



# Utilizing Response Time Models Throughout a Therapeutic Yoga Intervention



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## Cancer-Related Cognitive Decline

According to the American Cancer Society projections, there will be over 2 million *new* cancer cases diagnosed throughout the United States in 2025. A substantial portion of these patient will battle **cancer-related cognitive decline** (CRCD), commonly referred to as “chemo-brain.” CRCD is a cluster term referring to any cancer-related cognitive impairment, but the deficits most commonly occur in attention, executive control, working memory. CRCD can be debilitating, and patient experiences often include:

- Difficulty speaking, multitasking, and paying attention
- Getting lost while driving familiar routes
- Struggling to complete typical vocational tasks

These symptoms often have stark ripple effects, including financial strain, medication nonadherence, and lower survival rates. To minimize the impact to a patient’s quality-of-life, there has been a surge in CRCD research across the last 20 years.

## Measurement Concerns

So, what’s the problem?

- Rate of CRCD incidence ranges from 15%-75%, depending on the study
- Qualitative and quantitative measures frequently lack correlation
- Across 34 articles, 61 different assessments were utilized, all meant to represent CRCD
- Response time tasks are only analyzed with mean-based assessments, despite our understanding of response time distributions.

**Our measurements are not consistently capturing CRCD.**

## Response Time Modeling

Utilizing a response time modeling approach could help bridge the gaps in our understanding of CRCD, as it provides the following benefits:

- Increased sensitivity (White et al., 2010)
- A stronger connection between theory and data (Ratcliff et al., 2006)
- The ability to account for all behavioral data, including accuracy and error rates, with better fitting models

## The Current Study

The current study was a collaborative work led by the HEAL team from UT Health San Antonio. The goal of this collaboration was to determine if a holistic intervention could improve quality-of-life for cancer patients and survivors, particularly for underserved populations in Texas. This six-month intervention combined therapeutic yoga with mindset-based messaging, culturally-informed recipes, and social support. We assessed a wide variety of life sectors, including physical health, physical ability, mental health, social support, spiritual health, and cognition. As CRCD impacts multiple domains, the cognitive assessments included an attention task, a working memory task, an anticipated response inhibition task, and a self-report survey. We began this study in May with 41 women from San Antonio and Laredo, Texas, 32 of which completed the study this November.

## Modeling Attention

To assess attention, participants completed the Attention Network Test (ANT; Fan et al., 2002), as it is one of the most common attention tasks utilized in CRCD research. The ANT data was fit with a modified version of the drift diffusion model, the shrinking spotlight model (SSP; White & Curl, 2018). This model is composed of six parameters: spotlight width, shrinking rate, non-decision time, boundary separation, perceptual strength, and starting point. Spotlight width and shrinking rate are interpreted as a ratio, creating the parameter for **interference time**, providing a measure for how attention focuses onto the center arrow.

