Texture invariance and its neural basis

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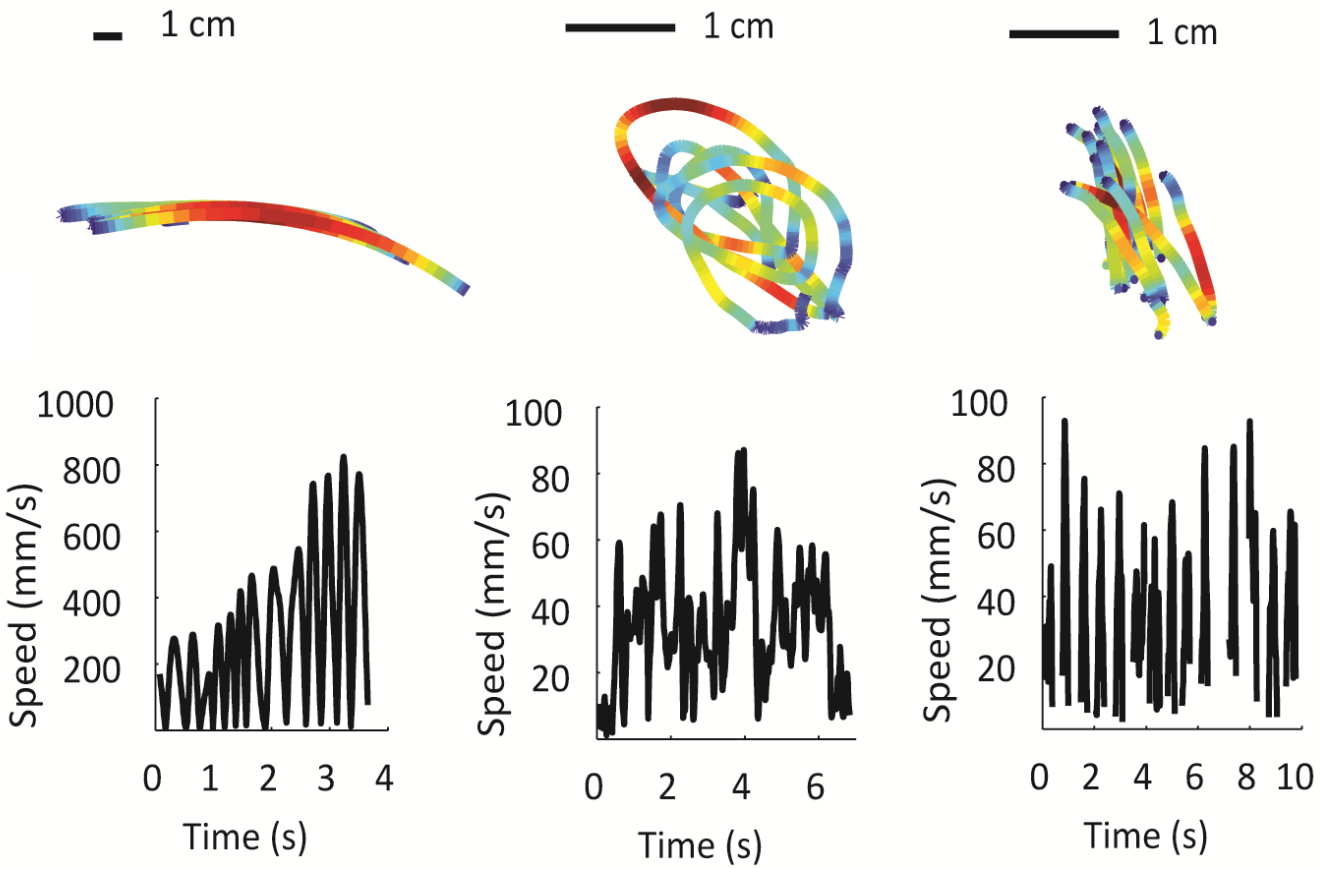
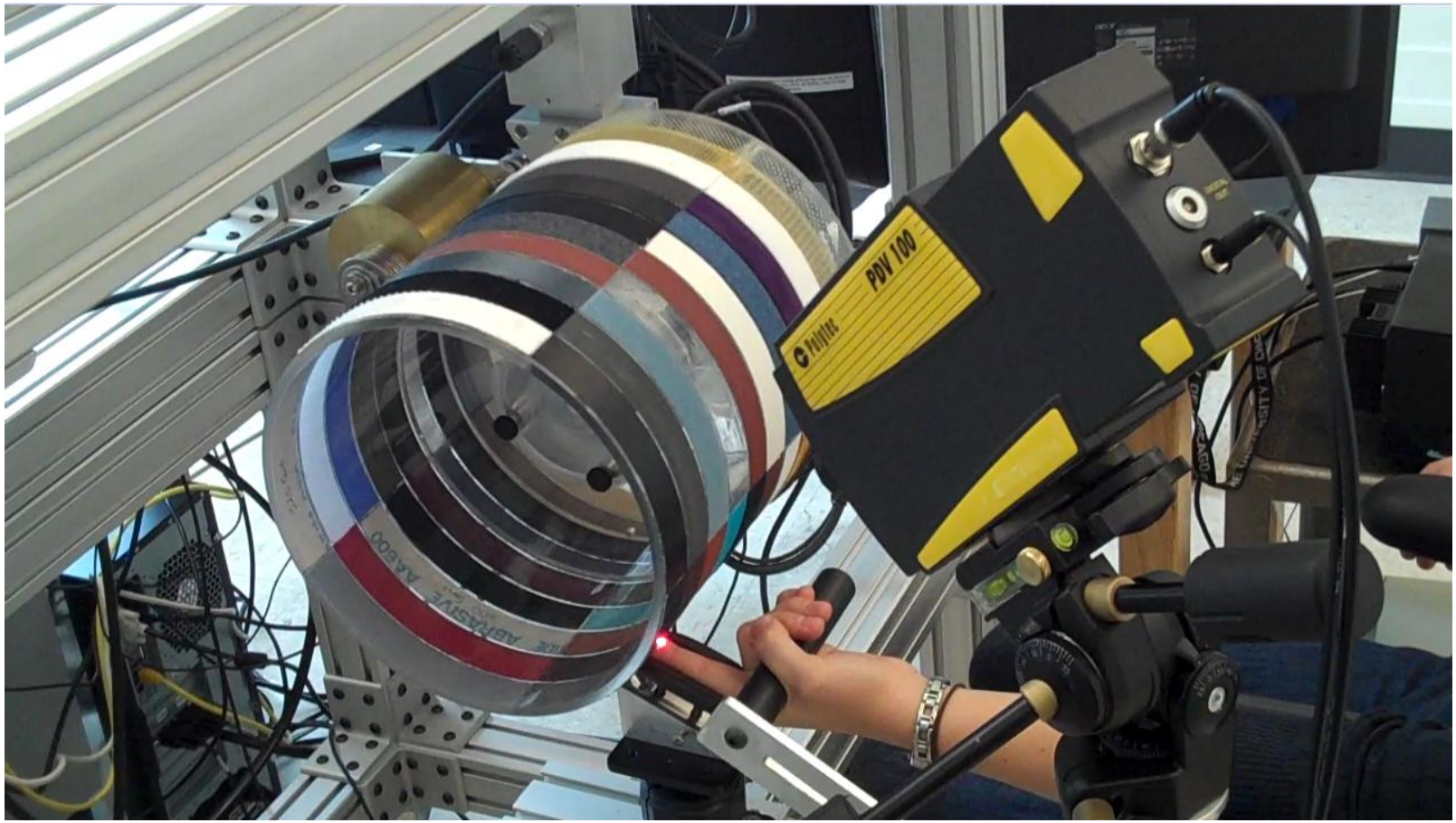
Kinematics of tactile texture exploration

