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Hue Bands and Human Perception: Revisiting the Rainbow

Introduction

We know rainbow color maps are bad, but experts insist on using them. *Why?*

Our community argues that rainbow color maps are ineffective, in part, because they implicitly discretize encoded data into hue-based bands[1,2,3].

Reasons Rainbow Color Maps Are Harmful

1. Hue is not perceptually ordered
2. Have regions that hide data variation
3. Have false boundaries that highlight non-existent data relationships

are discretized into hue-based bands*

No existing research shows:

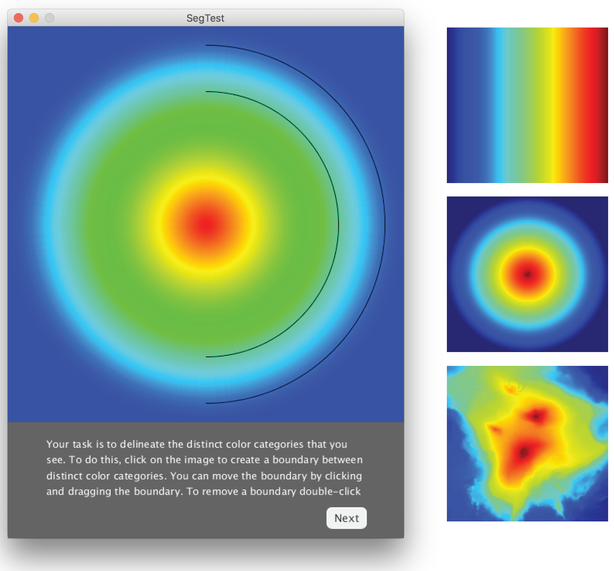
- what this discretization looks like
- whether it is consistent across individuals
- what this means for different spectral schemes

**...is implicit discretization truly problematic?*

Our prior work[4] showed that discrete encodings of continuous data are not necessarily problematic and sometimes even beneficial.

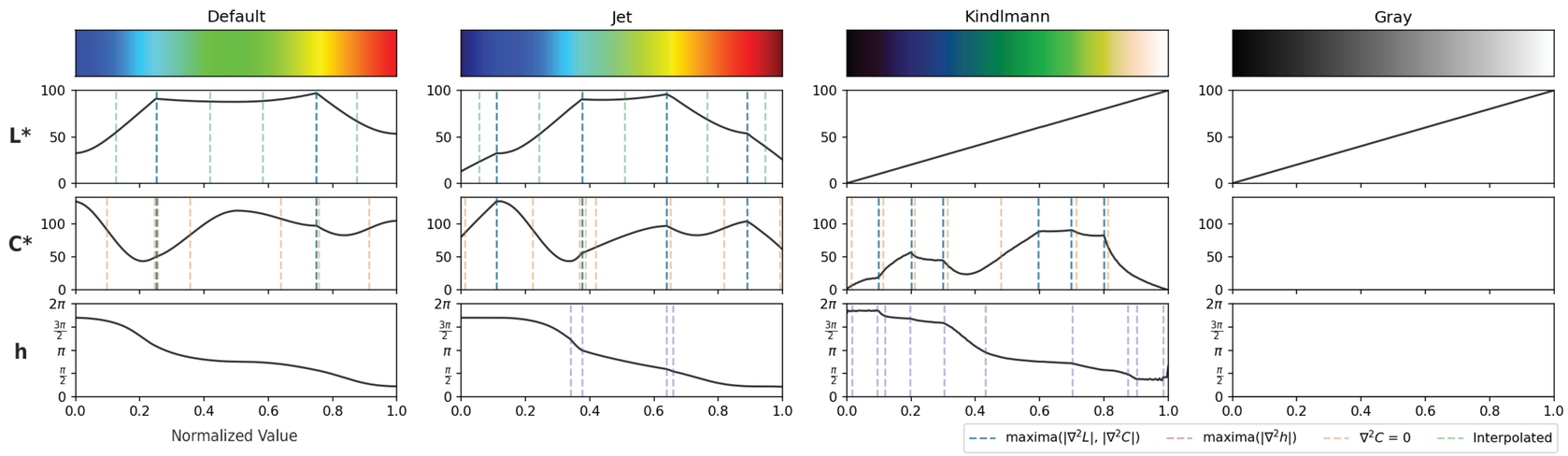
Exploratory Study

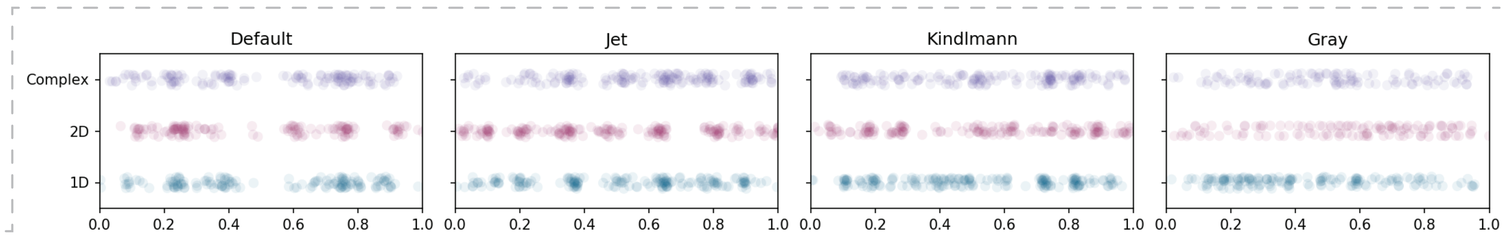
Where do people perceive color category boundaries?



