

Spatial memory impaired aged rats exhibit a reduced hippocampal gamma-frequency response to changes in running speed and altered spatial information in place fields.

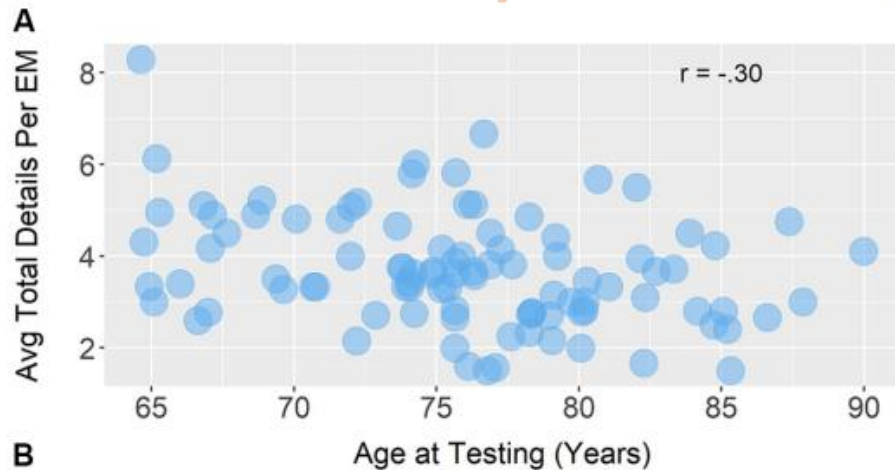
Lindsey Crown, Daniel Gray, Lesley Schimanski, Carol Barnes, Stephen Cowen

Society for Neuroscience 2021 Virtual Presentation

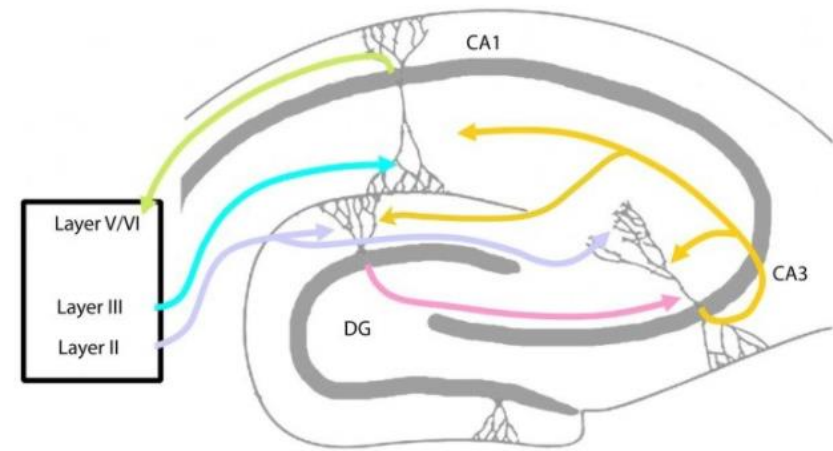
Age is associated with changes to episodic memory

Recall of episodic memory contains less detail, more gist-like information

Non-pathological aging is not associated with cell loss



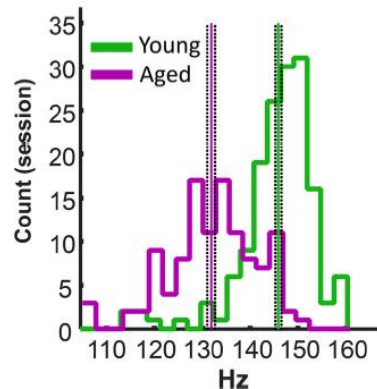
Wank et al. (2020)



Petrantonakis (2014) *Front. Sys Neuro*

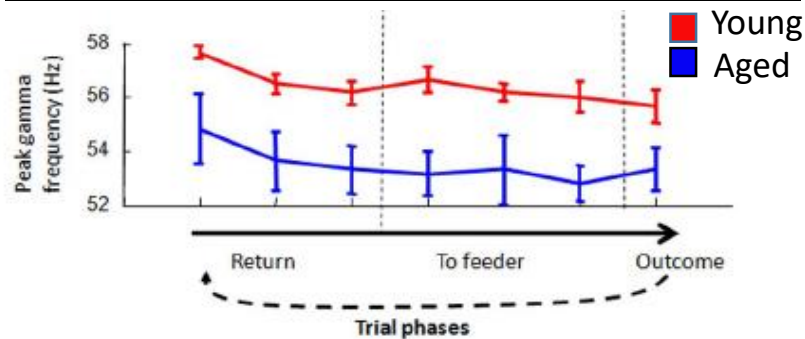
Changes to hippocampal electrophysiology with age should be evaluated with respect to behavior