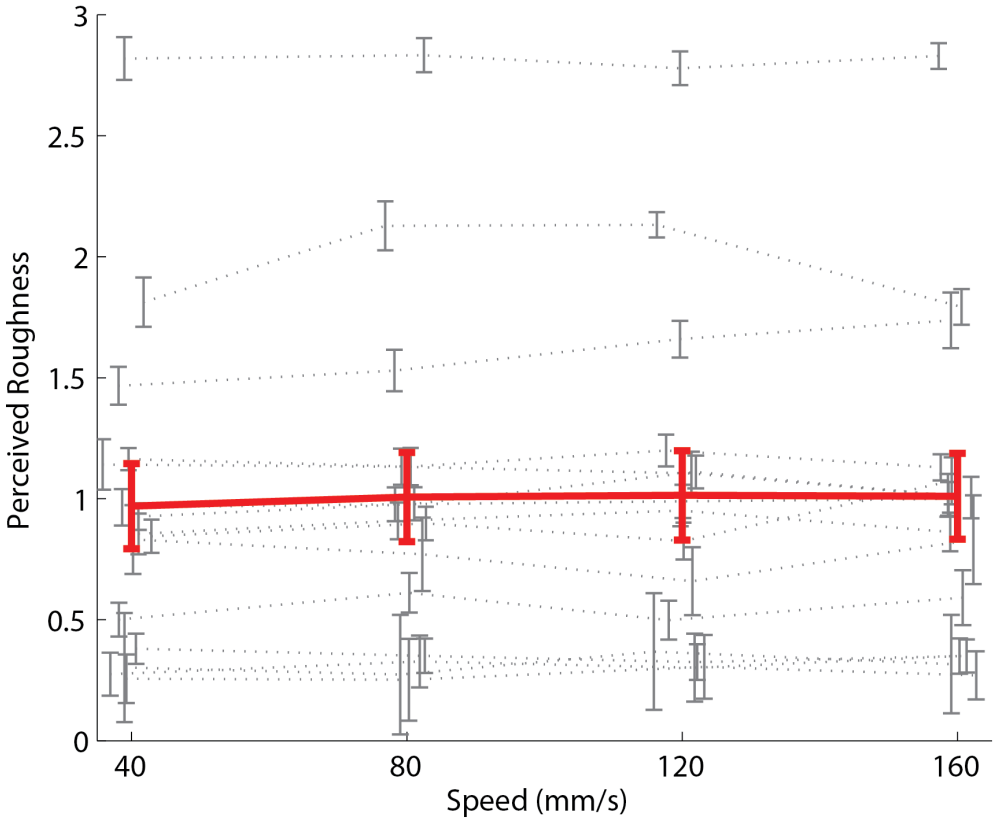


Psychophysics setup



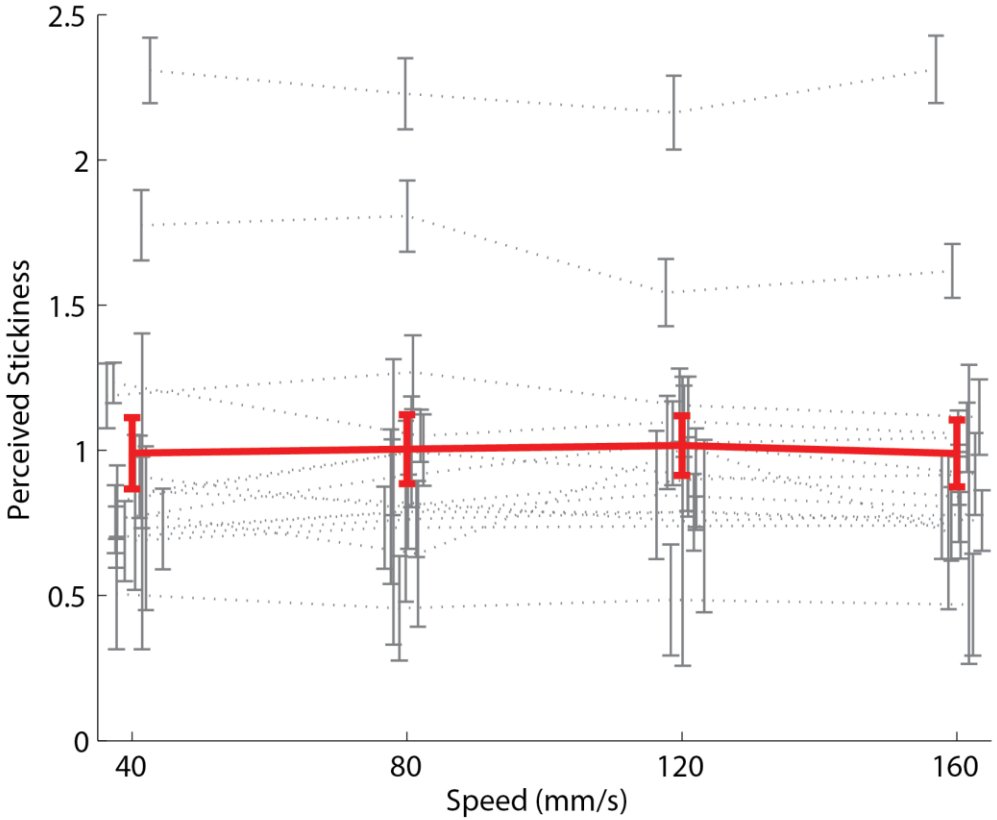
Roughness constancy

Roughness ratings are almost constant across speeds.



