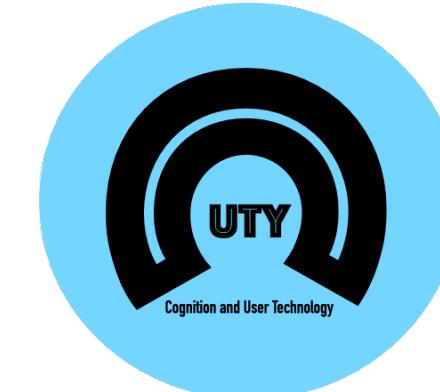
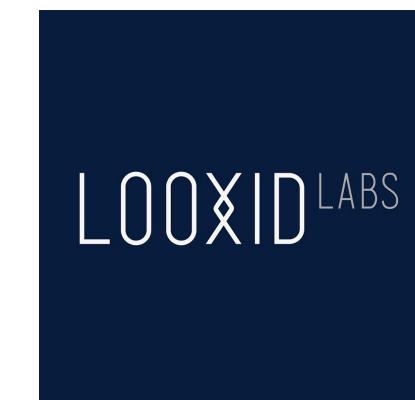
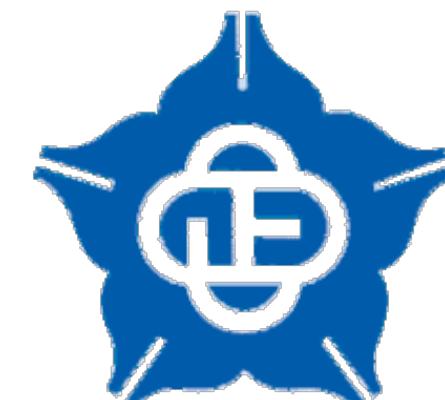
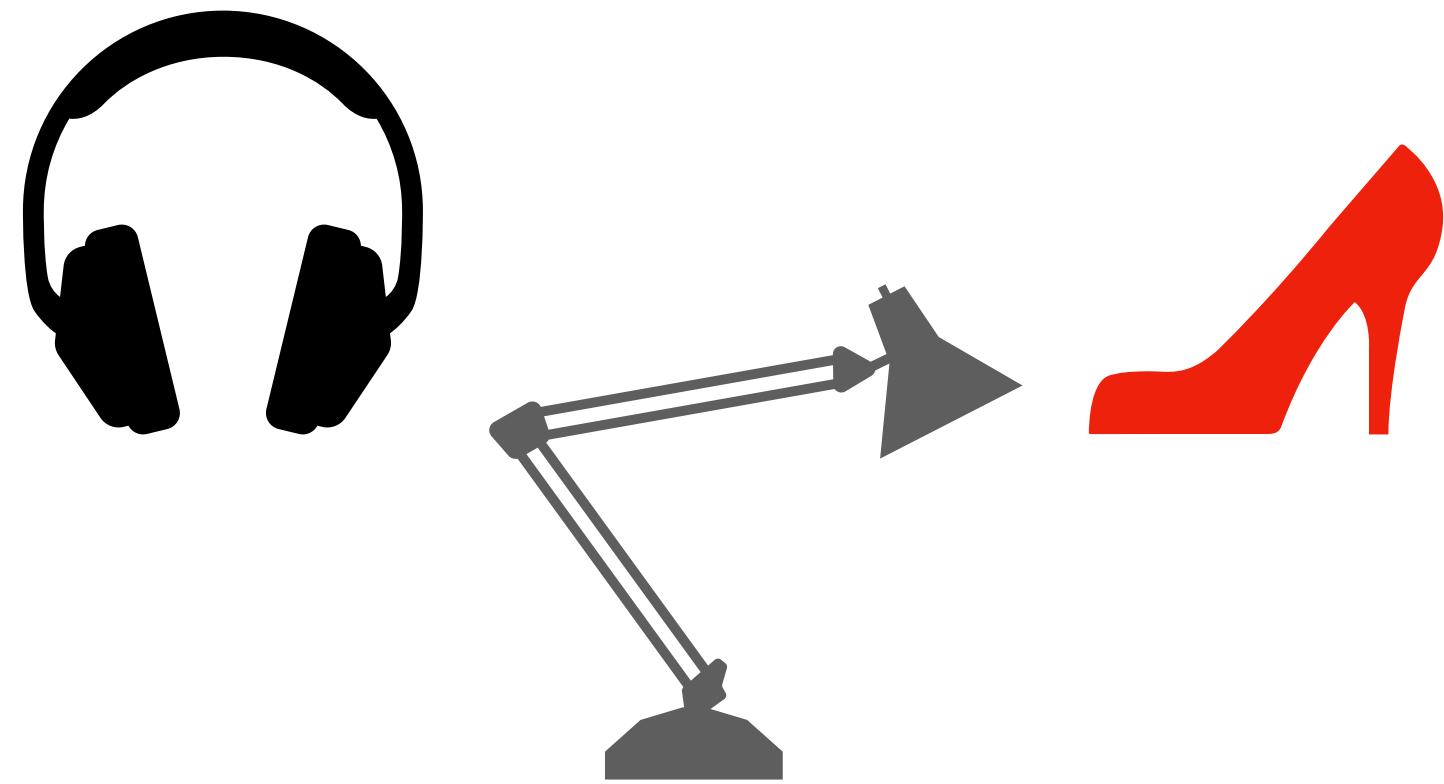


