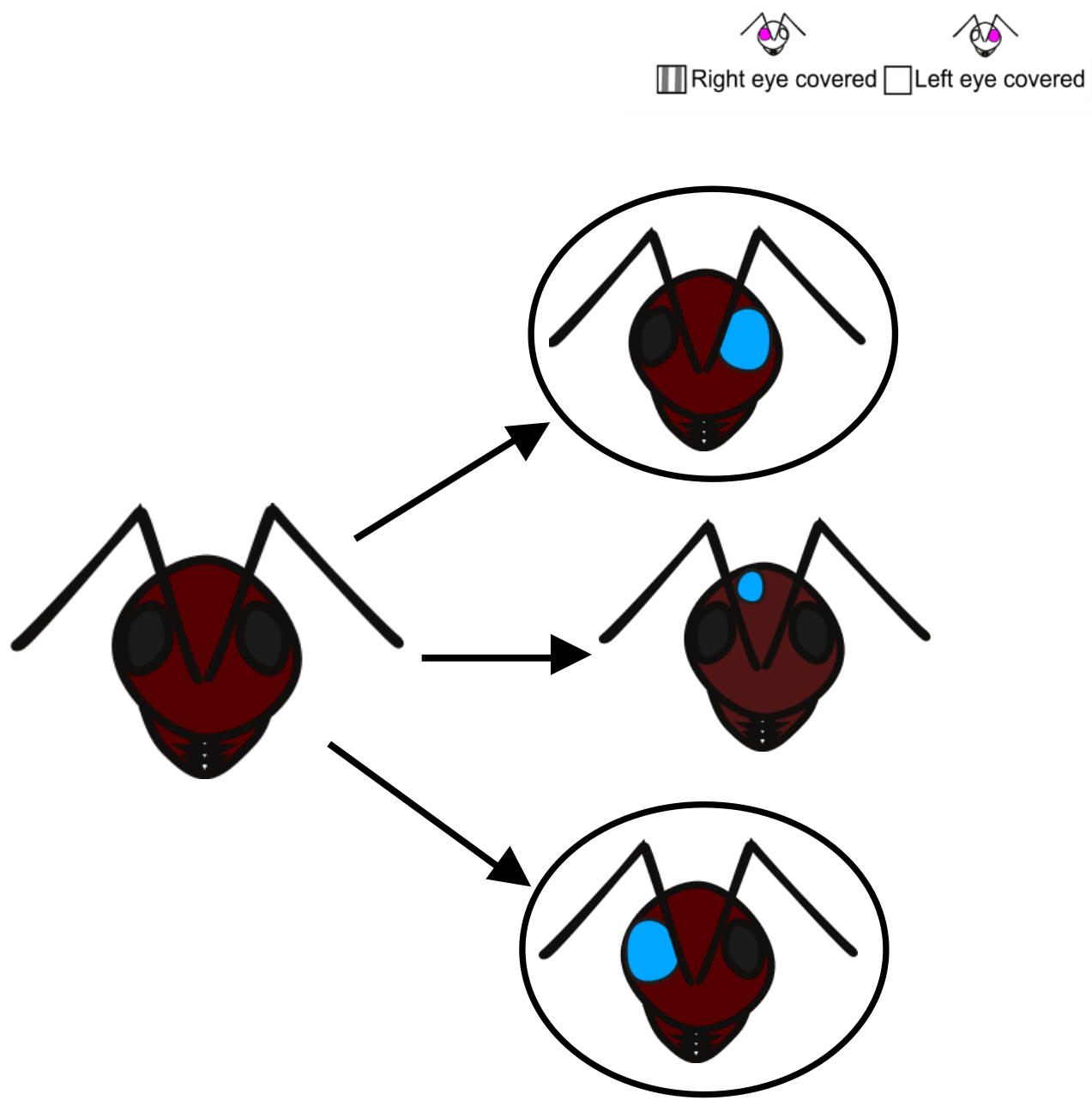
Neural model

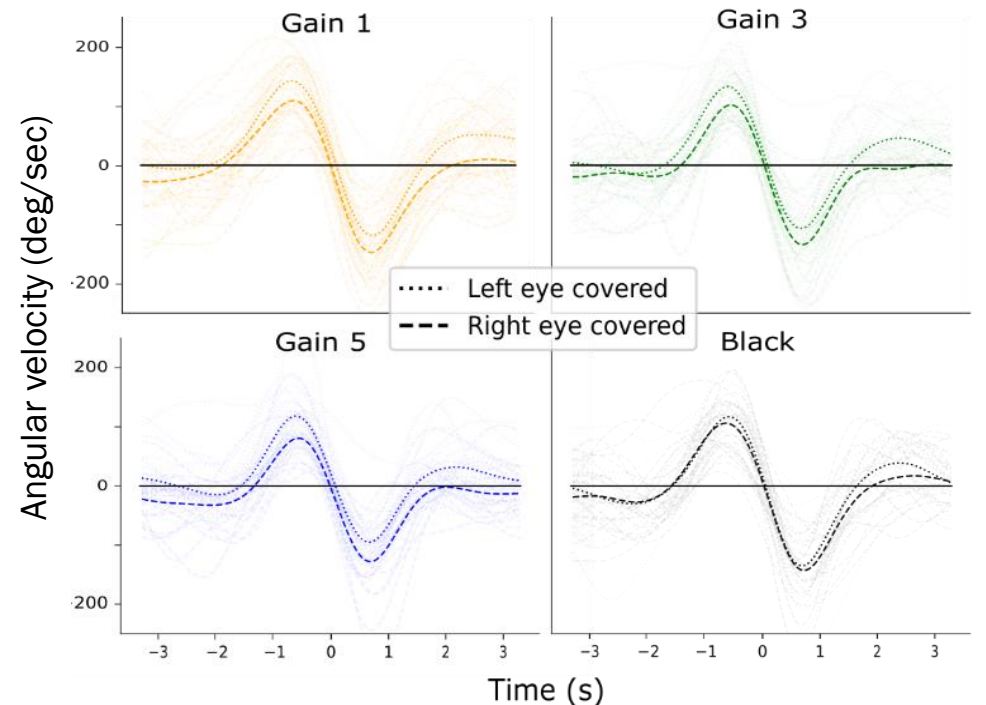
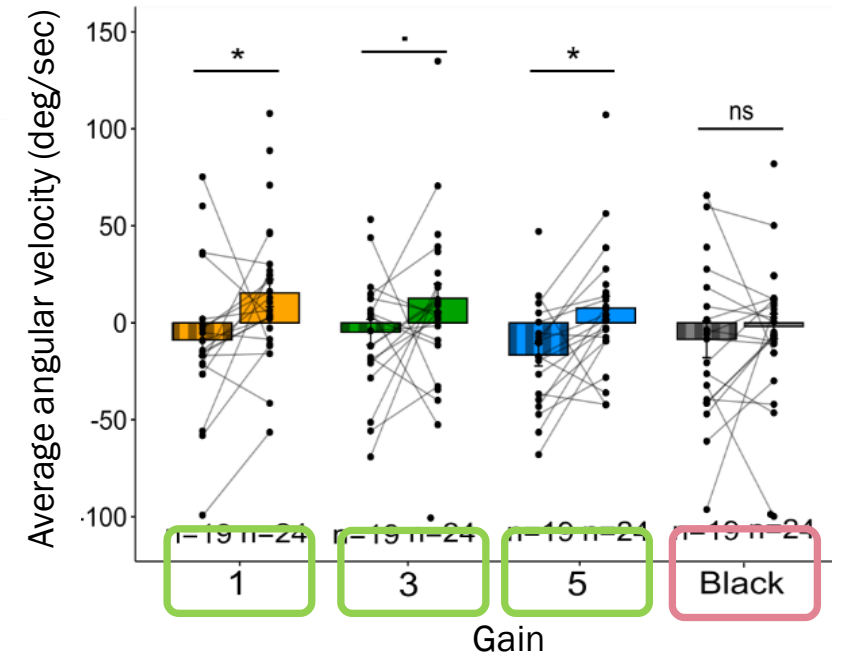
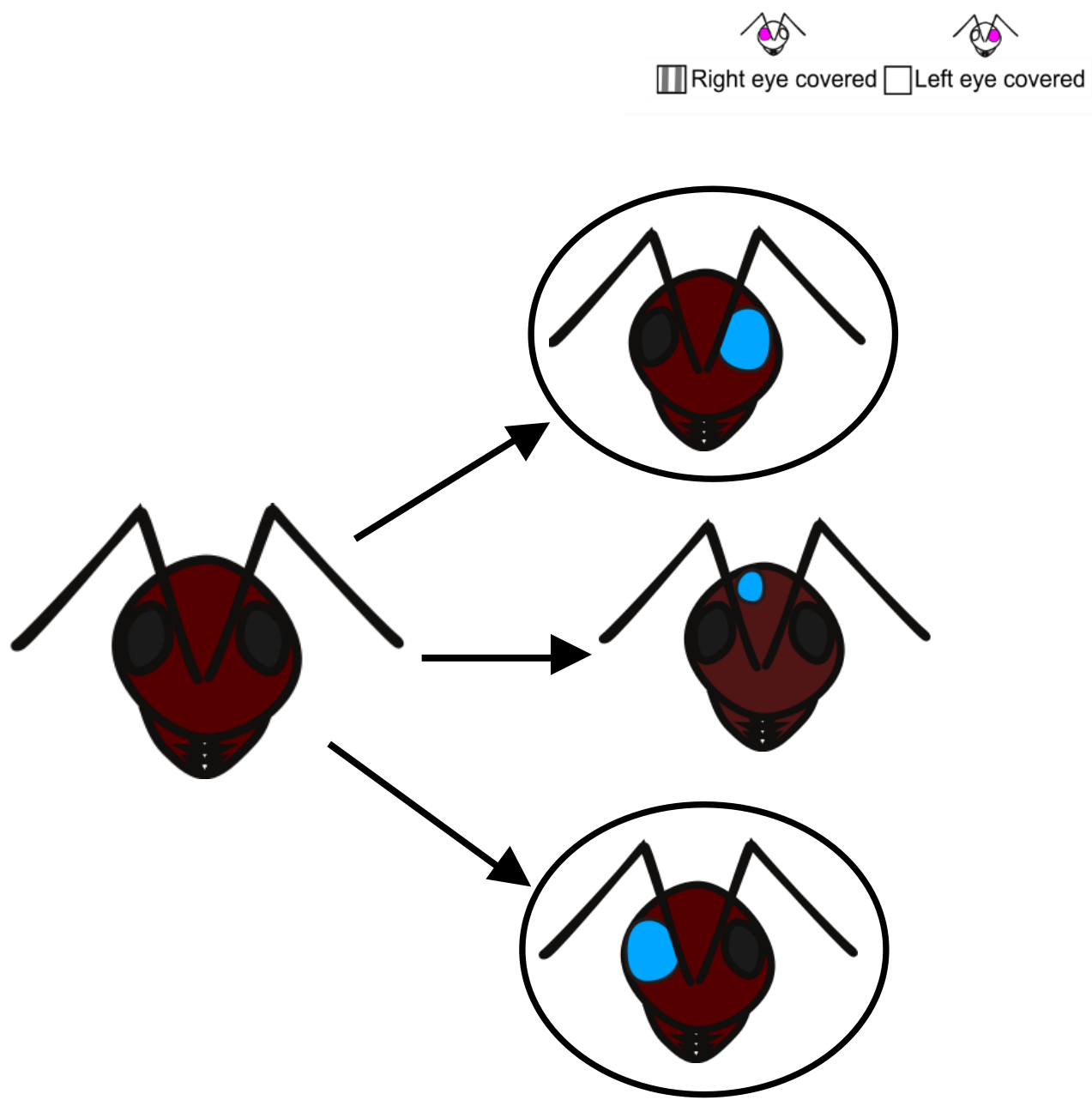