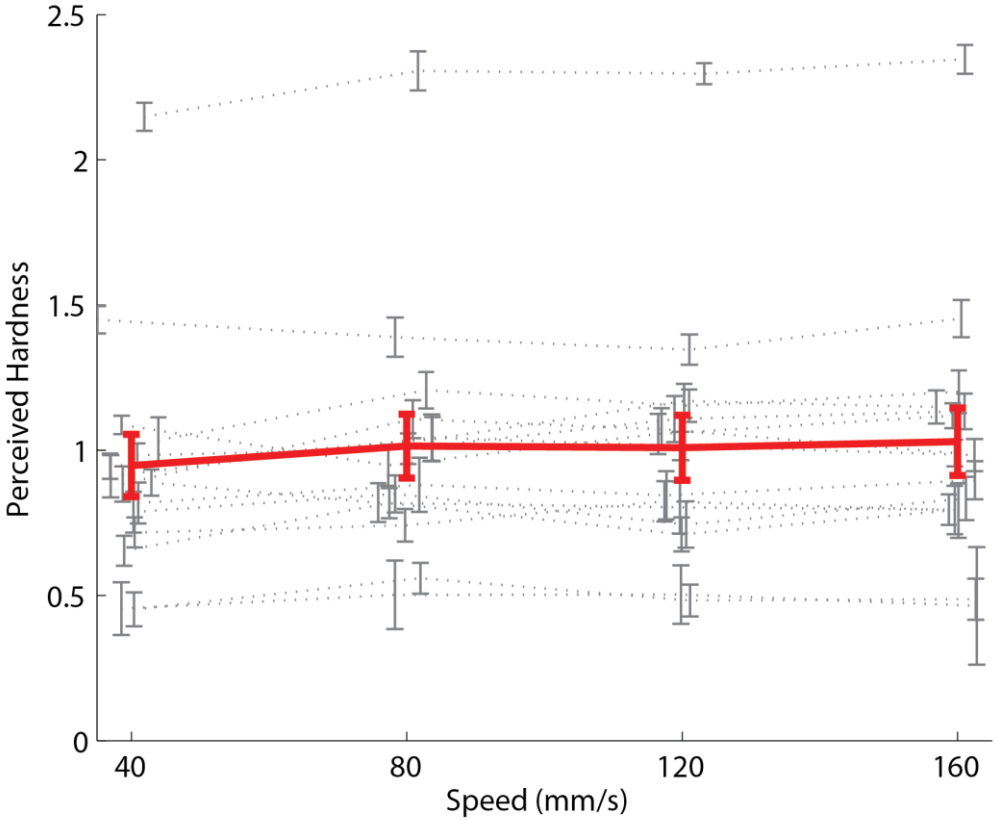
Stickiness constancy

Stickiness ratings are almost constant across speeds.



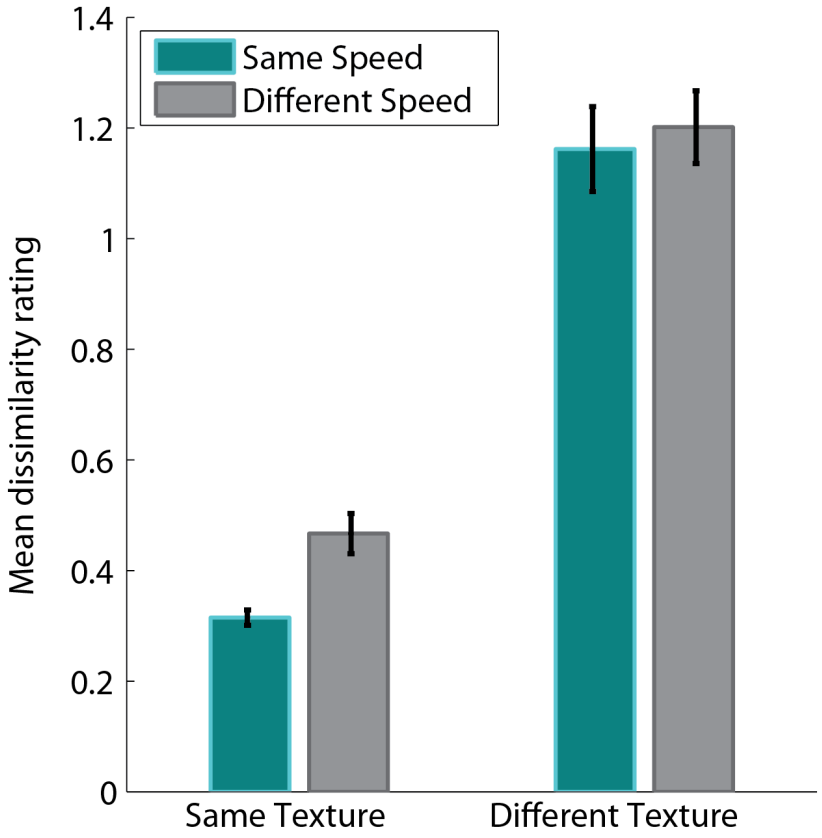
Hardness constancy

Hardness ratings are almost constant across speeds.



