Title: Neural population representation of visual features in mouse superior colliculus

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Abstract: The mammalian retina contains ~30 distinct types of RGCs. Each type sends a specific visual feature to the brain. One principal brain center receiving direct retinal inputs is the superior colliculus (SC), which is an evolutionarily conserved structure and the most sophisticated visual center before the emergence of the neocortex. More than 90% of RGCs send their axons to SC. However, it is not clear whether the SC simply inherits retinal features or additional and potentially de novo processing occurs in the SC. To answer this question, we investigated the population coding underlying the visual features representation in the SC of awake mice. Specifically, we tested whether the threat signals and neutral features such as orientation and direction information are represented by different subpopulations of collicular neurons. We compared how neurons responded to a looming stimulus and to a bar drifting in different directions. We found that strong direction or orientation selective neurons did not respond to the looming stimulus at all, and looming responsive neurons showed weak direction and orientation selectivity. This observation indicates the looming motion and translating motion are encoded by different neuronal populations, and suggests the beginning of an isolation of the threat signal. Furthermore, we found looming responsive neurons showed strong adaptation. The neuronal response is consistent with behavioral observation that a freely moving mouse shows robust defensive reaction on its very first exposure to the stimulus. Thus these neurons likely function as the threat detector during innate defensive behavior.