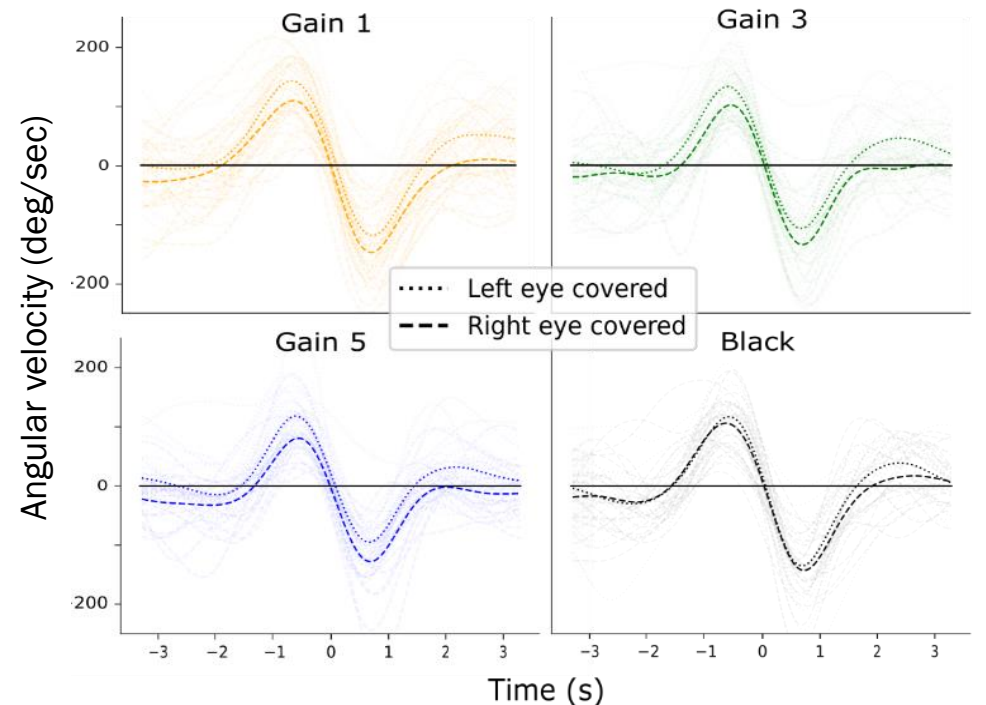
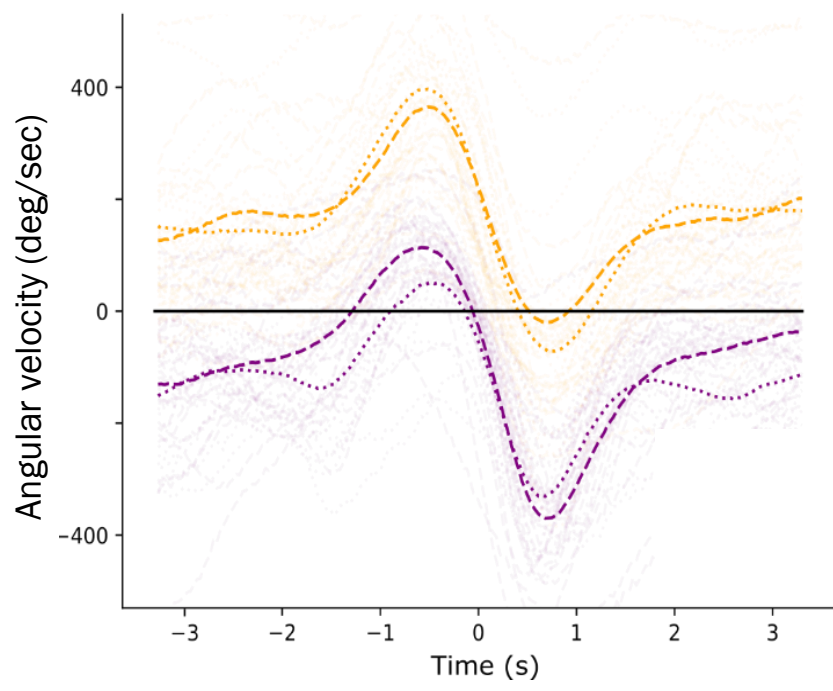
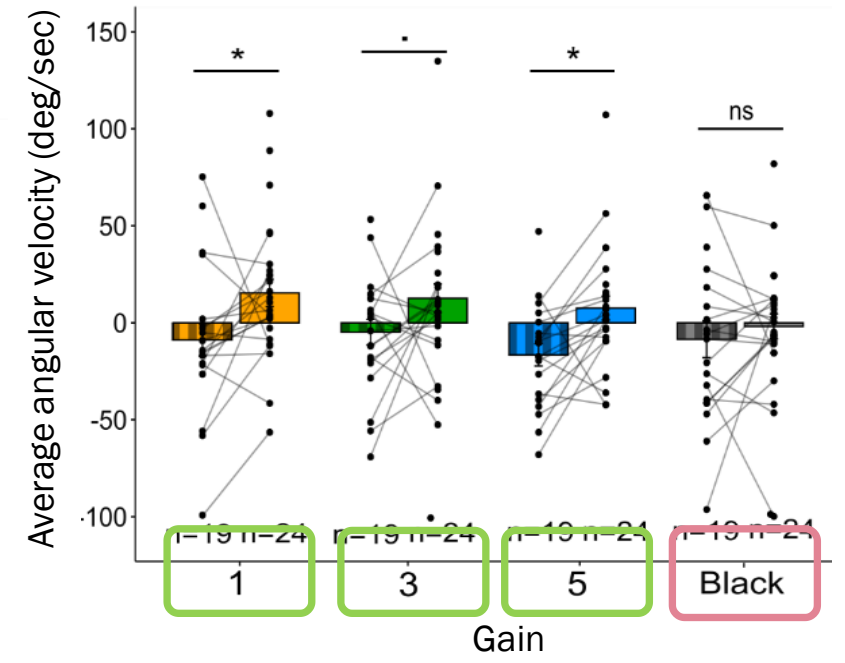
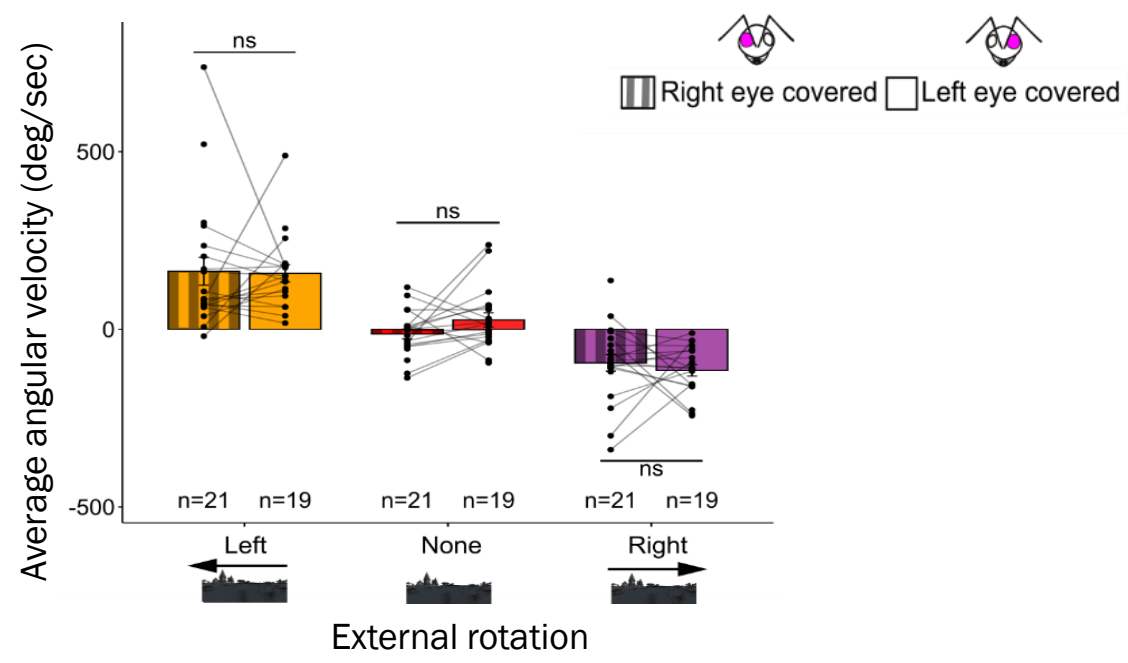
Neural model

