Visual and vestibular information in the mouse brain

July 20, 2021

Abstract

We wanted to test in five brain regions (SUB: subiculum, V1: primary visual cortex, SC: superior culliculus, RSg, RSd: granular and dorsal layers of retrosplenial cortex) of the mouse brain if the firing rate of neural populations contained information about visual stimuli speed, vestibular stimuli speed and/or their joint occurrence.

Using neural population recordings from these five regions in three stimulation conditions (Vestibular: vestibular only stimulation, Visual: visual only stimulation, VisVes: combined visual and vestibular stimulation) we regressed the spike rate against the absolute value of the stimuli speed.

Table 1 present the p-values of statistical tests checking if the regression slope coefficient is zero (i.e., there is no linear relation between the spike rate and the absolute value of the stimuli speed). Figures 1-5 plot the data, the regression line and the corresponding p-value.

We observe that in all tested brain regions for the VisVes stimulation condition there was a significant linear relation ($p < 0.05$) between spike rates and the absolute value of the stimuli speed (Table 1).

This observations are very preliminary. Among other things:

1. whe have not assess effect sizes (e.g., strength of linear association),
2. the p-values we present are only valid under the assumptions of the linear regression model (e.g., heteroskedasticity, normal errors) that we have not checked here,
3. it would be helpful to test the significance of linear association using non-parametric methods (e.g., permutation test).

Region	Vestibular	VisVes	Visual
SUB	0.10856839509510649	0.0024170947672328778	0.24384544519655185
V1	0.1679184222559498	6.0090516385833564e-05	0.47092162563404194
SC	0.020047996404641628	0.013546391625890969	0.019721225348521776
RSPg	0.00039523011388667504	1.3611286306101672e-05	0.16517866321338592
RSPd	0.7072497697418264	0.06923718687850022	0.20832572464753255

Table 1: p-values for hypothesis test of zero slope coefficient in linear regression

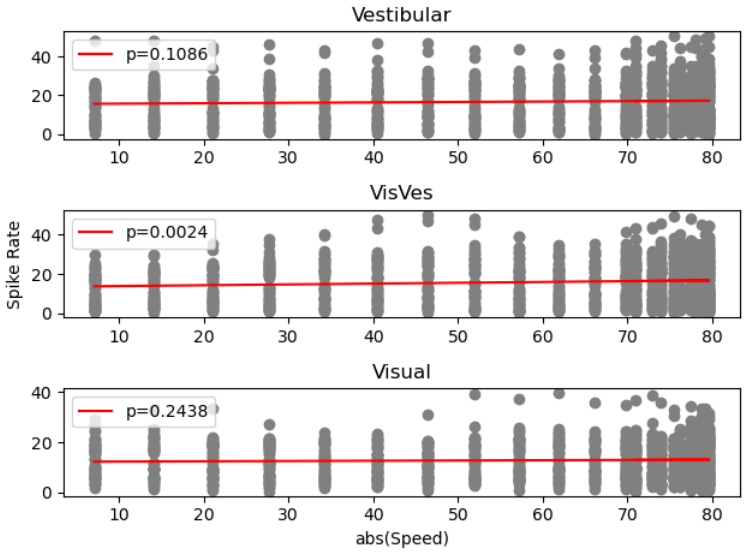

Figure 1: Regression analysis for the Subiculum (`region=SUB`)

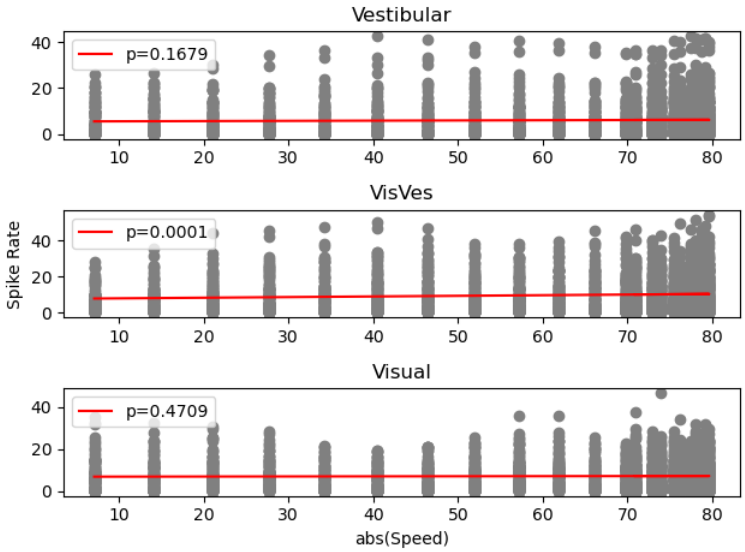

Figure 2: Regression analysis for the primary visual cortex (`region=V1`)