# Understanding Social Influence in Collective Product Ratings Using Behavioral and Cognitive Metrics

**Fu-Yin Cherng, Jingchao Fang, Yinhao Jiang, Xin Chen, Taejun Choi, Hao-Chuan Wang**

National Chung Cheng University, University of California, Davis, Looxid Labs





#### Top reviews from the United States



★★★★★ Good quality at a great price  
Reviewed in the United States on November 7, 2019  
Color: Black | **Verified Purchase**  
I really liked quality of this product for how relatively i  
pieces came wrapped up in a snug little box. The base  
dimming works as advertised, and the 3 different tone

#### Customer reviews

★★★★★ 4.8 out of 5

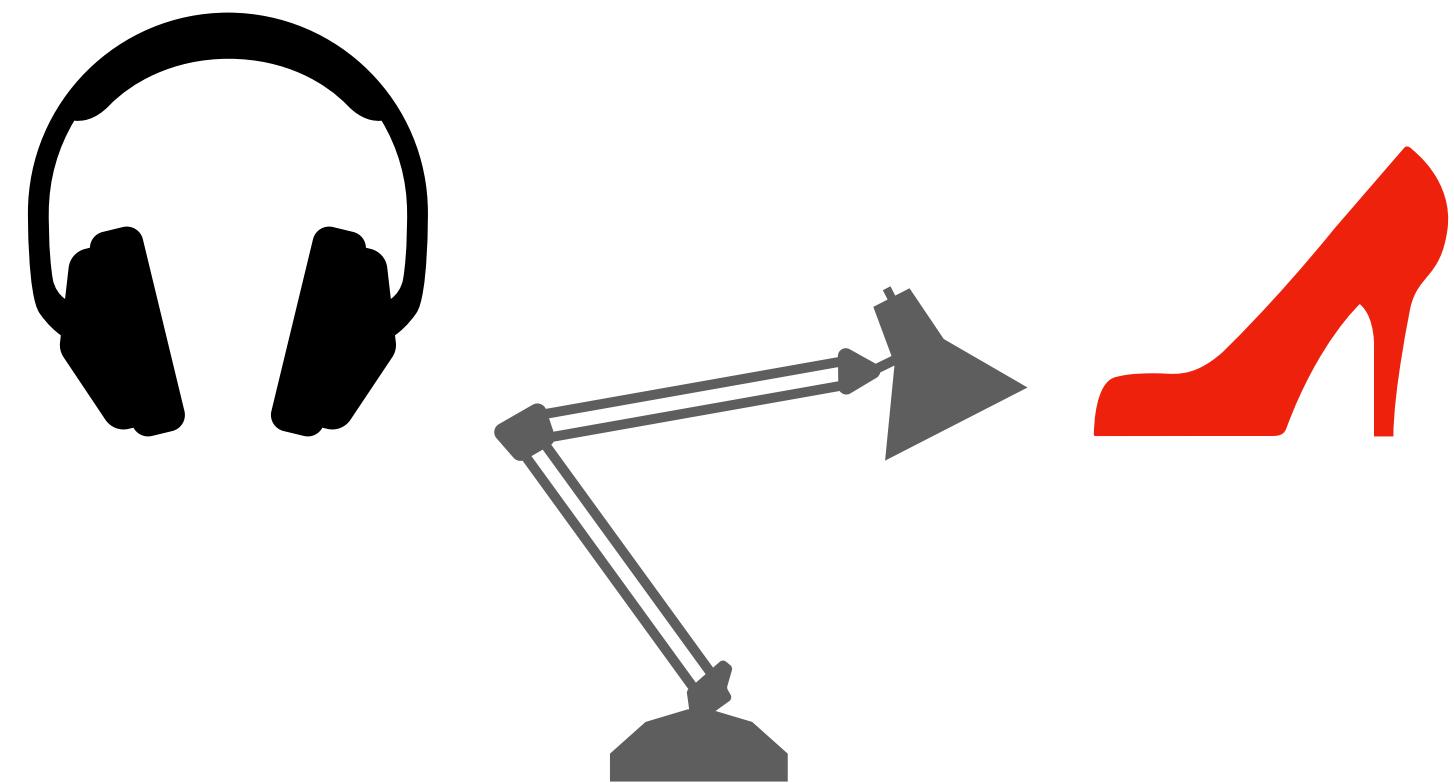
2,463 global ratings



[▼ How are ratings calculated?](#)

**Collective intelligence** to support decision making  
Correlation between sales and product review

[Moe 2011]



## Recommendation for you



### Top reviews from the United States



**★★★★★ Good quality at a great price**  
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★★★★★ 4.8 out of 5

2,463 global ratings

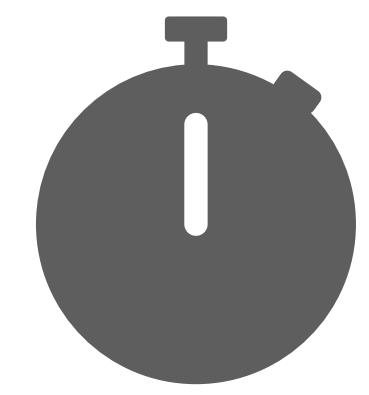


[▼ How are ratings calculated?](#)

**Collective intelligence** to support decision making  
Correlation between sales and product review

[Moe 2011]

### Inspired by your shopping trends



Personalized **recommendations** by modeling customers' preferences through collective ratings