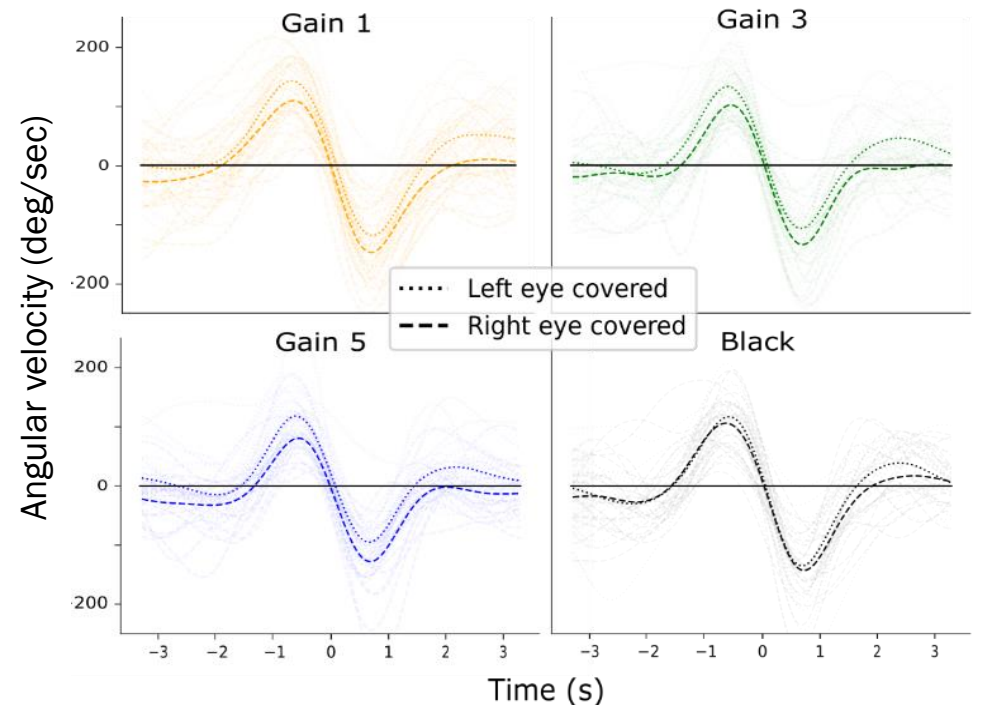
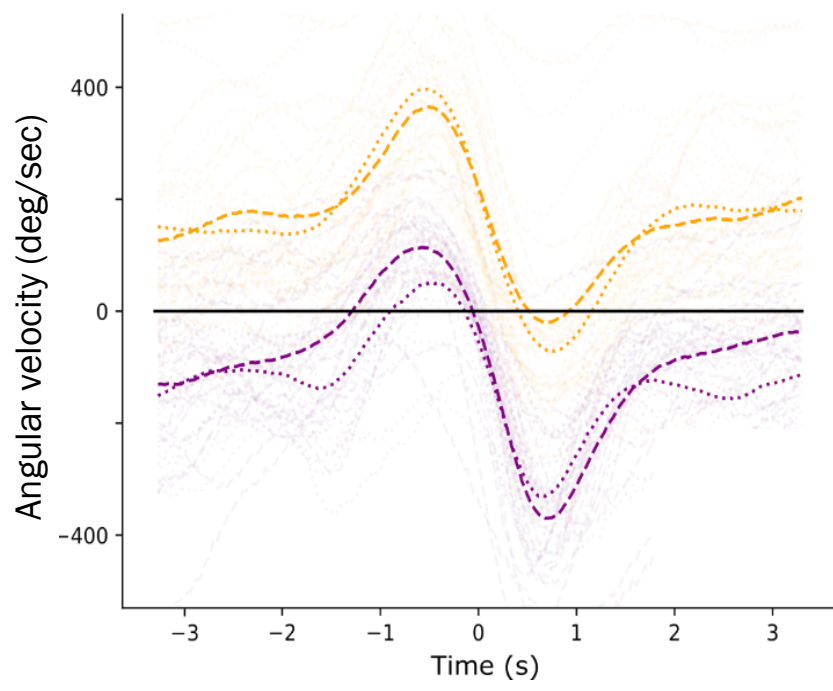
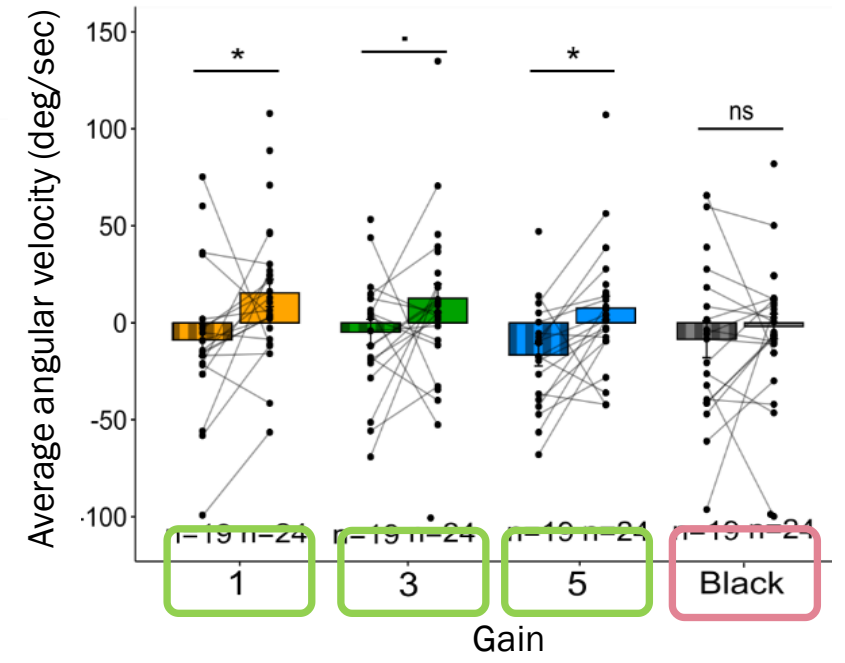
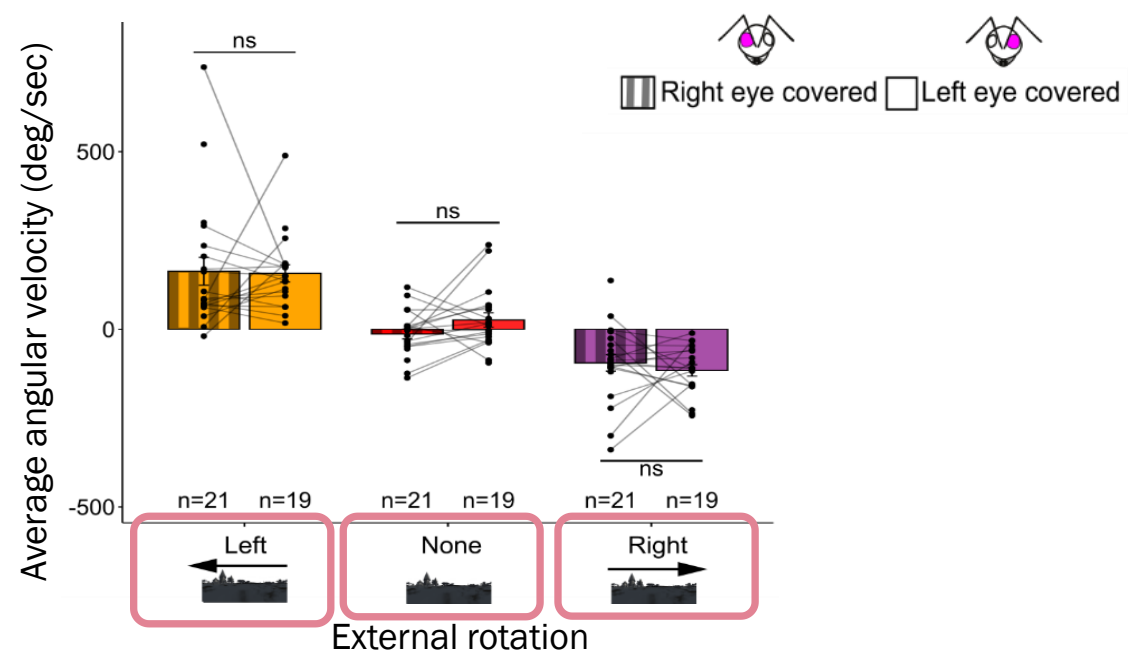