Texture constancy

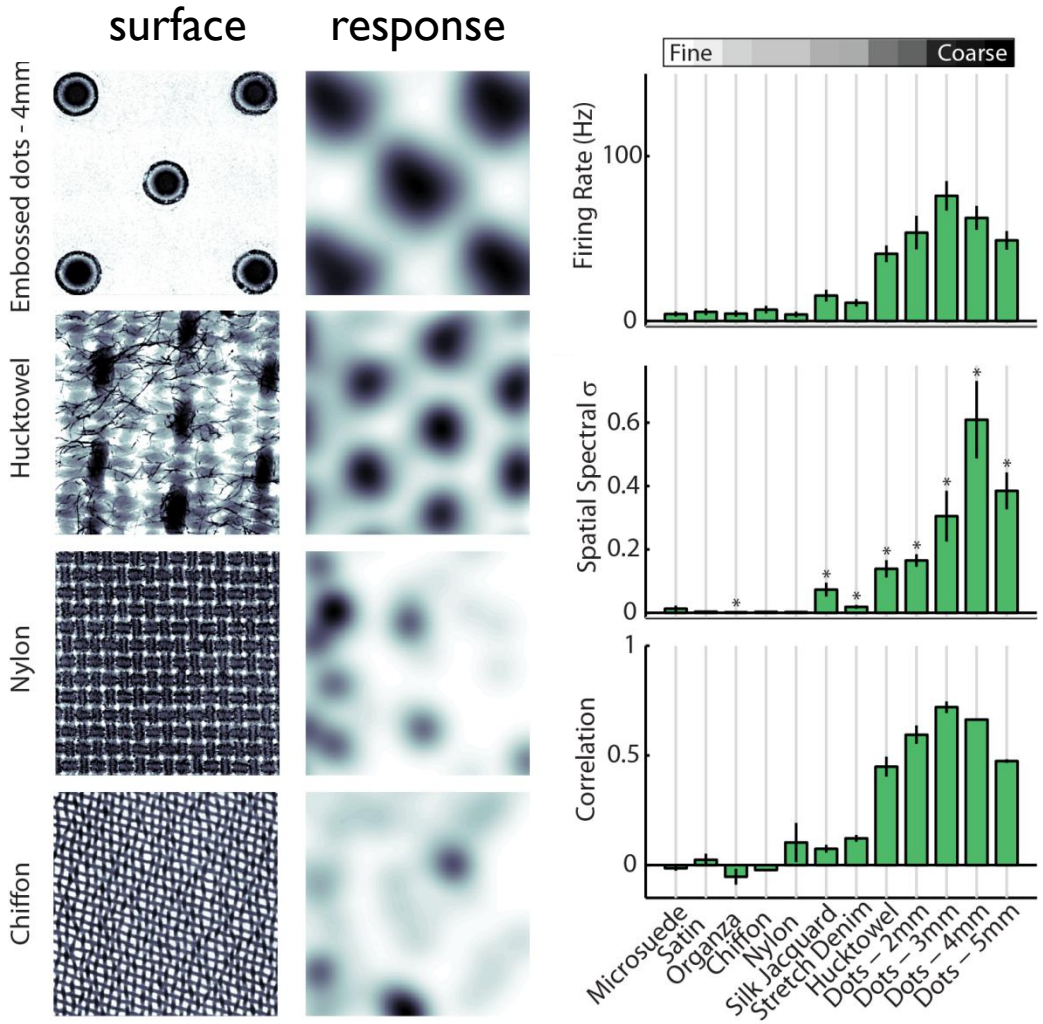
How dissimilar two textures feel is mainly determined by the textures themselves, not the scanning speed.



Texture coding in the nerve

How is texture represented in the nerve and how does this representation change with speed?