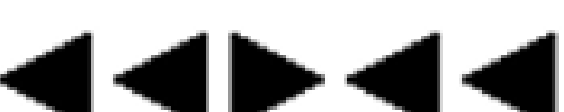
Neutral Trial



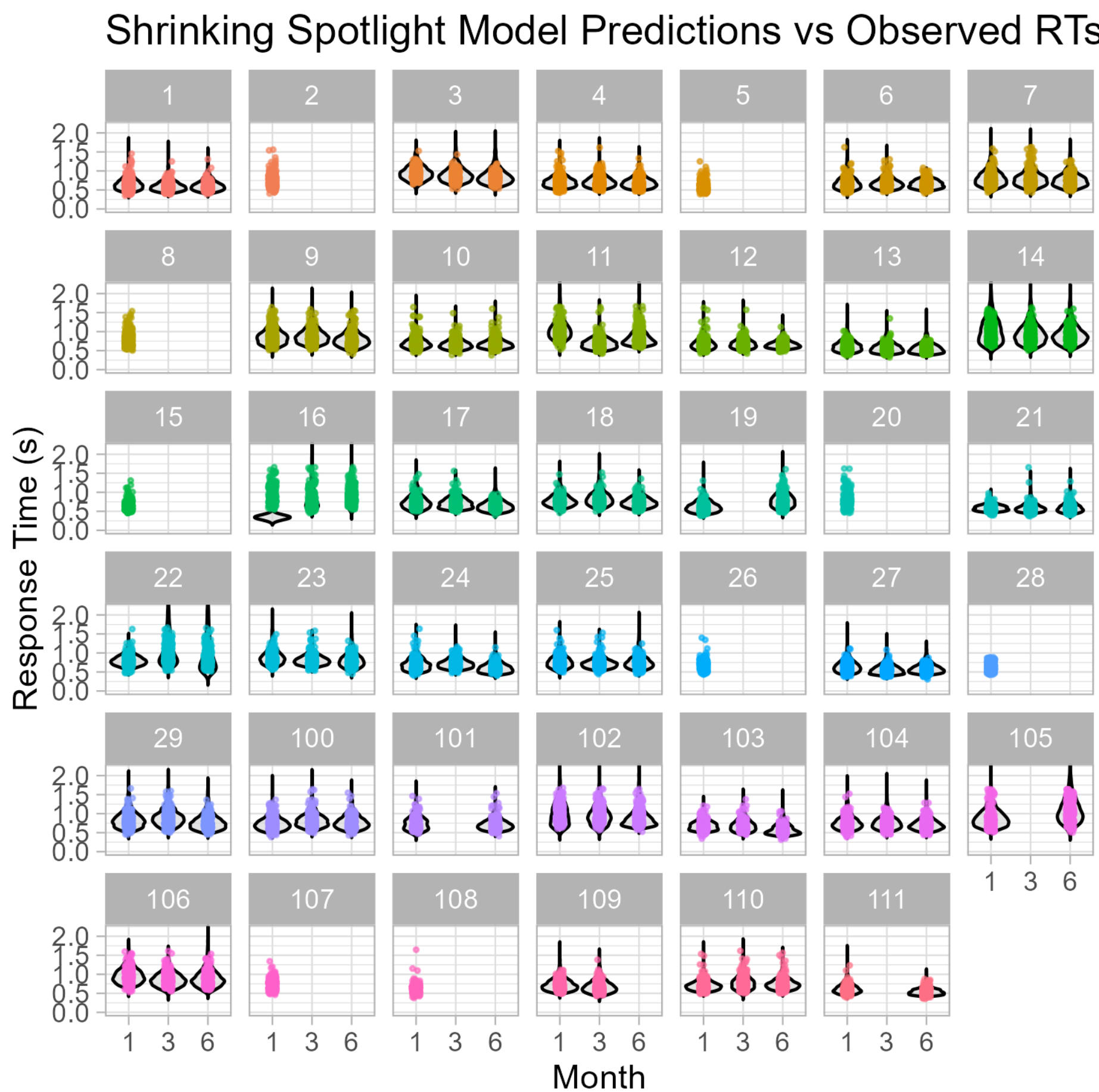
Congruent Trial



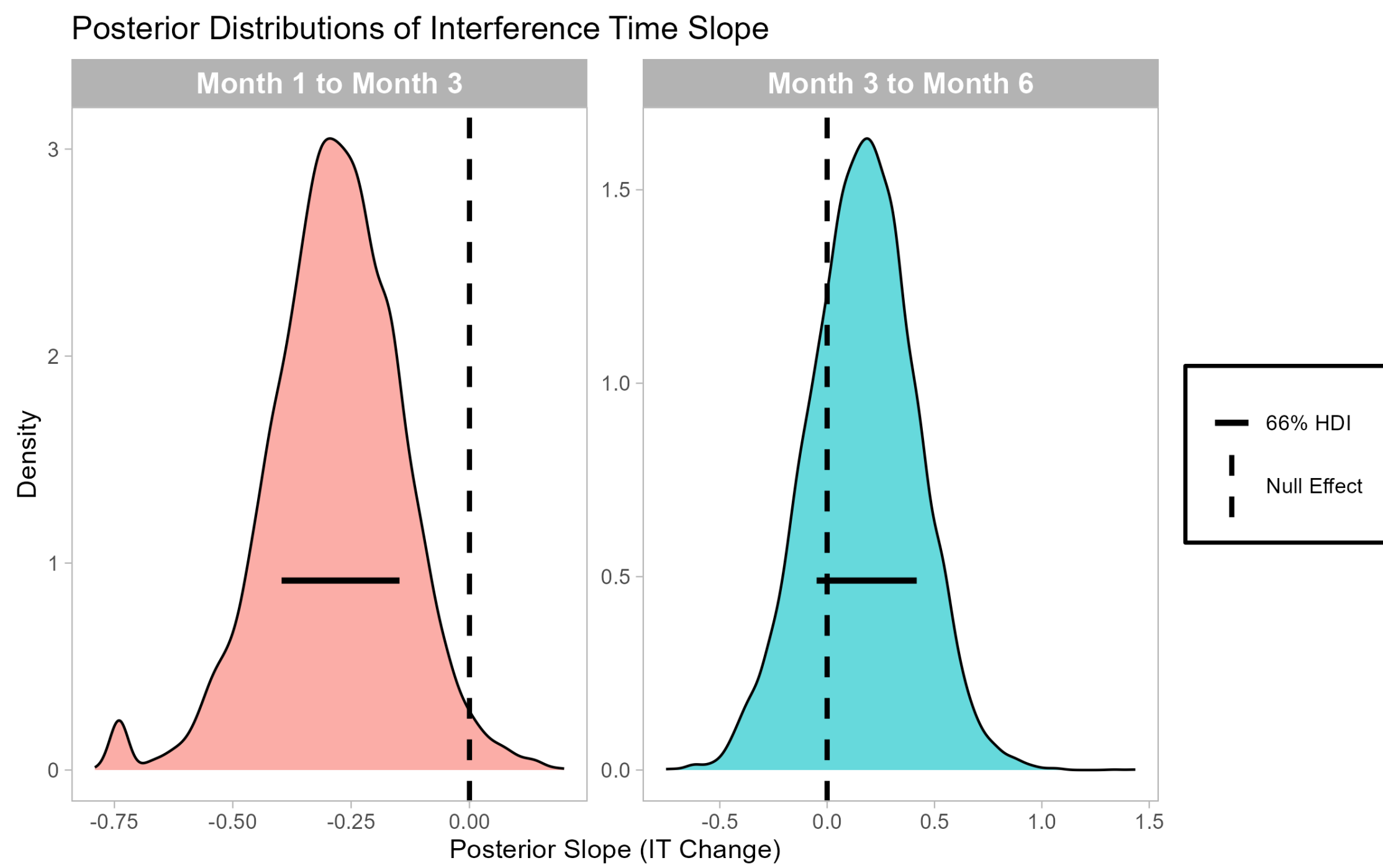
Incongruent Trial



## Model Fit



## Changes Over Time



**Pre-Intervention to Midpoint:**

- Mean change for interference time was -0.284
- 98.14% of the posterior distribution supported a decrease from pre-intervention to midpoint
- The 66% HPDI fell between -0.397 and -0.148

**Midpoint to Post-Intervention:**

- Mean change for interference time was 0.167
- 24.58% of the posterior distribution supported a decrease from midpoint to post-intervention
- The 66% HPDI fell between -0.049 and 0.417

## Discussion & Next Steps

While we did not see a decrease between the midpoint and post-intervention, this is not particularly surprising, as there is a limit to how much attention can improve. What will be more informative is determining if there were biological shifts that coincided with attentional improvements. Thus, the next steps of this project will include:

- Applying the ex-Gaussian stop-signal model to the executive control task data (He et al., 2022; Matzke et al., 2013)
- Evaluating working memory capacity with systems factorial technology (Townsend & Wenger, 2004; Cox & Criss, 2017)
- Assessing the role of inflammation and stress in the changes in attention
- Comparing the sensitivity of response time modeling to mean-based assessments
- Evaluating the efficacy of a response time modeling approach in the health sciences

For references, contact information, and more, please see QR code. Questions, concerns, or ideas are welcome.