Reduced Sharp-wave ripple Frequency

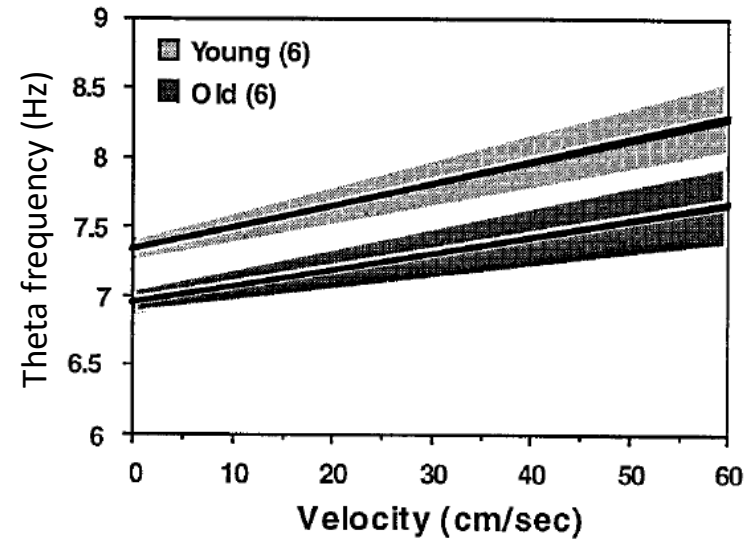


Wiegand et al. (2016) *J. Neurosci*

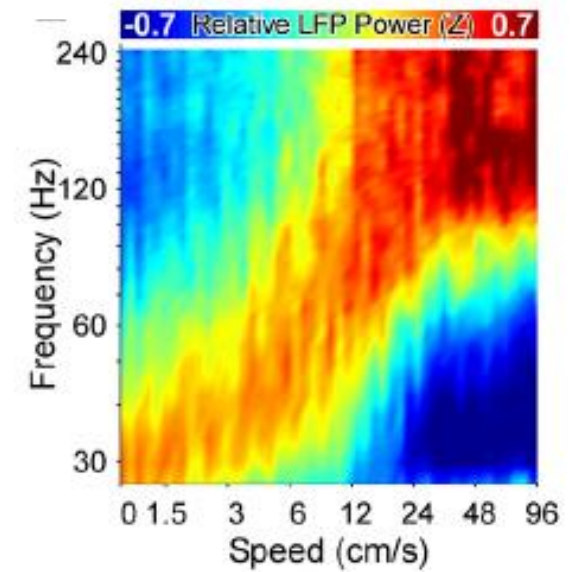
Reduced medial prefrontal Gamma Frequency