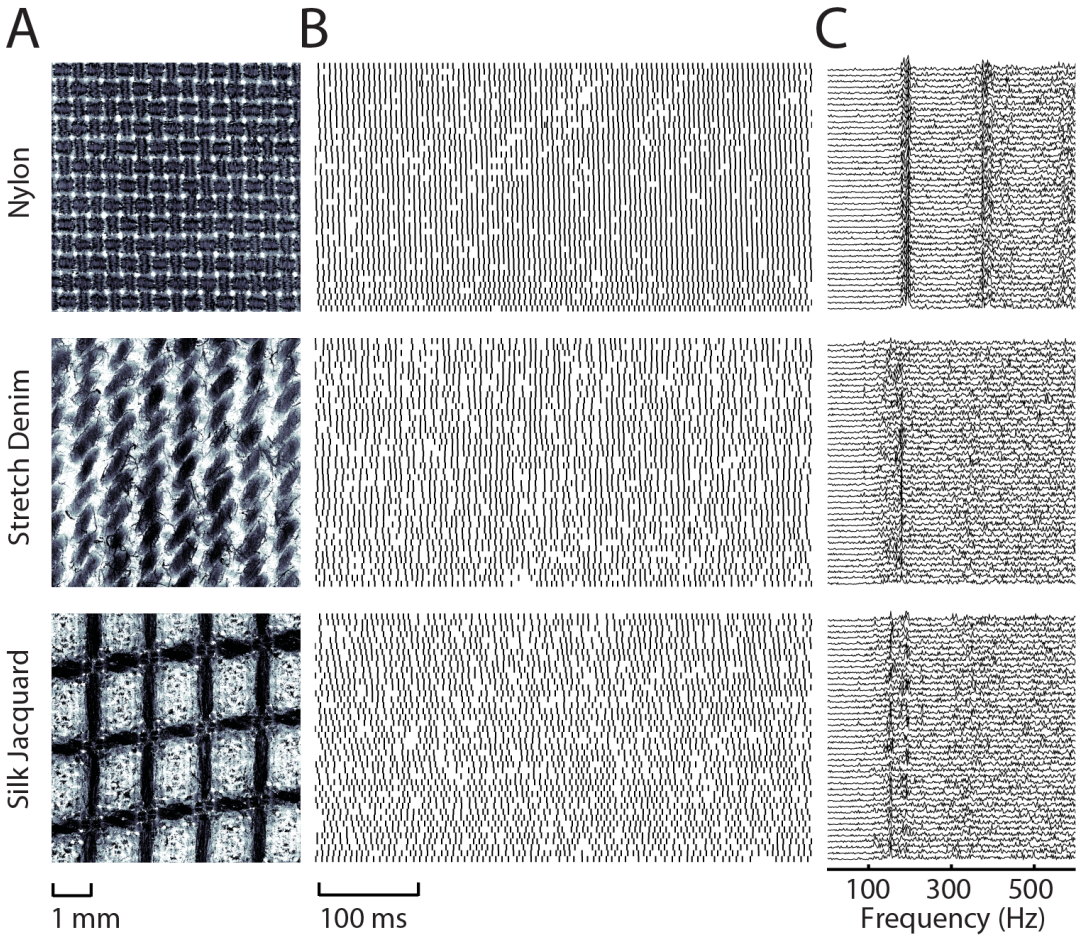
Texture coding in the nerve



Weber et al., PNAS, 2013

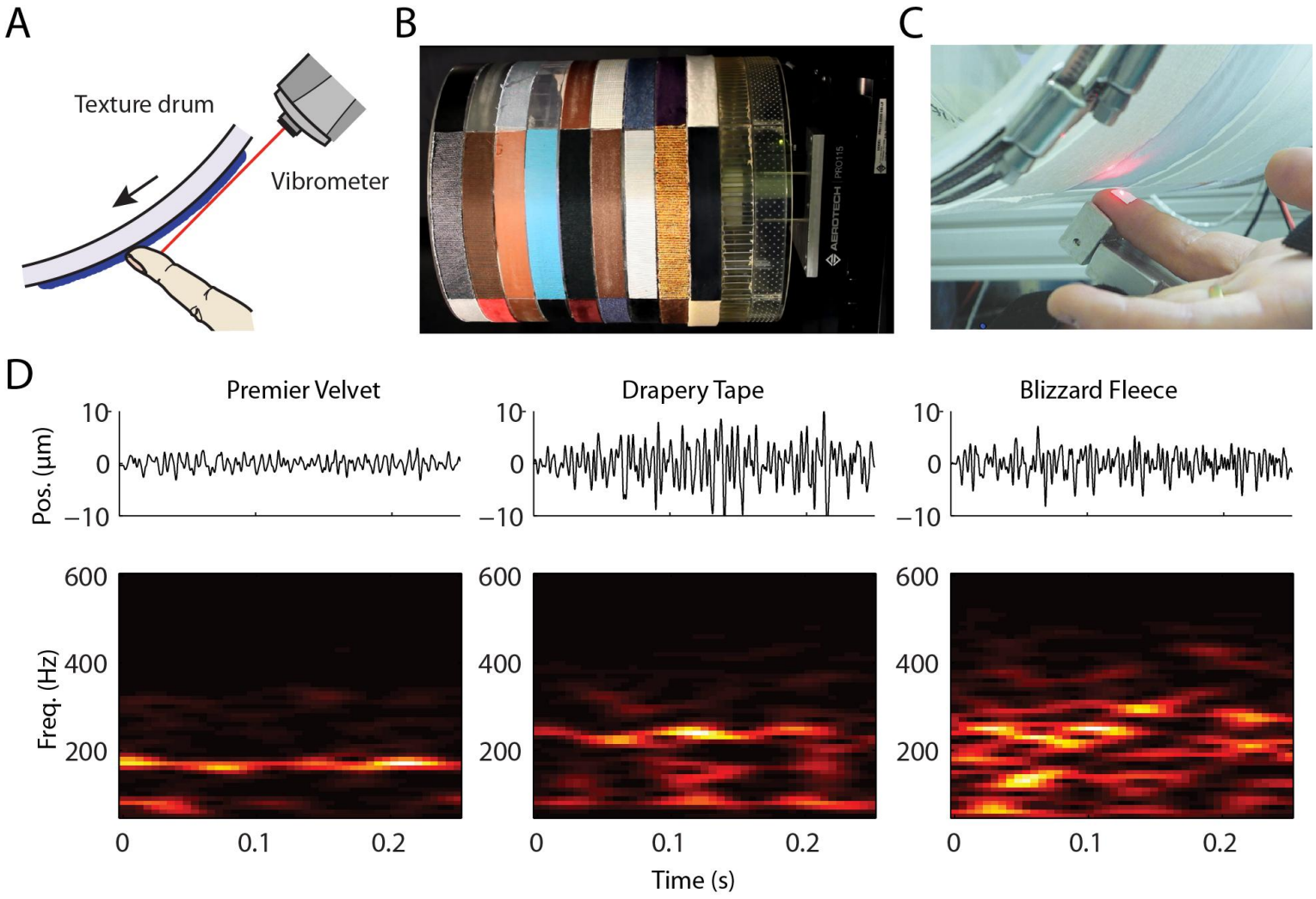
The spatial pattern of SA1 activation reflects coarse but not fine textural features