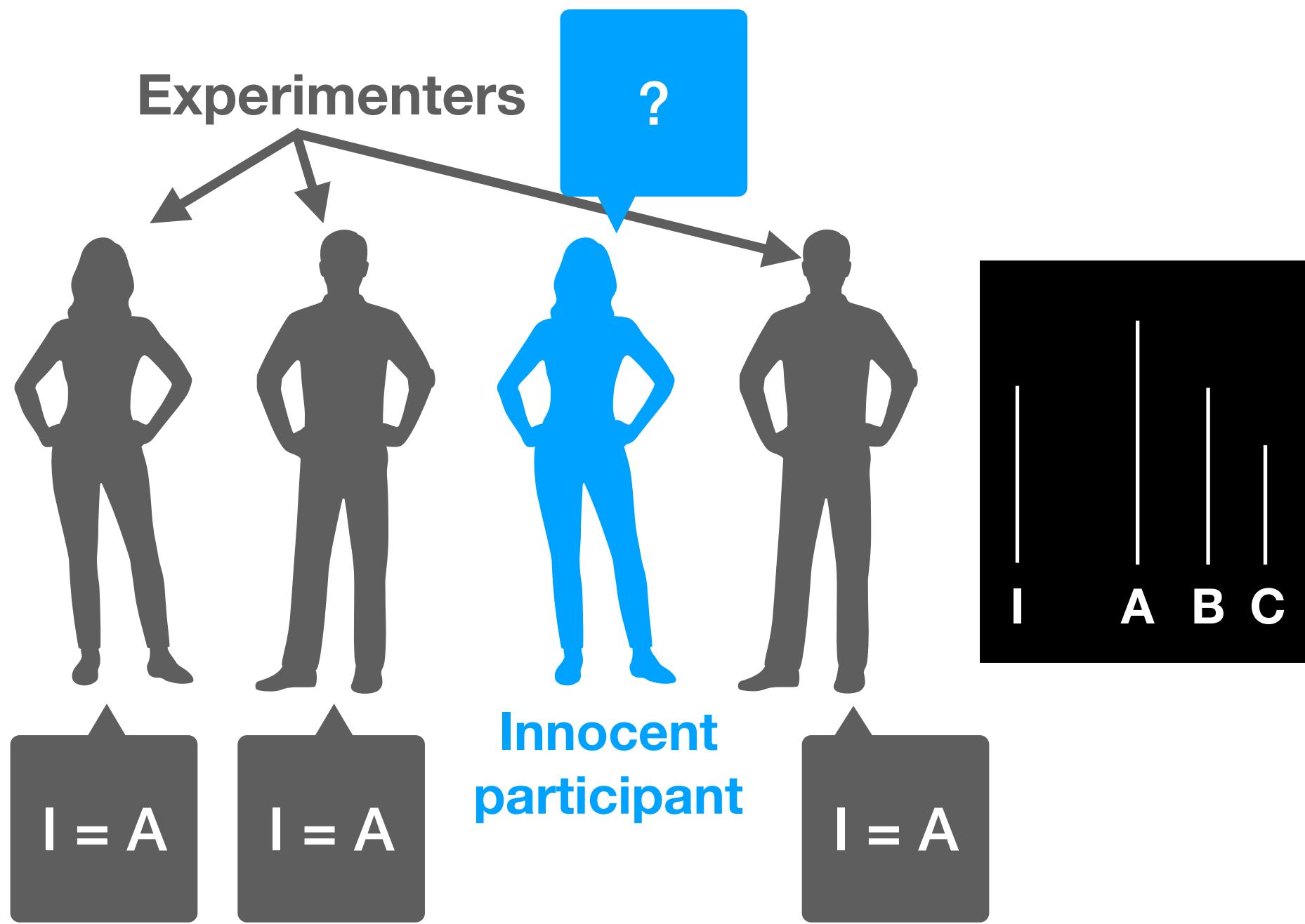
[Cosley, 2003; Krishnan 2014]



Users **lower** their rating score of **preference** after viewing **others'** negative rating

[Wu et al 2010; Nov et al. 2015]