Insel et al. (2012) *J. Neurosci*



Shen et al. (1997) *J. Neurosci*



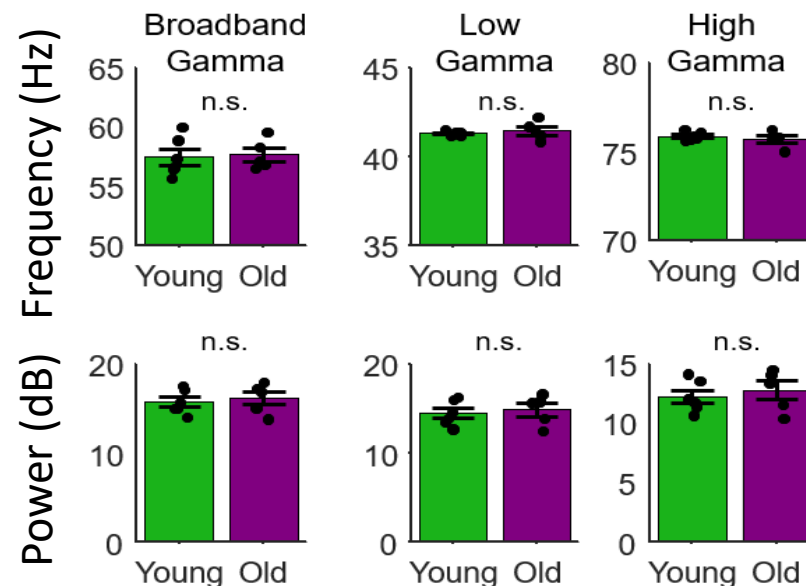
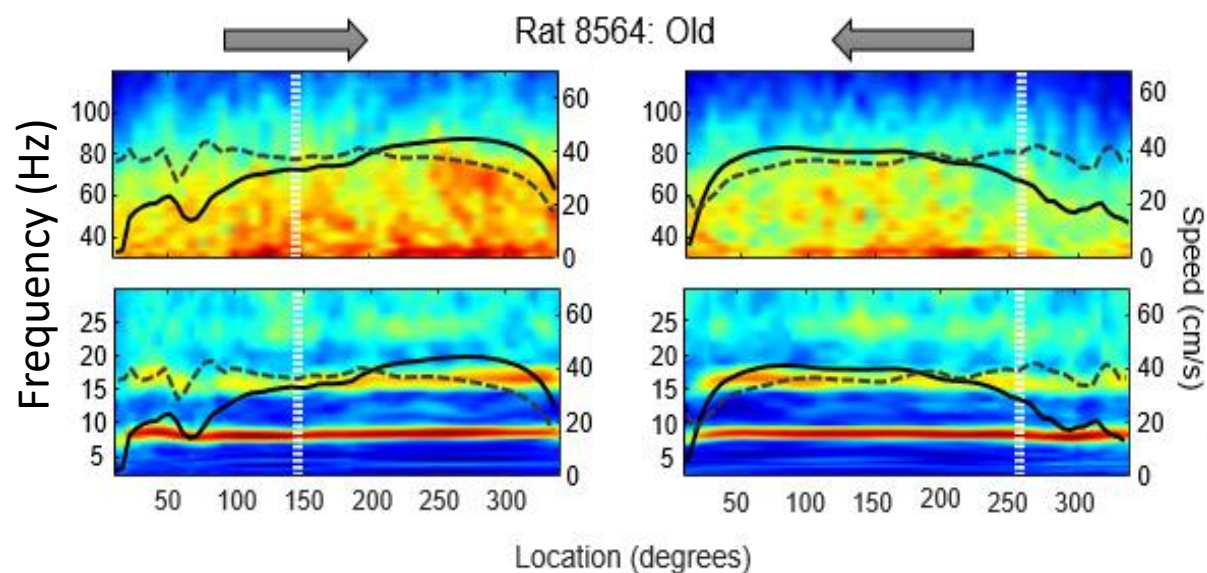
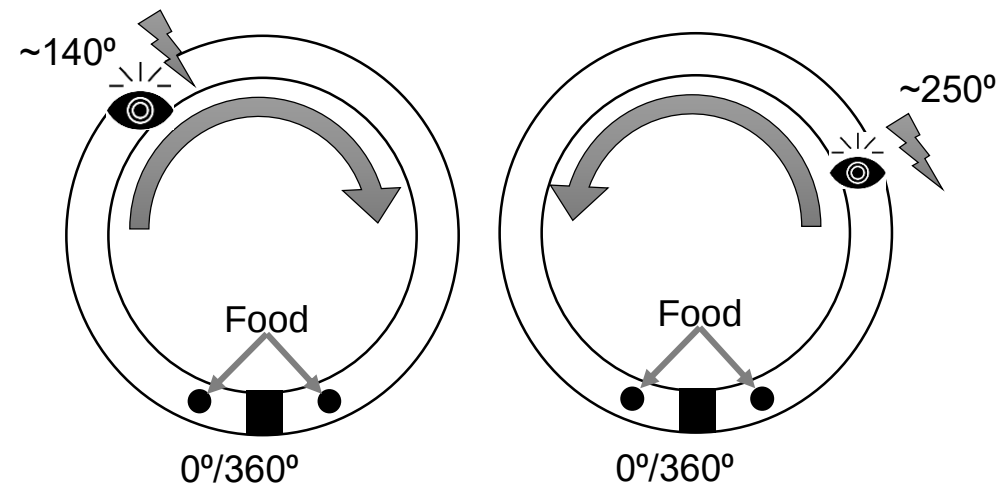
Ahmed and Mehta (2012) *J. Neurosci*

Hypothesis: During locomotion, aged animals will show a decreased relationship between gamma frequency and speed