Texture coding in the nerve

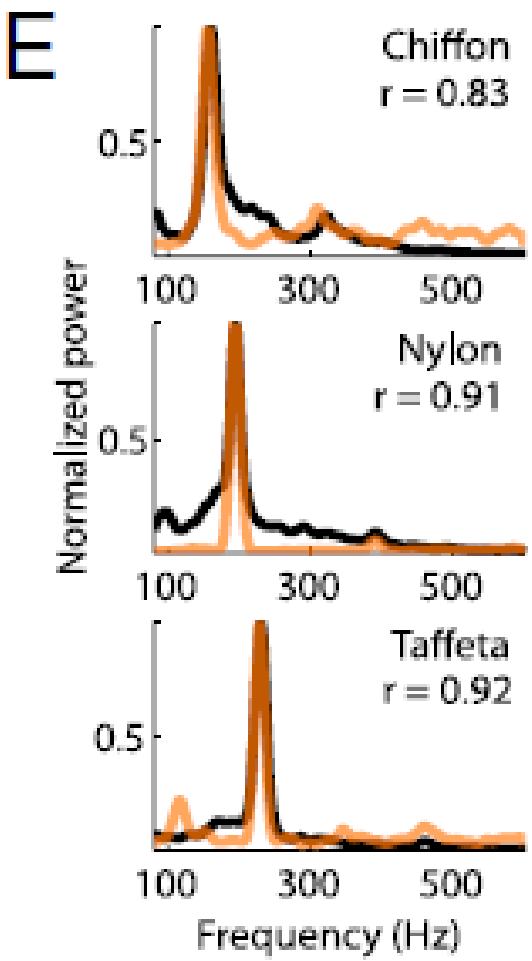


Fine textures evoked highly patterned and repeatable temporal spiking patterns

The vibrations of texture



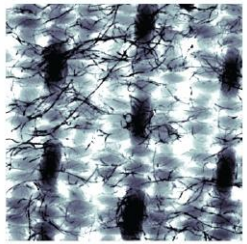
Texture coding in the nerve



PC spikes
vibrations

The big picture

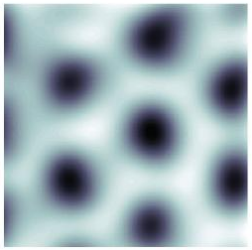
Natural textures



Fingertip deformations

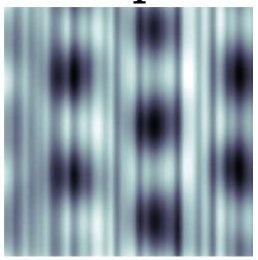
High-frequency skin oscillations