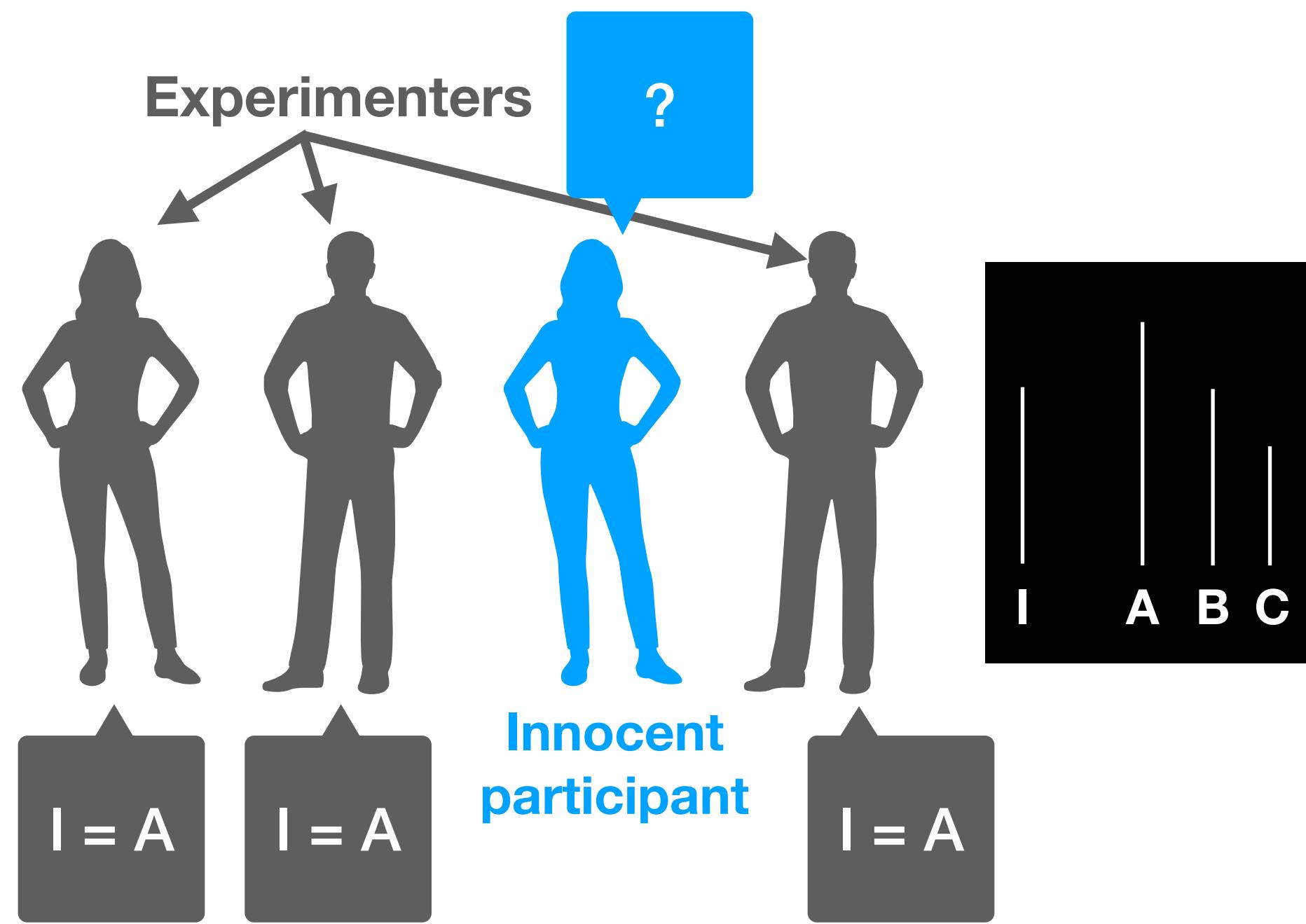
# Social Conformity



**Aligning one's opinion & behavior to those of others**

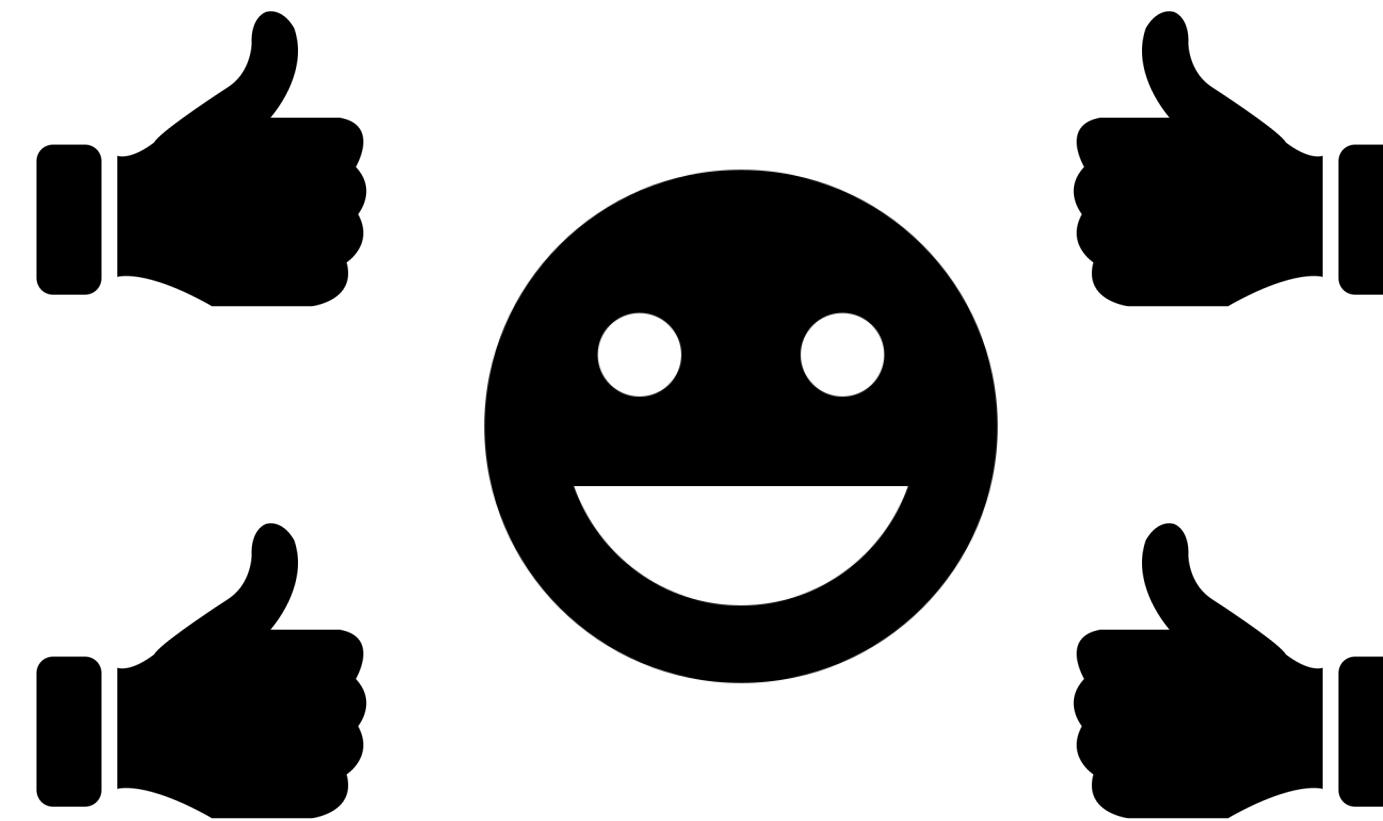
*Asch experiment (1956)*