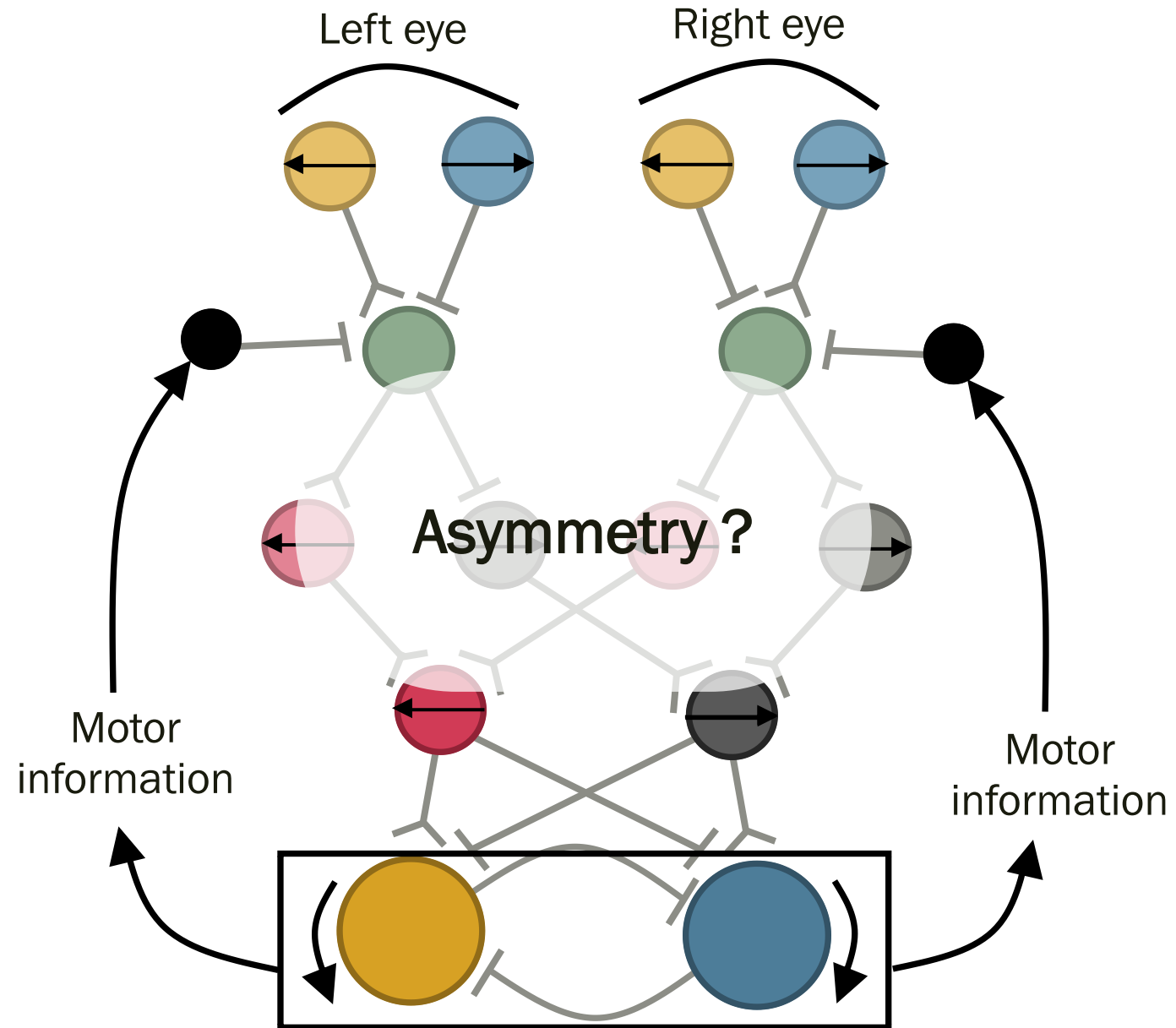




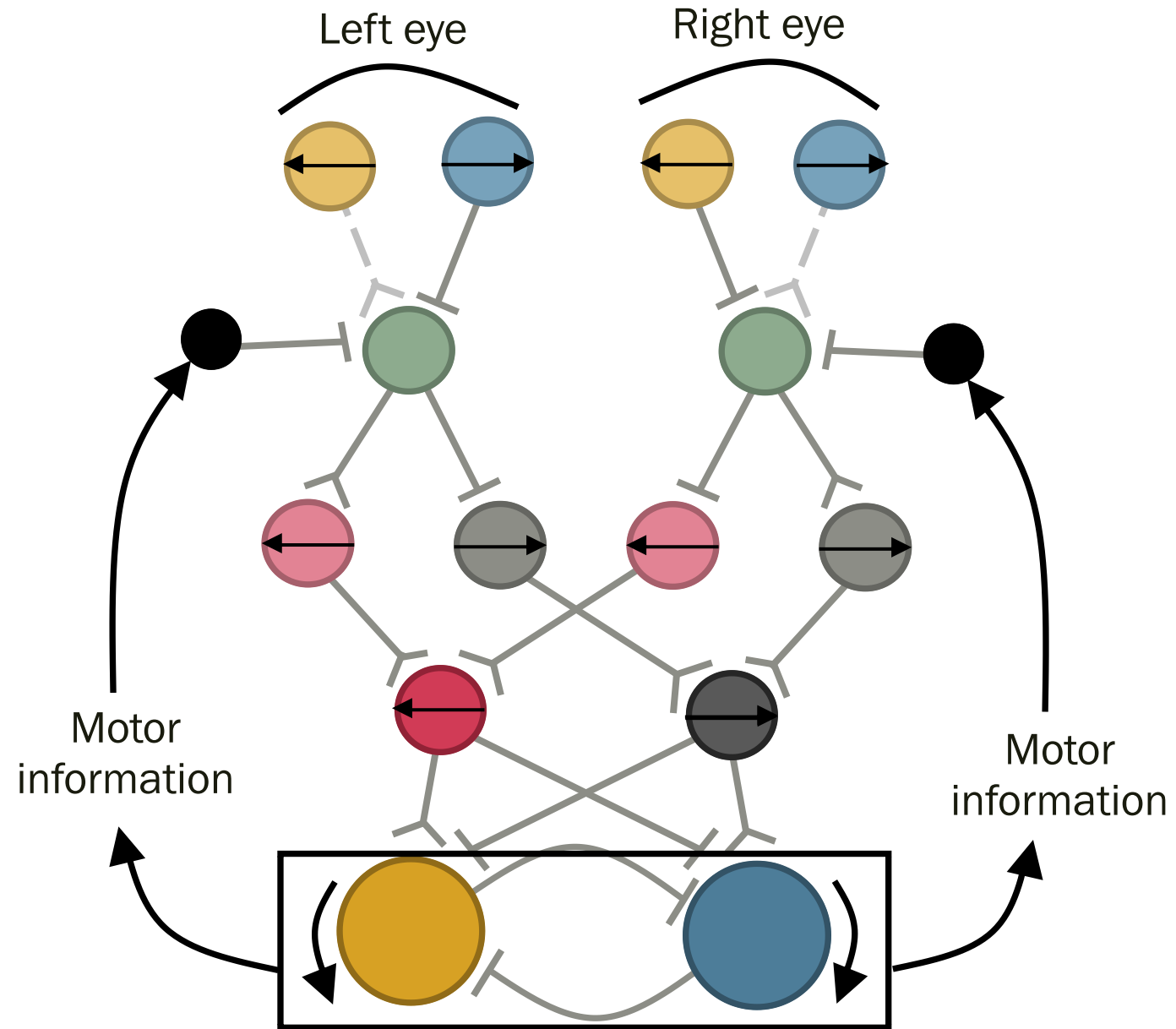




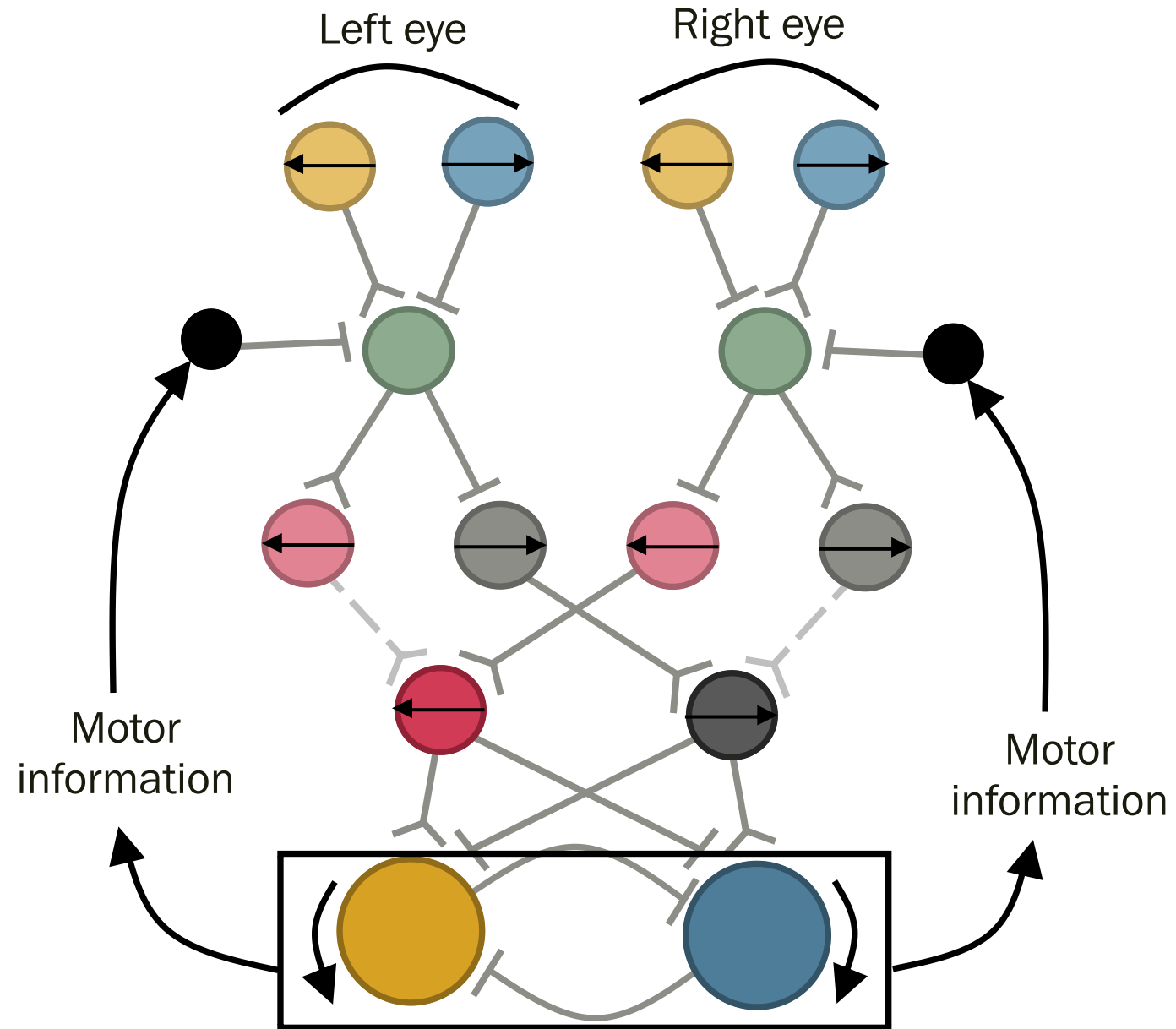