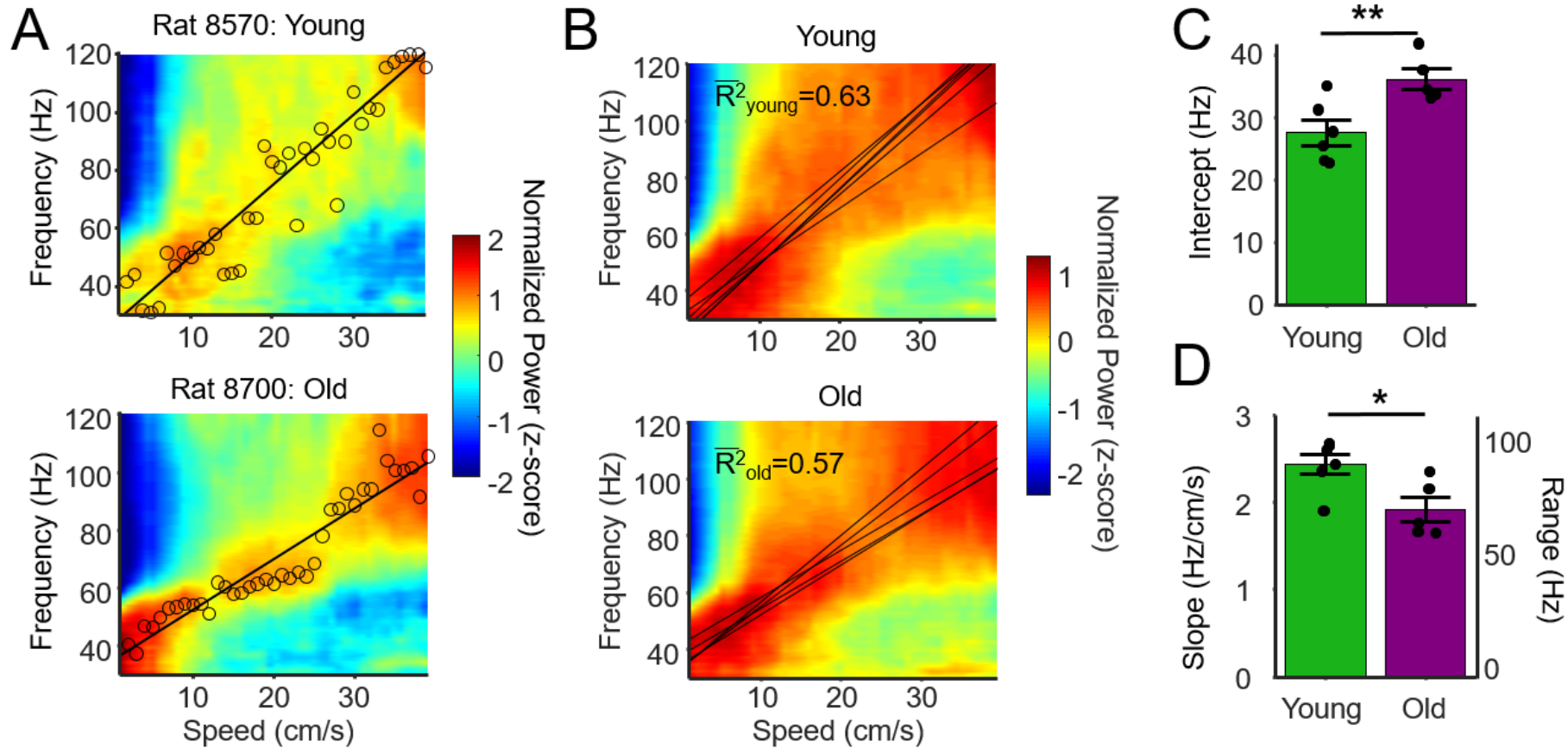
Task Design

- N=5 old, 6 young Fisher-334 rats
- 2 x day, 31 consecutive days
- Only speeds from 1-40 cm/s considered because aged animals could not reach higher speeds
- Aged rats were significantly impaired in learning the location of the hidden platform in the Morris water maze
 - Data published in Schimanski et al. (2013) *J.Neurosci*

