Serial Dependence in Radiologist Perception across Naturalistic Mammogram Stimuli

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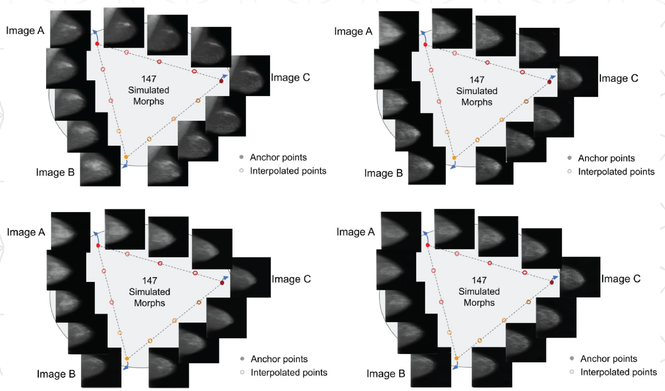
Introduction

Radiologists rely on visual perception to diagnose breast diseases via mammograms. A basic underlying assumption in medical image perception is that clinician visual perception and decision at any moment is largely independent of recently seen radiographs; however, that may not be true. Researchers have found that serial dependence, the tendency for the visual system to bias representations toward recent history, occurs more frequently between ambiguous stimuli just like those found in radiological screening[1][2]. In particular, recent work shows that radiologist perception of simulated tumors is biased toward previously seen stimuli[3]. However, previous work was limited to unrealistic stimuli. To address the limitation, a generative adversarial network was developed to produce naturalistic mammogram stimuli[4]. In this study, we aimed to investigate if radiologists also experience serial dependence with these realistic stimuli.

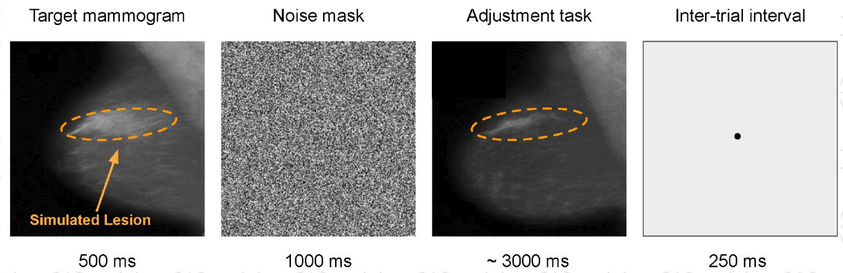
Experiment Stimuli

We utilized a controllable generative model[4] trained on Digital Database for Screening Mammography (DDSM) to generate morph wheels as experiment stimuli.



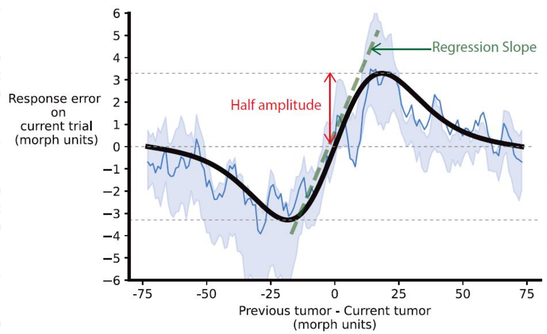
Sample Morph Wheels

Experiment Design



Data Analysis

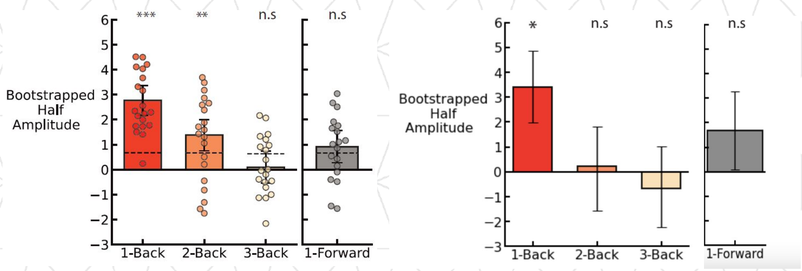
- A derivative of Von-Mises curve was fitted onto the raw data of response error vs morph difference.
- A linear slope was also captured between the peaks.



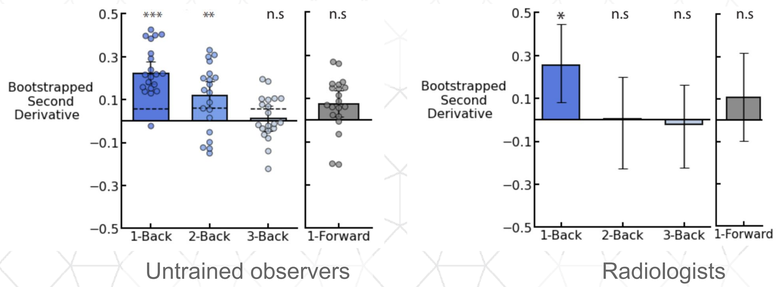
$$y = -\frac{a\kappa \sin(x-\mu)e^{\kappa\cos(x-\mu)}}{2\pi I_0(\kappa)}$$

Results

- Half amplitudes



- Regression slopes



Conclusion

The reported mammograms were pulled 9% towards those seen in the previous trials for radiologists. These findings suggest that serial dependence extends to realistic radiographs and that it occurs even for radiologists. Serial dependence could therefore have a negative impact on the diagnostic accuracy of practicing clinicians.

References

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3. Manassi, Mauro, Árni Kristjánsson, and David Whitney. "Serial dependence in a simulated clinical visual search task." Scientific reports 9.1 (2019): 1-10.
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