Neural model



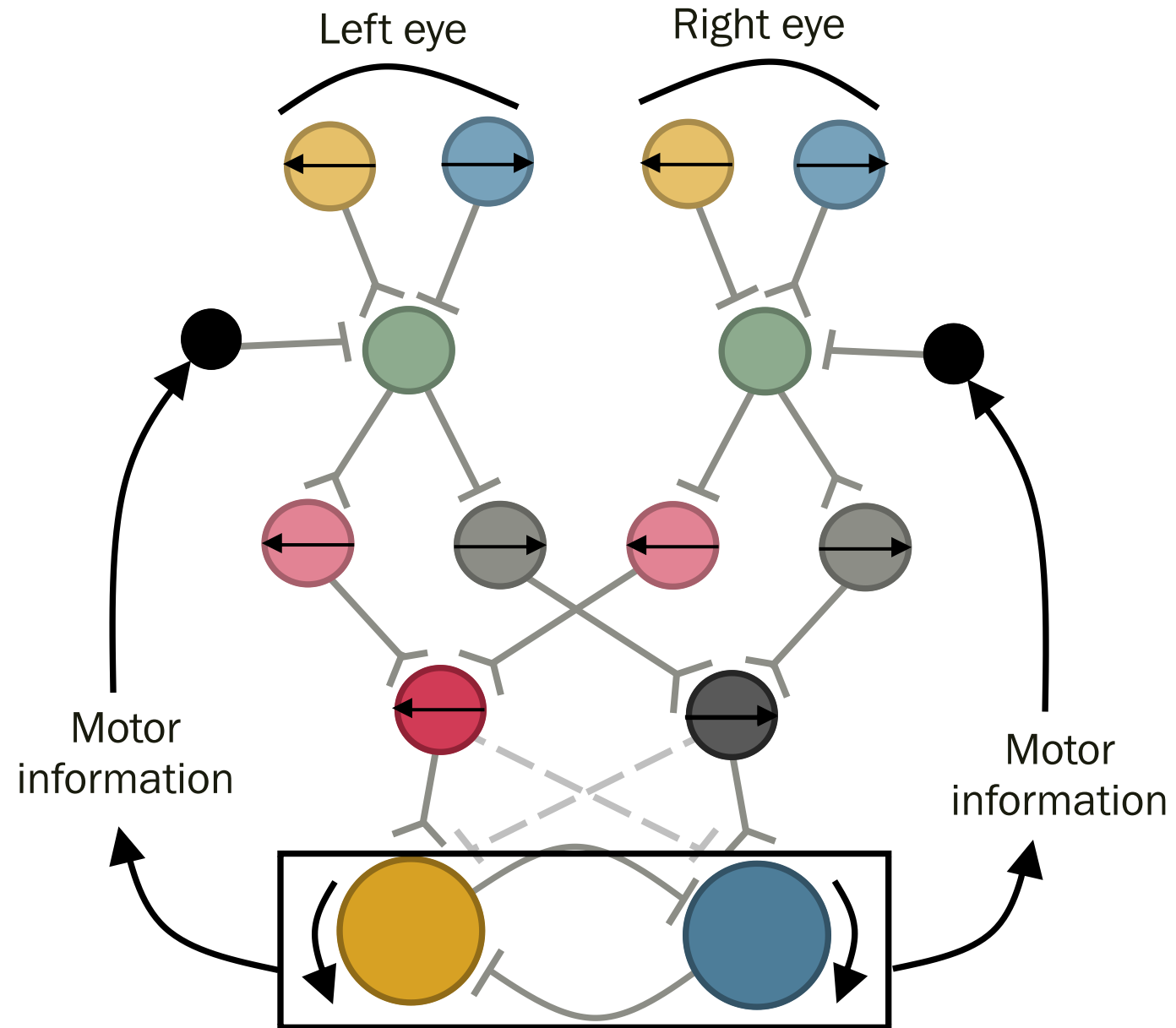
Neural model



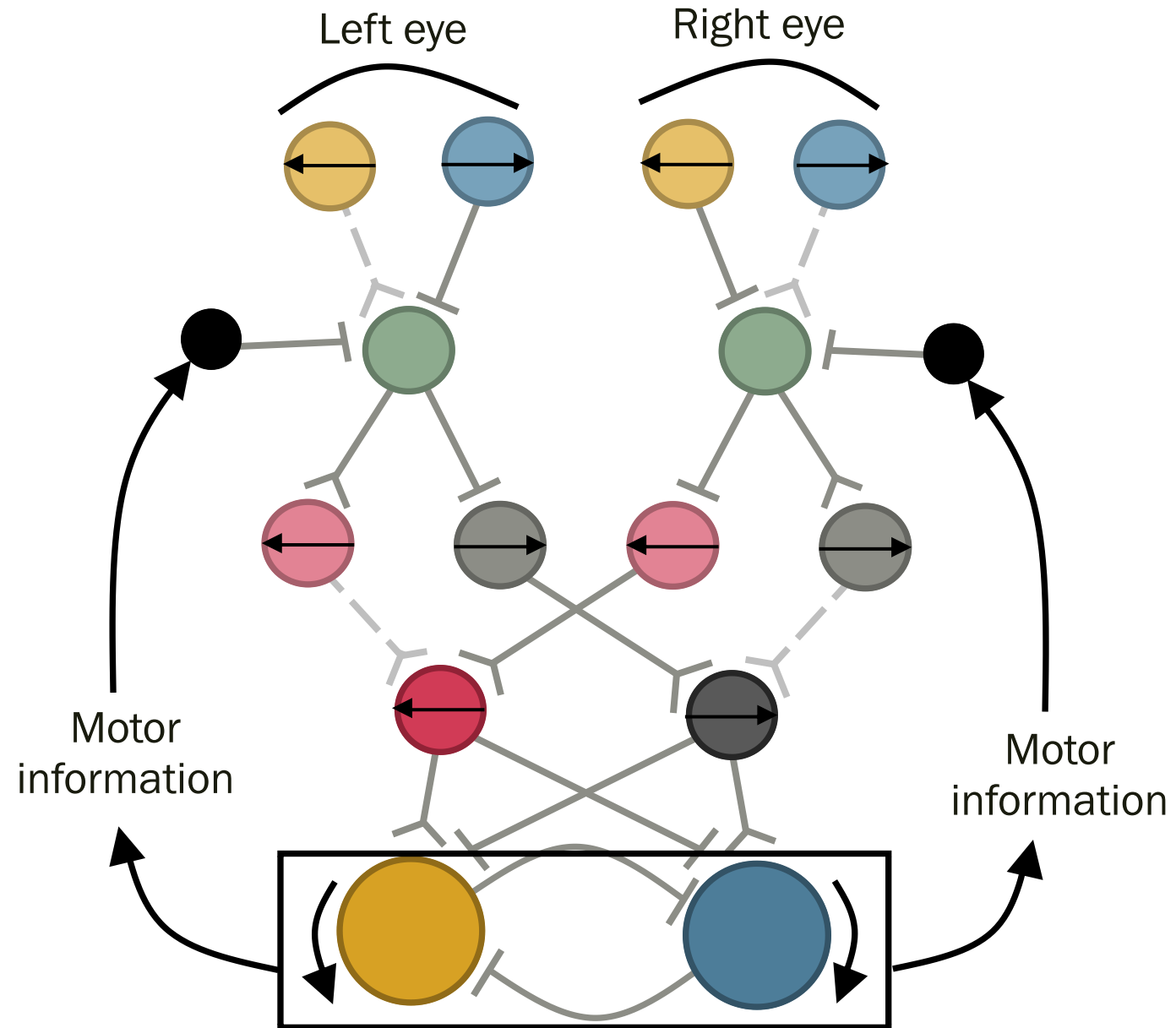