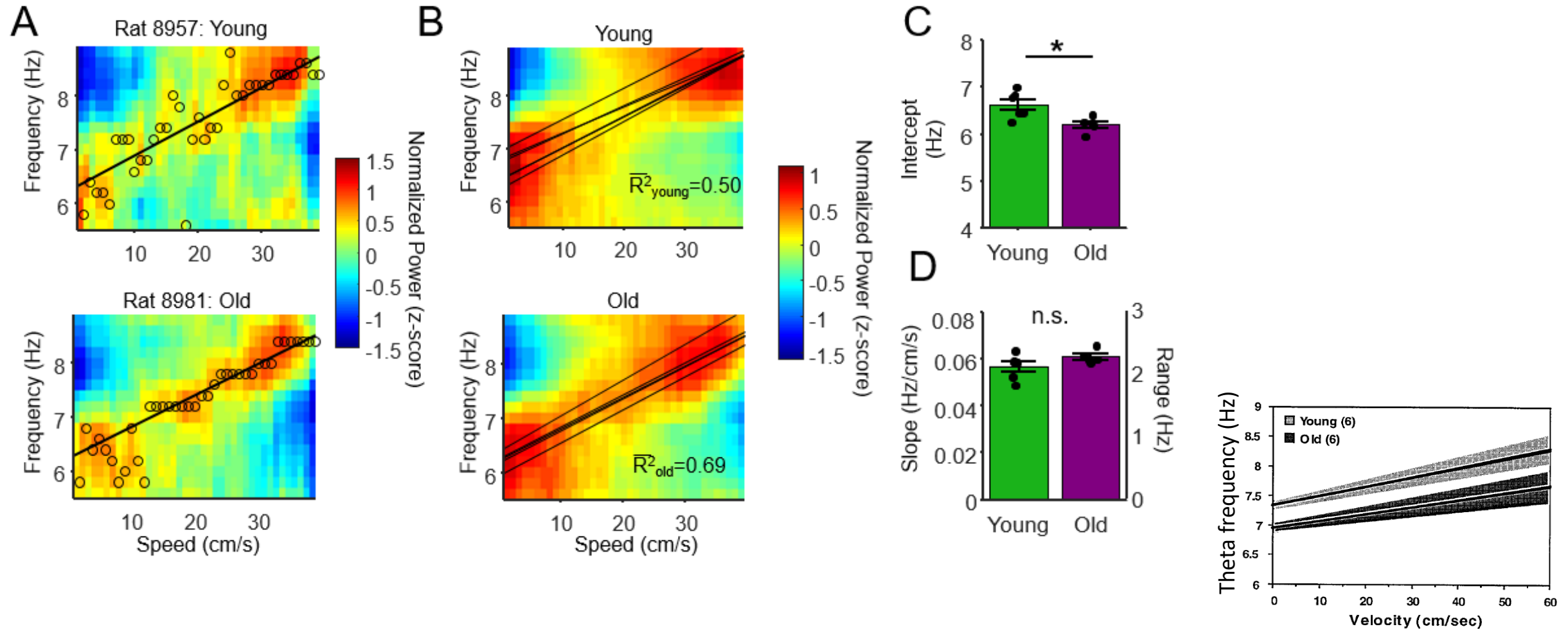
Spatial eye-blink conditioning



Results: The range of gamma frequencies in response to increased running speed is reduced in aged rats



The relationship between speed and theta frequency is not altered by age, though theta frequency is lower across all speeds

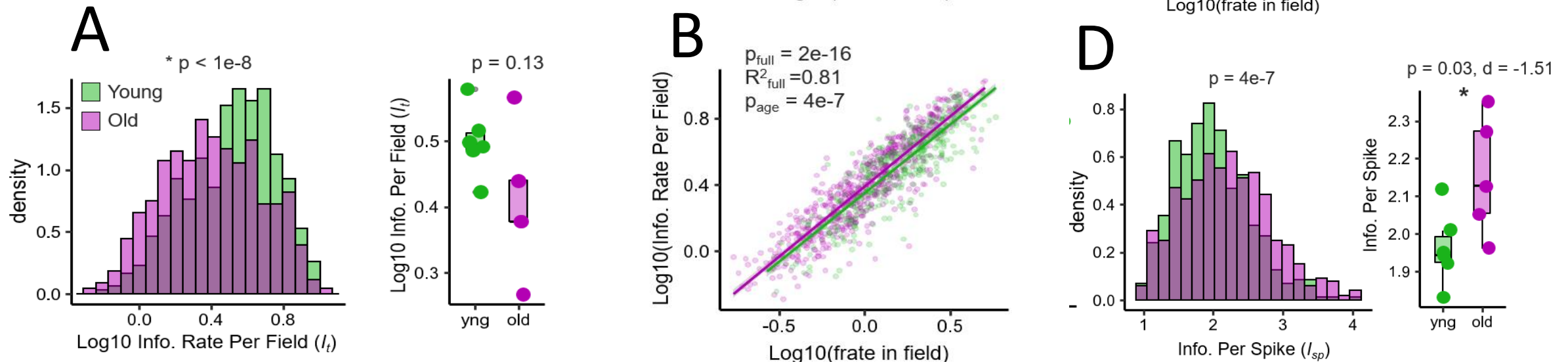


Place cells in old animals increased spatial information per spike and reduced within-field firing rates