Stimuli varied color map and data type.

Can variation in lightness and chroma predict perceived color category boundaries?





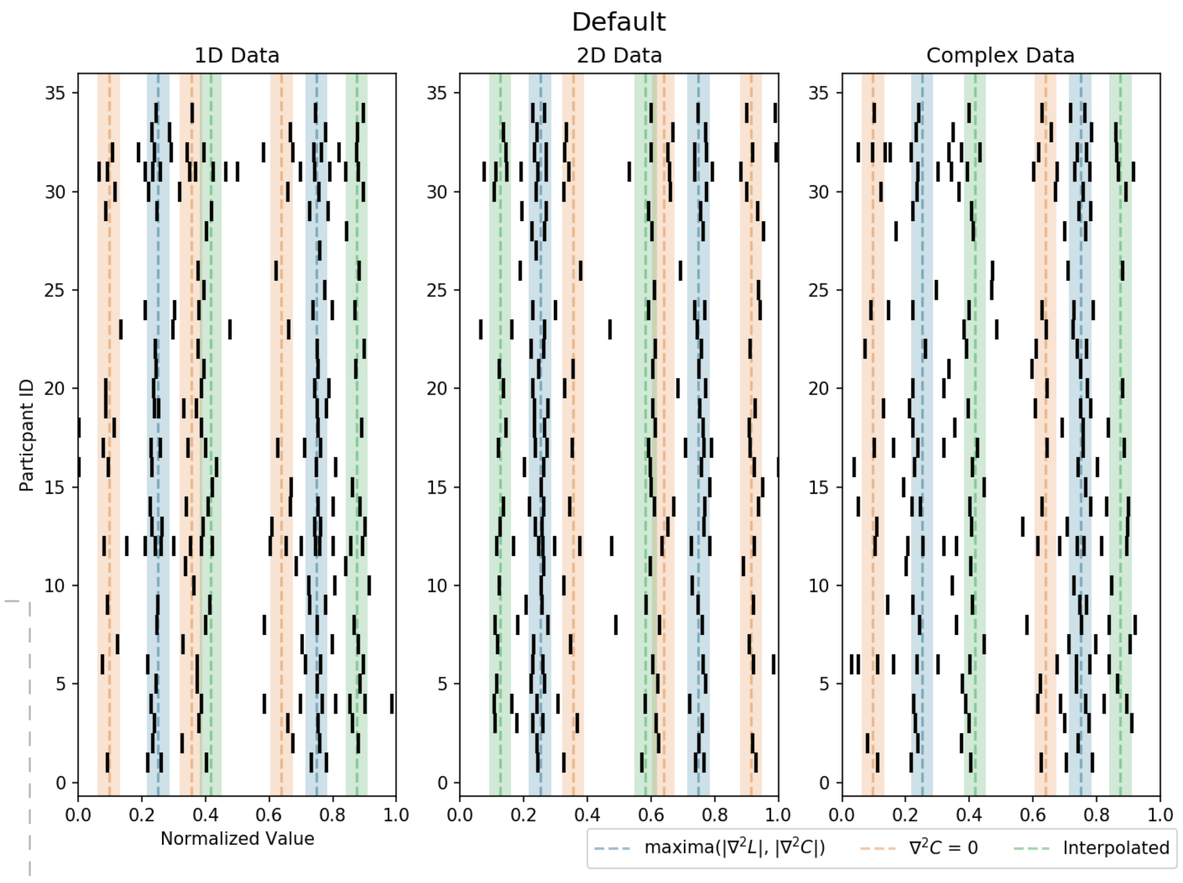
Participant's color category boundary placements aggregated by color map and dataset. Opaque regions highlight stronger response trends across participants.

Results

We found trends in the boundary placement locations across individuals for each of the rainbow color maps, but not gray-scale.

High curvature appears to predict a subset of these trends, though it is not clear whether luminance or chroma is driving the effect.

The remaining trends, however, *shift dramatically* depending on the data being visualized.



A black line indicates the location of a boundary placed by a given participant (*i.e., a given row*). The colored bands highlight a small interval around different indicators we examined. The high-curvature indicators (blue) consistently match up with the strongest response trends. The remaining response trends vary across the different datasets, but do so consistently across individuals.

Conclusions

Our results suggest that rainbow color maps *do* implicitly discretize data and do so in a consistent way across individuals. That said, this implicit discretization is highly dependent on some aspect of the encoded data.

This provides us a new, alternative hypothesis for what *really* makes rainbow color maps so harmful.

References

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[2] D. Borland and R. M. Taylor. Rainbow Color Map (Still) Considered Harmful. IEEE Computer Graphics and Applications, 27(2):14–17, Mar. 2007.

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[4] L. Padilla, P. S. Quinan, M. Meyer,and S. H. Creem-Regehr. Evaluating the Impact of Binning 2D Scalar Fields. IEEE Transactions on Visualization and Computer Graphics, 23(1):431–440, Jan. 2017.

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