Neural model



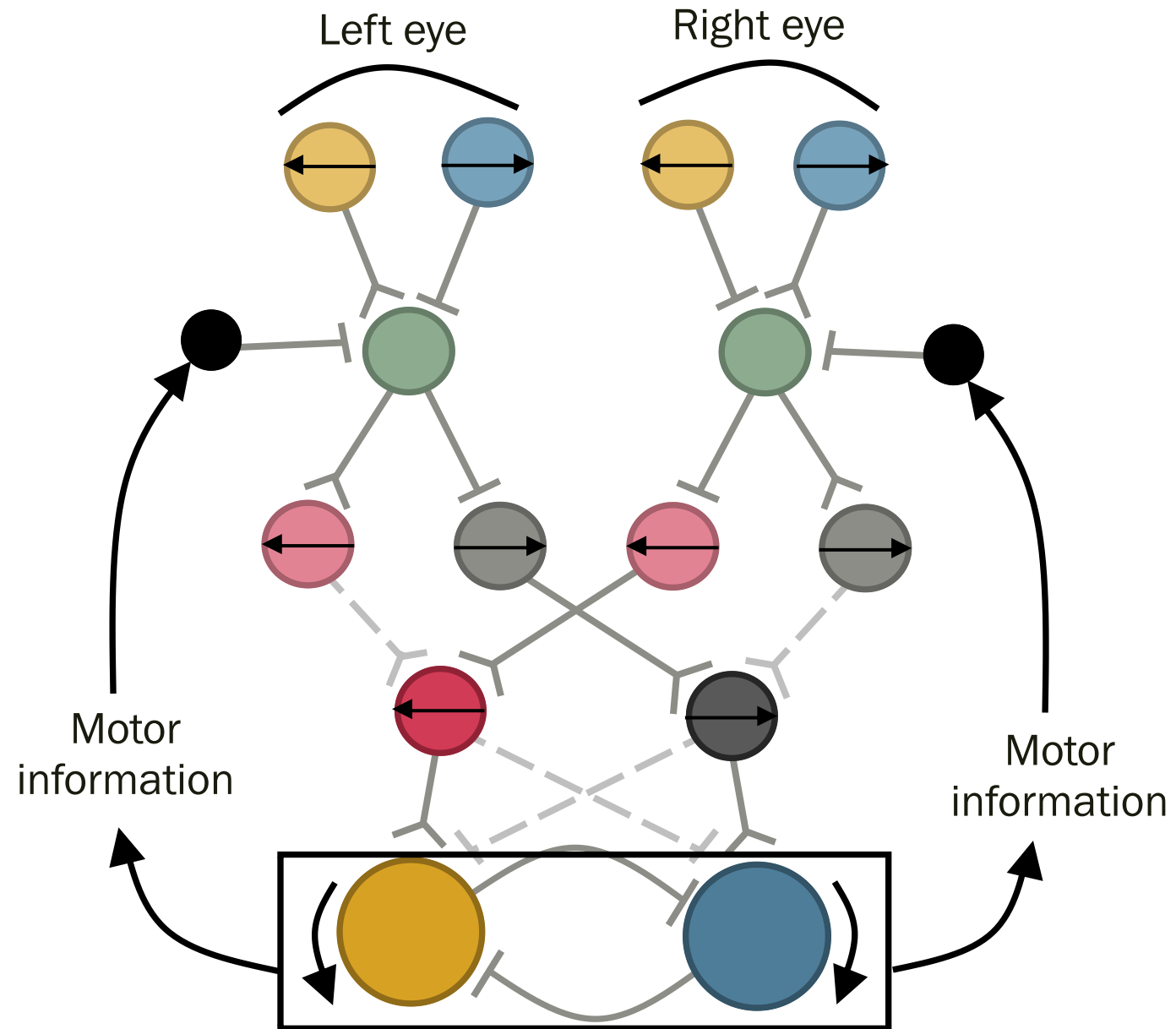
Neural model



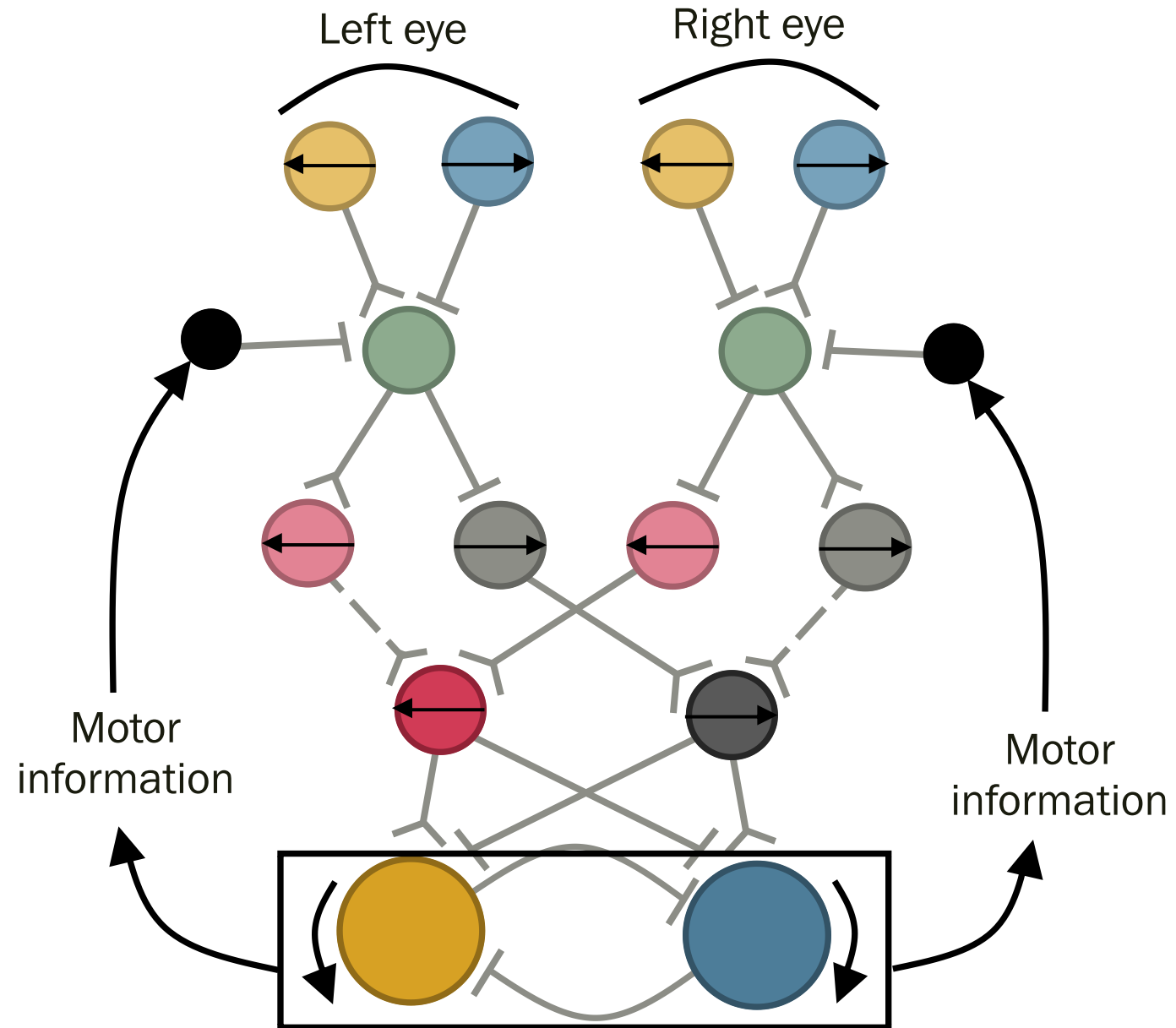