- Analysis of 1054 CA1 pyramidal cells, activity restricted to speeds between 5-40 cm/s

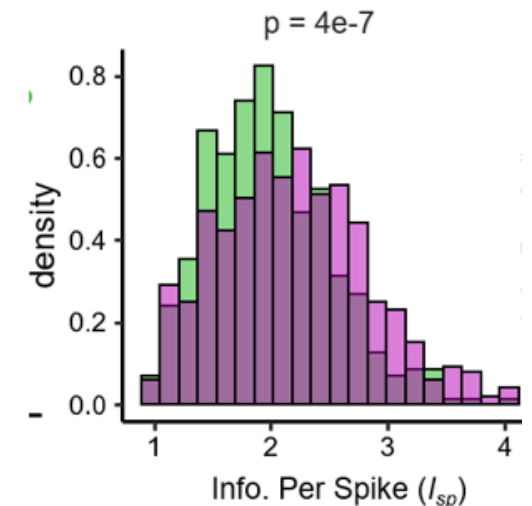
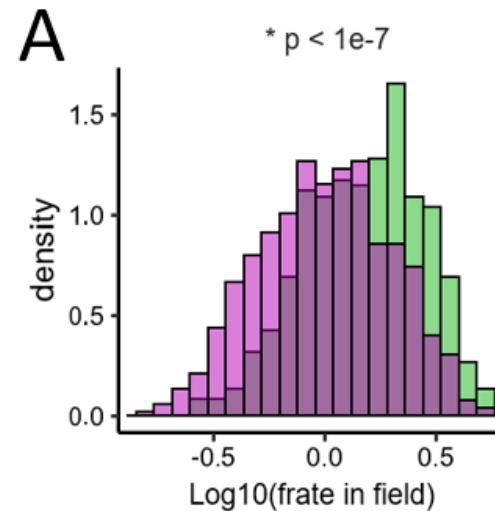
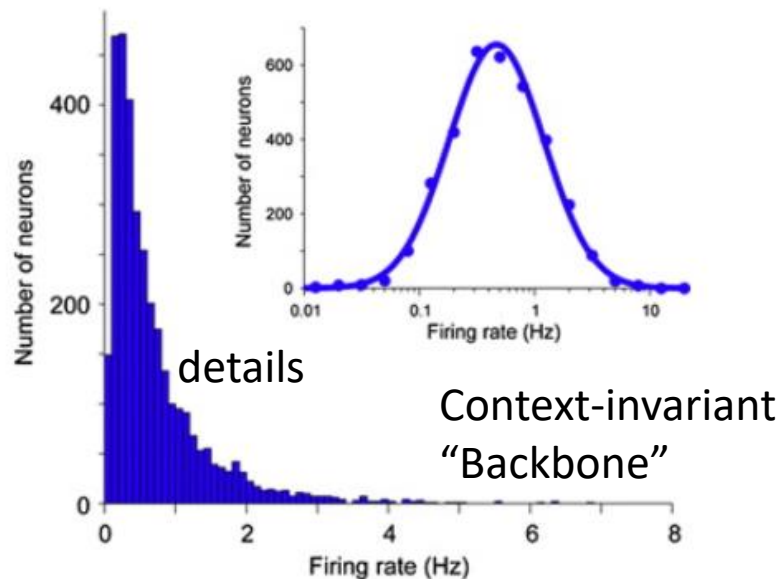
$$I = \int_x \lambda(x) \log_2 \frac{\lambda(x)}{\lambda} p(x) dx$$

Skaggs et al. (1993)



Discussion

- Age does not degrade the “capacity” of a cell (beyond firing rate) to represent spatial information
- Aged neurons may represent different information content



Thank you!



Dr. Stephen L. Cowen



Dr. Carol A. Barnes



RESEARCH, DISCOVERY & INNOVATION
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Older animals had greater spike-field coherence (SFC) to gamma, but not theta