Spatial image in SA1 afferents

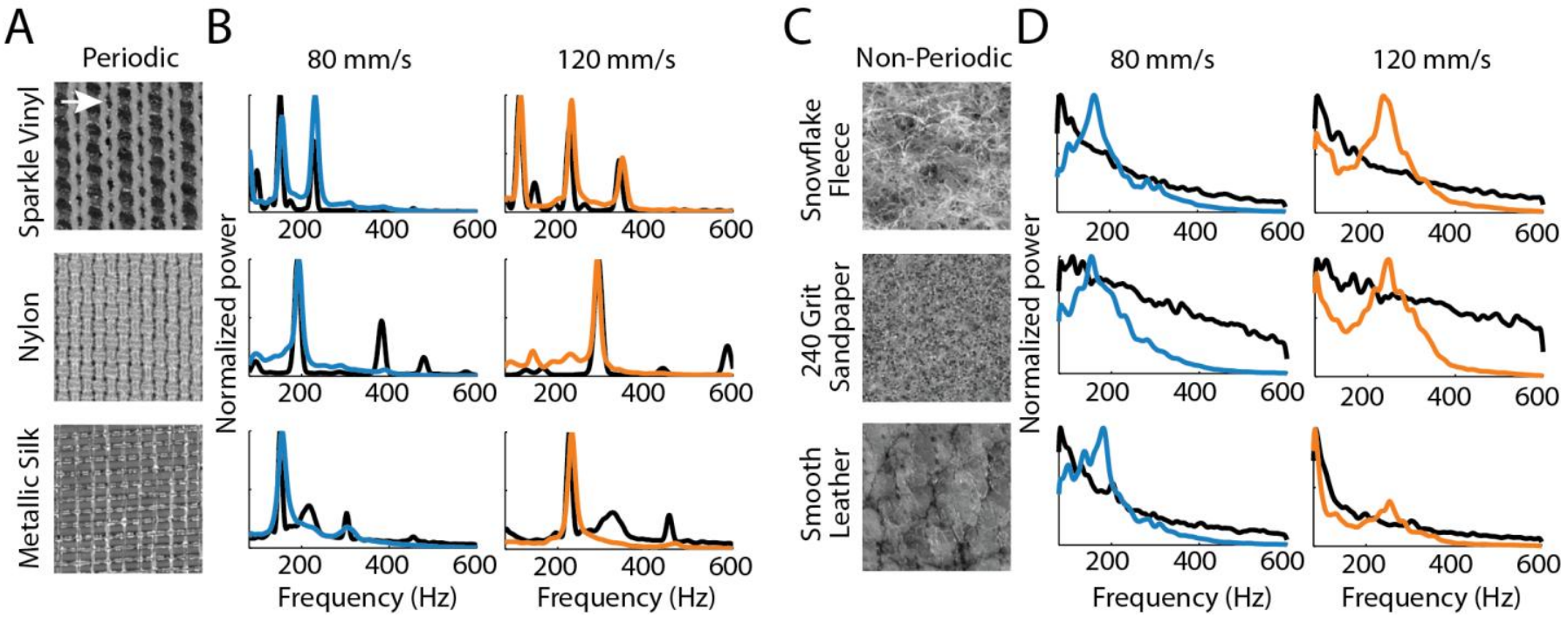


Spike patterns in RA and PC afferents

Unified percept

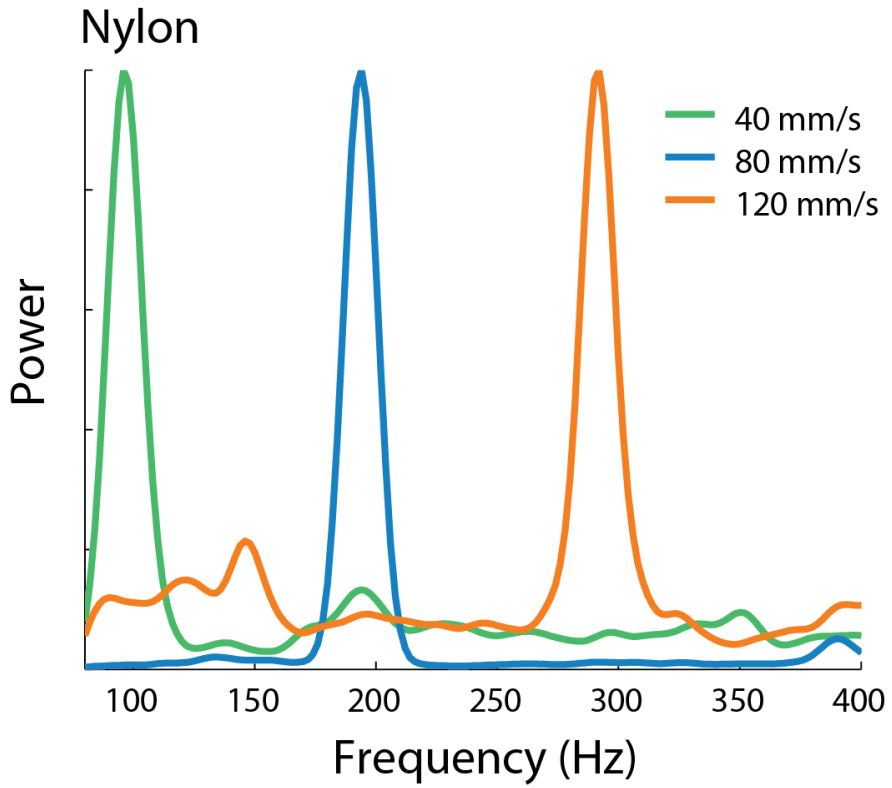


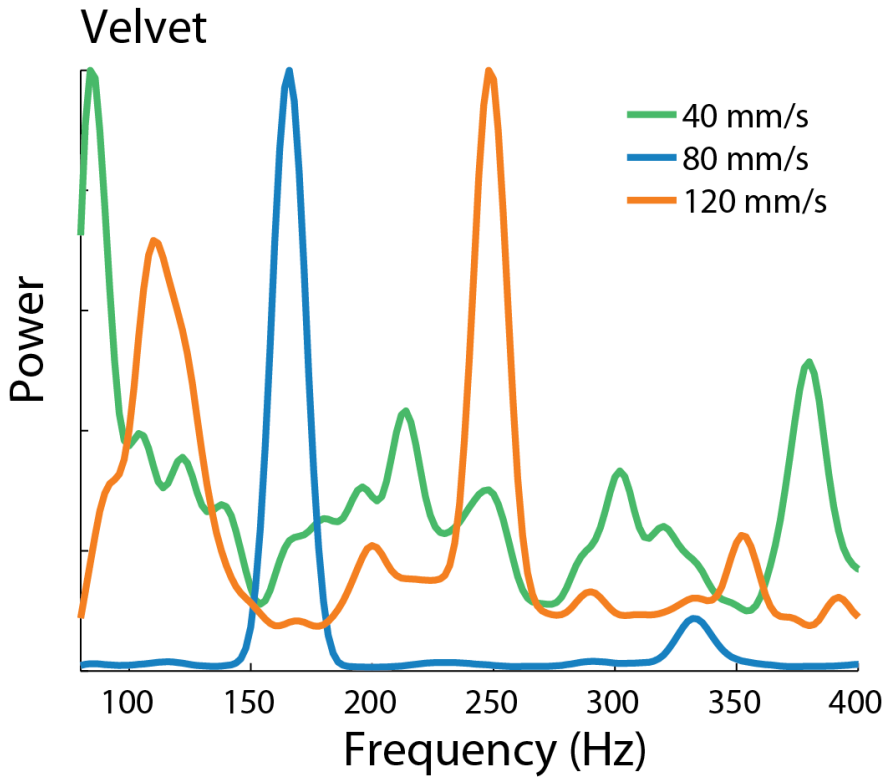
The vibrations of texture



- Textures do not simply reflect surface microgeometry

Texture invariance in the nerve



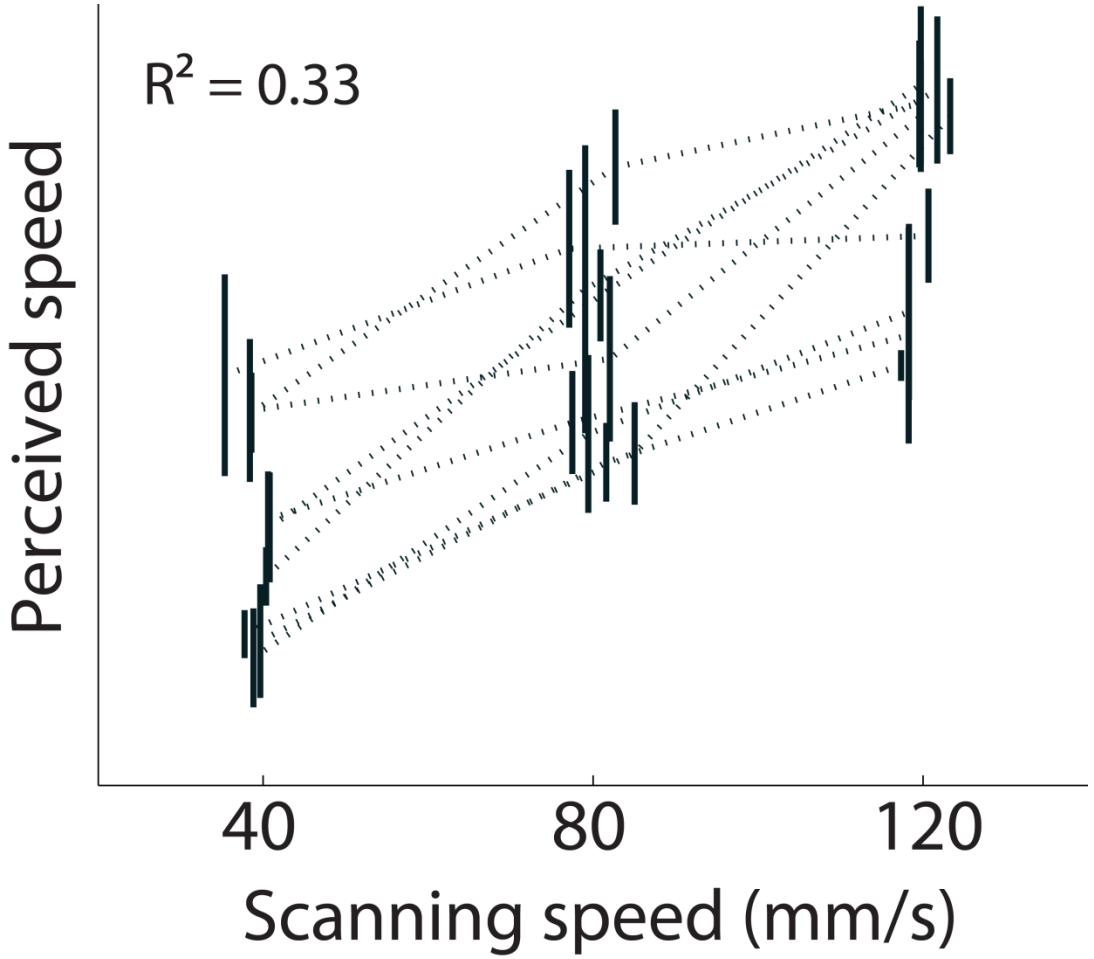


- Temporal patterns dilate or contract with decreases and increases in scanning speed

