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Background and Goals

People associate word meanings with distributions of colors, which influences a variety of judgements in visual cognition (e.g., interpretations of information visualizations). (Lin et al., 2013; Schloss et al., 2018, Rathore et al., 2020; Mukherjee et al., 2022)

Do color-concept associations likewise influence perceived similarity of word-meaning? E.g., Do the words "day" and "happy" have similar meanings, by virtue of similar associated colors?

We considered three competing hypotheses. Color concept associations... (1) reflect statistics of natural language and play little direct role in shaping perceived word-meaning.

- (2) do capture structure beyond natural language statistics, but only influence semantic similarity when colors are explicitly evoked.
- (3) capture structure beyond natural language statistics and influence perceived semantic similarity even when color is not explicitly evoked.

To adjudicate these possibilities, we measured pairwise similarities between words based on color associations and compared these to semantic similarities estimated via standard natural language processing techniques (Mikolov et al., 2013). We tested how the two representational spaces contribute to human judgements of word-relatedness based on similarity of color, in symbolic/metaphorical relationships, or in kind.

General Method

Color color-concept association rating task (275 participants)

Display



Directions	<u>Clot</u>
Above	Dres
Below	Pant
Beside	Shir
Far	Sho
Near	Socl

	Conce		
<u>S</u>	Emotions	<u>Times</u>	<u>Scenerie</u>
	Angry	Dawn	Beach
	Disgust	Day	Field
	Fearful	Dusk	Ocean
	Нарру	Night	Sky
	Sad	Noon	Sunset

<u>s</u>	<u>Fruits</u>
	Blueberry
	Lemon
	Mango
	Strawberry
	Watermelor



Estimating representational spaces

Color-concept associations				
dress	hilling a start and the start of the start o			
pants	II, Indiana and a second a			
above	$\mathbb{E}_{q} (\mathbf{x}, \mathbf{u}_{i}) \in \mathbb{E}_{q} (\mathbf{x}, \mathbf{u}_{i}) \in $			
below	ومحمد للإراطي ومرمع فالماحد	cosine		
angry	وارتبع والمالية المالية والمراكر	similarity		
disgust	լ <mark>եսկելն</mark> շրջ _{նգիրու} րությո			
blueberry	processing and the starting			
lemon	allest where we have a state of the second			
beach	and the second state of th			
field	Dille and a second s			
dawn	Jydlelli Jykersenski arginarski			

Natural language vectors

above below angry disgust blueber lemon beach field





Similarity in natural language





How do color-concept associations and natural language vectors contribute to similarity judgements?

less similar



Color-concept associations reveal an abstract conceptual space

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Measuring conceptual structure with human triadic judgements



Different judgements evoke different similarity structures

~2500 judgements collected/condition

Words embedded beach in 3 dimensions multi-dimensional scaling

principal and color-concept associations.





Conclusions

Color-concept associations reveal a different representational space from the semantic space derived from natural language. Thus, natural language semantics do not explain color-concept associations.

Yet, color-concept associations explain unique variance in human judgements of semantic similarity, regardless of whether the task explicitly evokes color knowledge.

Our results support Hypothesis 3: the meanings that people attribute to words may partially reflect associations between concepts and color distributions in ways that are not reflected by the statistics of natural language.

Acknowledgements and References

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Color-concept ratings help explain human behavior for all judgements

Visual

Lab

Reasoning

WARF