# Social Conformity



**Aligning one's opinion & behavior to those of others**

*Asch experiment (1956)*



Desire for social **approval** &  
dependency on **crowd's opinion**

[Cialdini and Goldstein 2004; Stallen 2015]



## Affect when no social interaction presented

[Klucharev et al. 2009; Edelson et al. 2014]



Affect when no social interaction presented

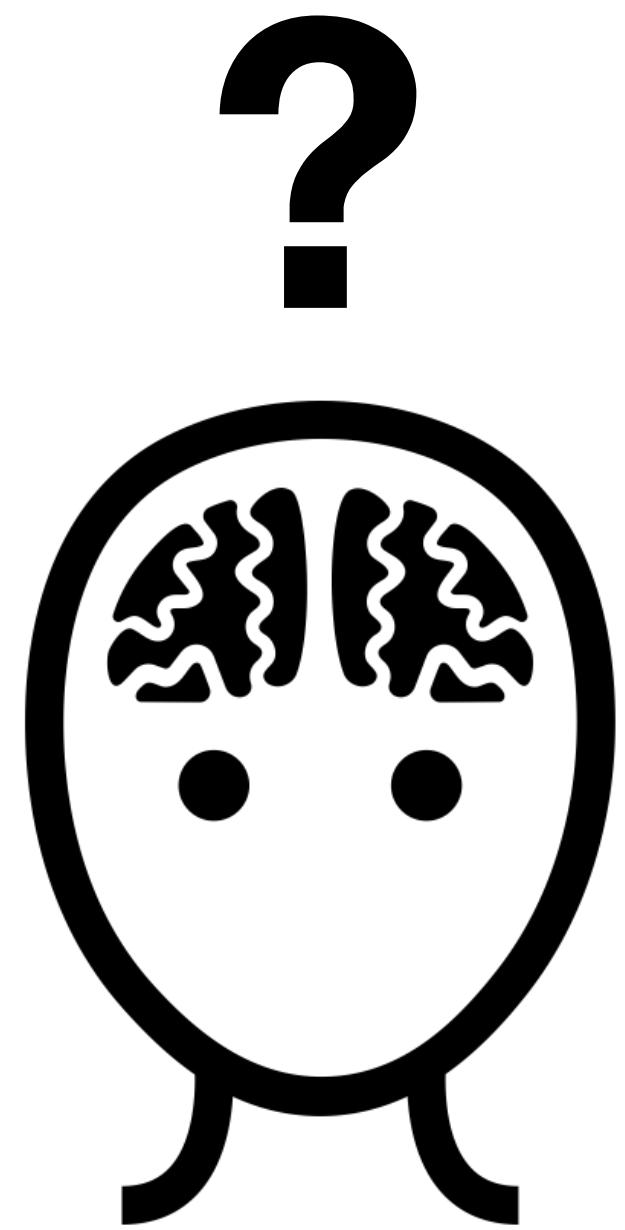
[Klucharev et al. 2009; Edelson et al. 2014]