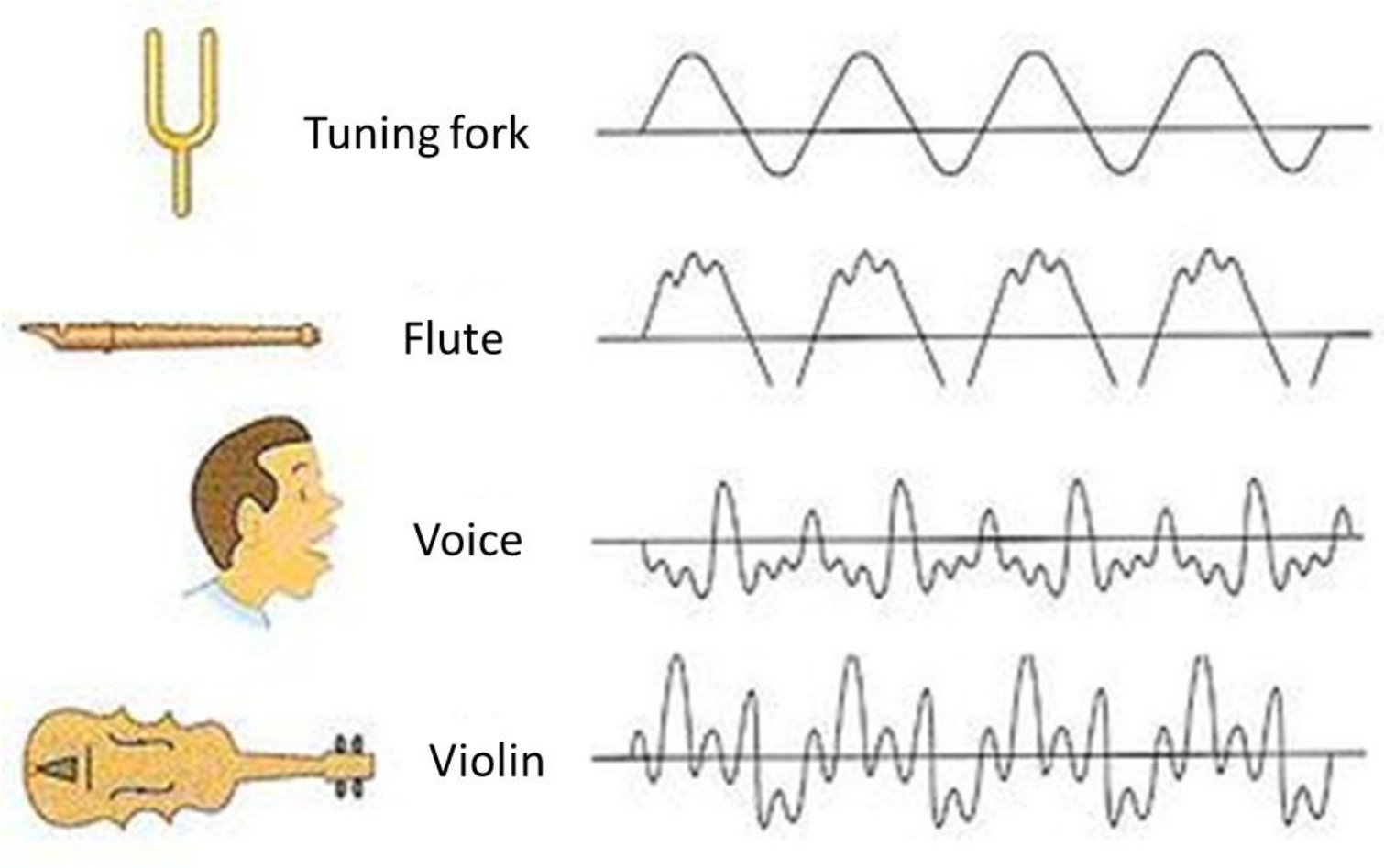
Texture invariance in the periphery

Spiking patterns are invariant texture "signatures" if we know the scanning speed.

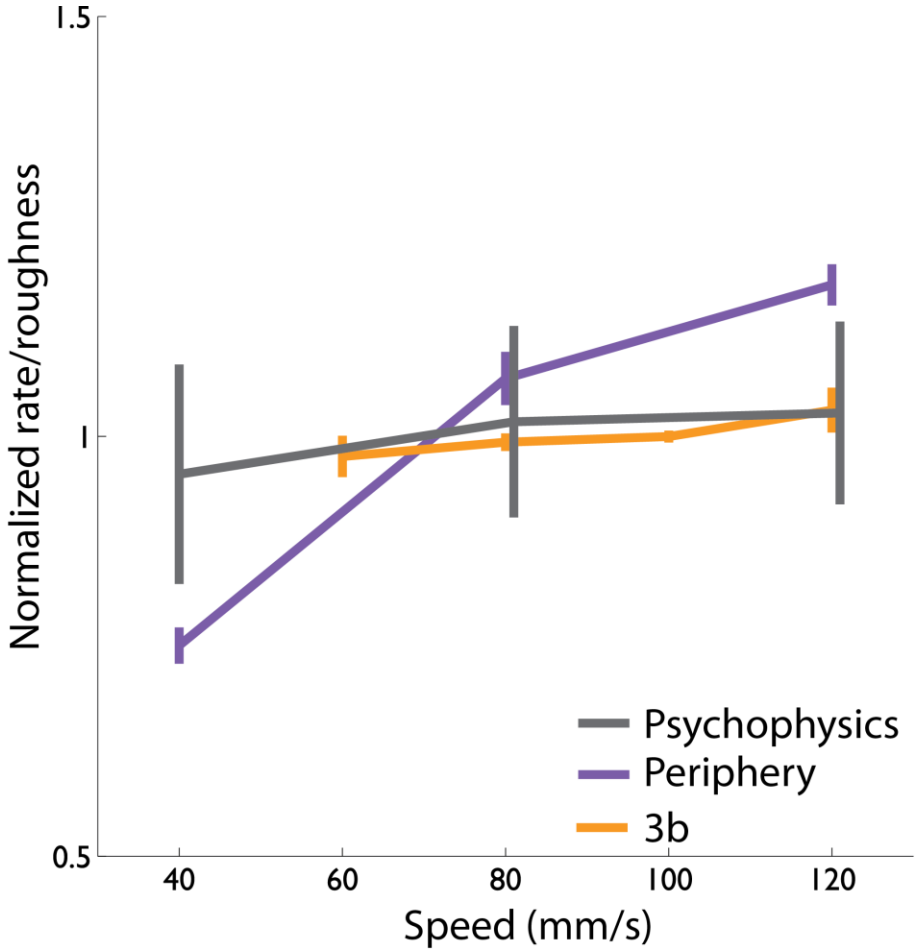
Speed perception depends on the texture



Is texture like timbre?



Texture constancy in cortex



Conclusions

- Our perception of texture is constant across a wide range of scanning speeds and textural dimensions
- The peripheral representation of texture changes with scanning
- An invariant representation of texture can be achieved when scanning speed is taken into account
- Our perception of scanning speed, however, is biased and imprecise
- Texture might be akin to auditory timbre
- Cortical neurons are invariant with respect to scanning speed