Neural model



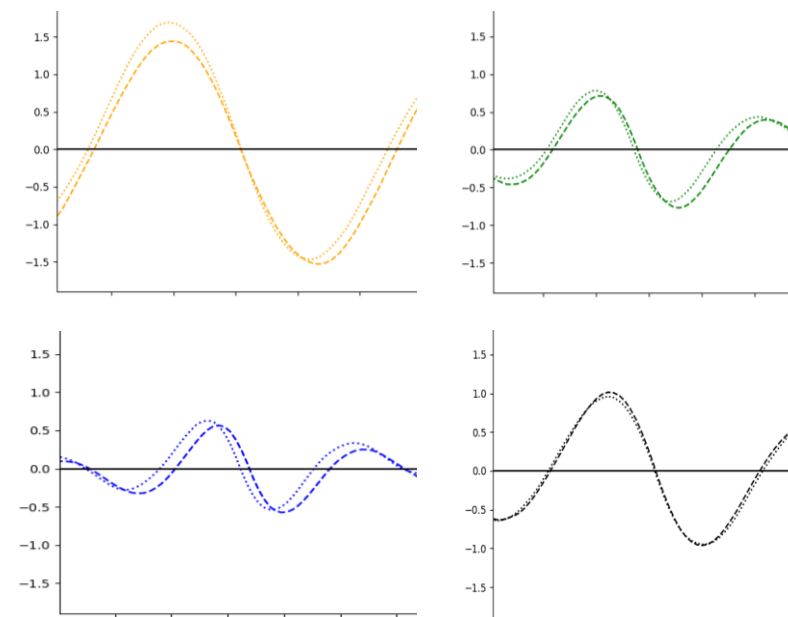
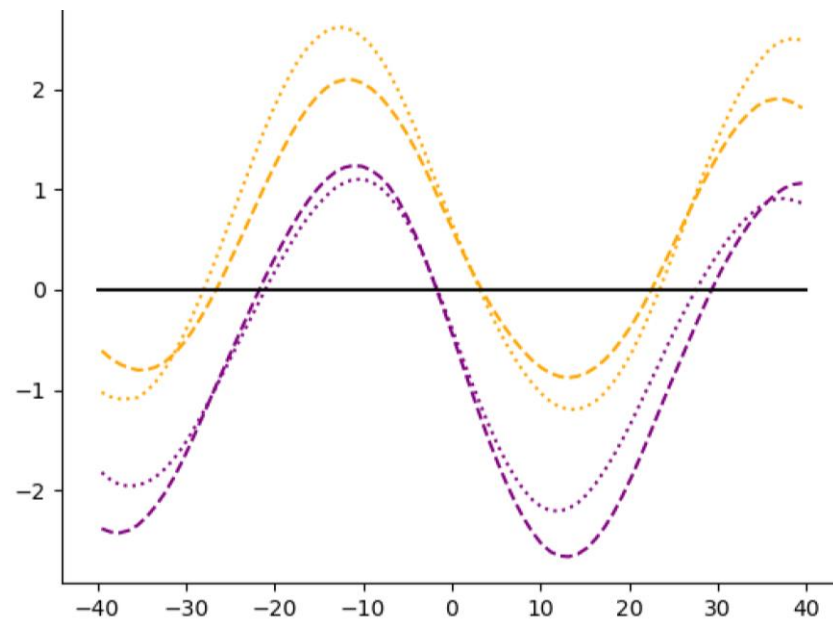
Neural model