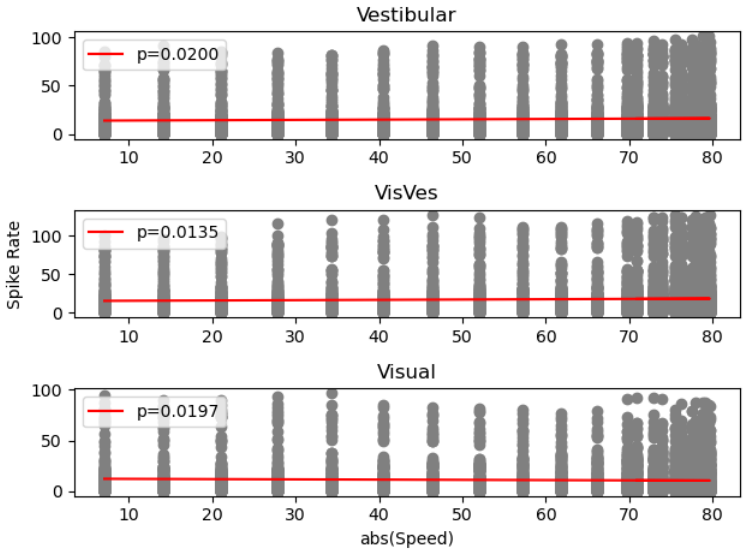

Figure 3: Regression analysis for the superior culliculum (`region=SC`)

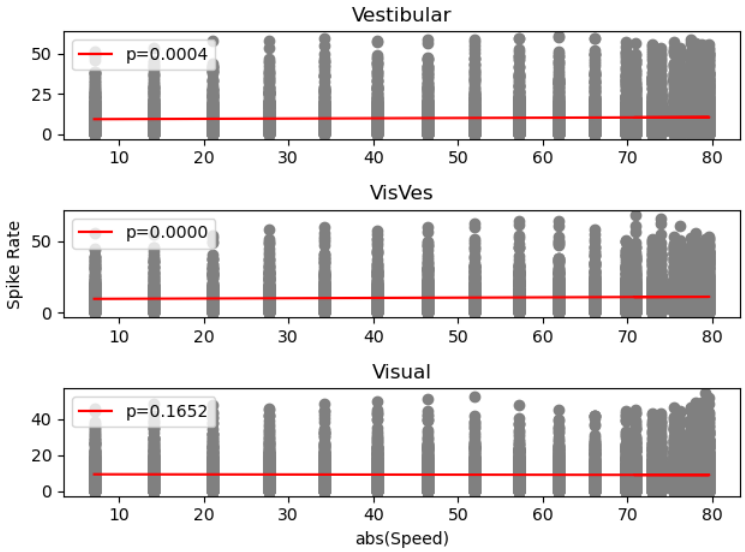

Figure 4: Regression analysis for the granular layer of the retrosplenial cortex (`region=RSPg`)

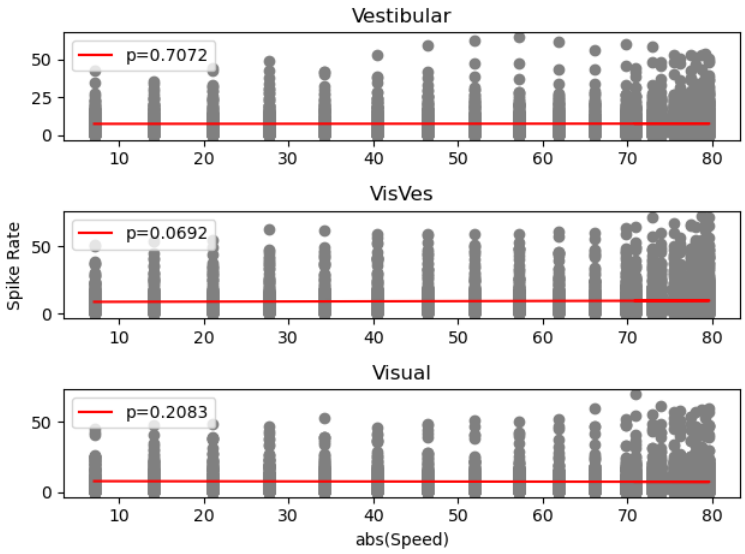

Figure 5: Regression analysis for the dorsal layer of the retrosplenial cortex (`region=RSPd`)