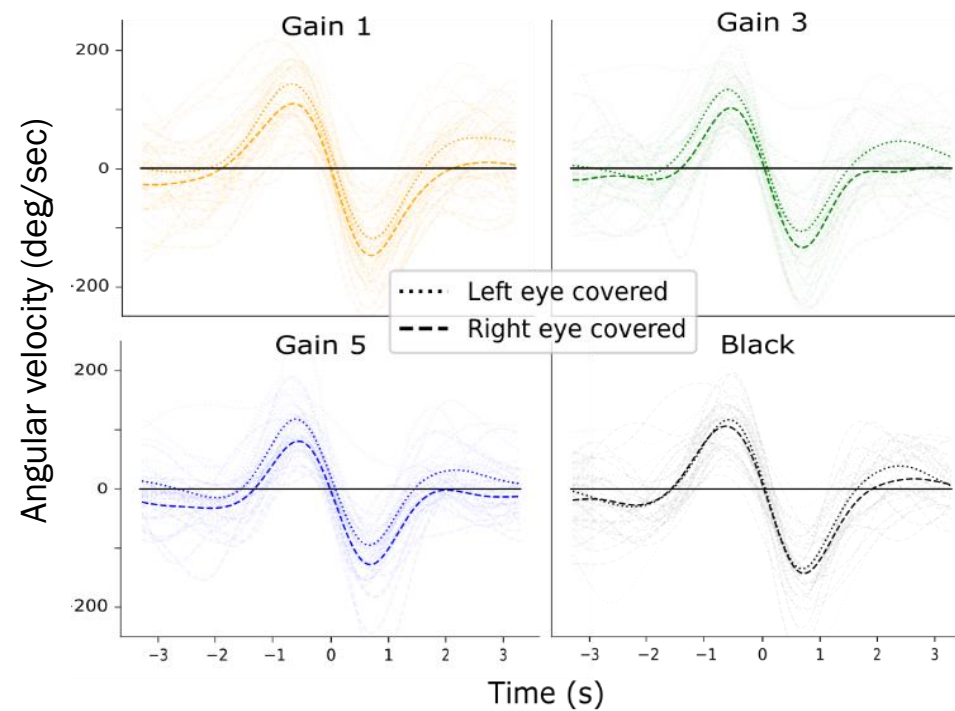
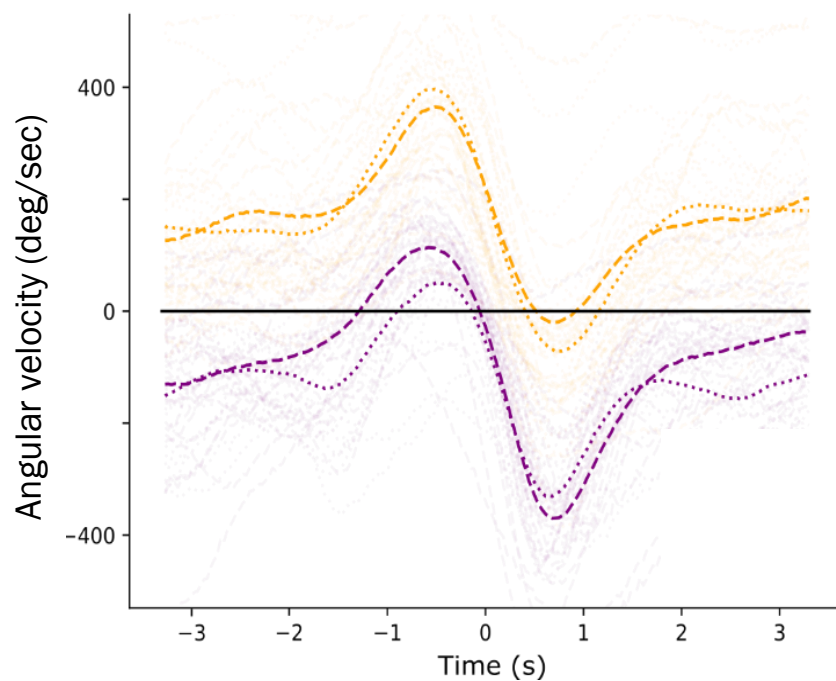
Neural model



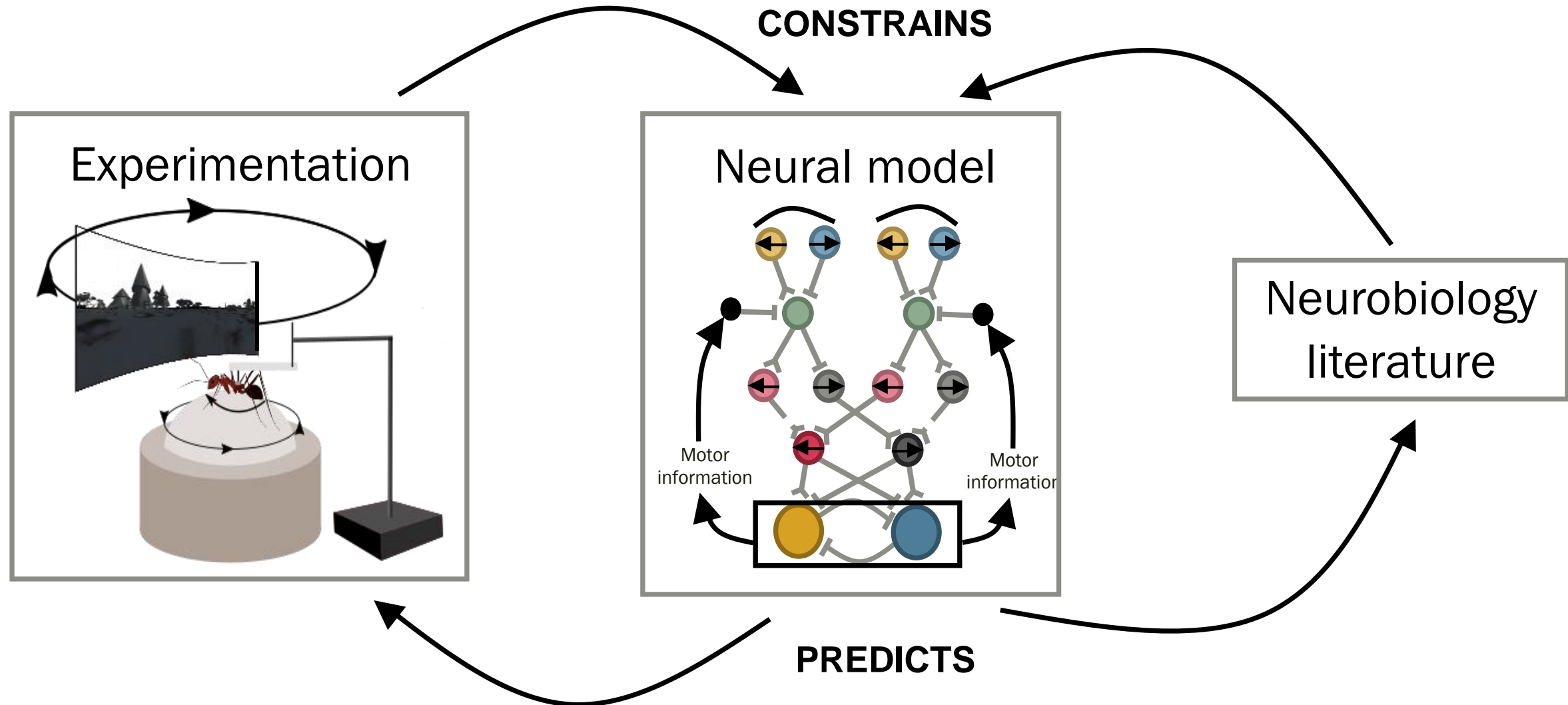
Model average oscillations

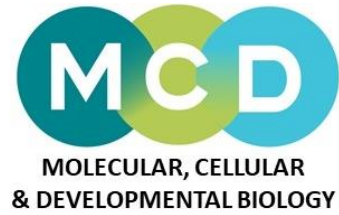


Ants' average oscillations



Conclusion





Thank you for your attention!