- Extreme *she* occupations**
  - 1. homemaker
  - 2. nurse
  - 3. receptionist
  - 4. librarian
  - 5. socialite
  - 6. hairdresser
  - 7. nanny
  - 8. bookkeeper
  - 9. stylist
  - 10. housekeeper
  - 11. interior designer
  - 12. guidance counselor
  
- Extreme *he* occupations**
  - 1. maestro
  - 2. skipper
  - 3. protege
  - 4. philosopher
  - 5. captain
  - 6. architect
  - 7. financier
  - 8. warrior
  - 9. broadcaster
  - 10. magician
  - 11. fighter pilot
  - 12. boss

*Gender biases in word embedding model Word2Vec*

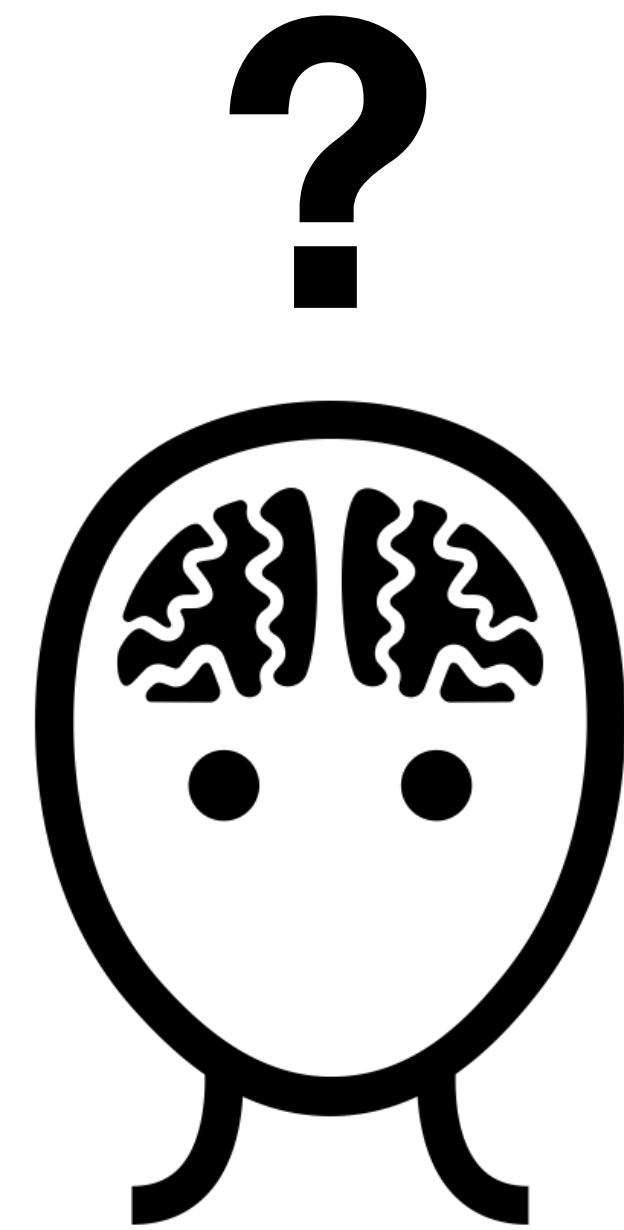
Lead to incorrect decisions & algorithmic fairness issue

[Cosley, 2003; Krishnan 2014; Bolukbasi 2016]



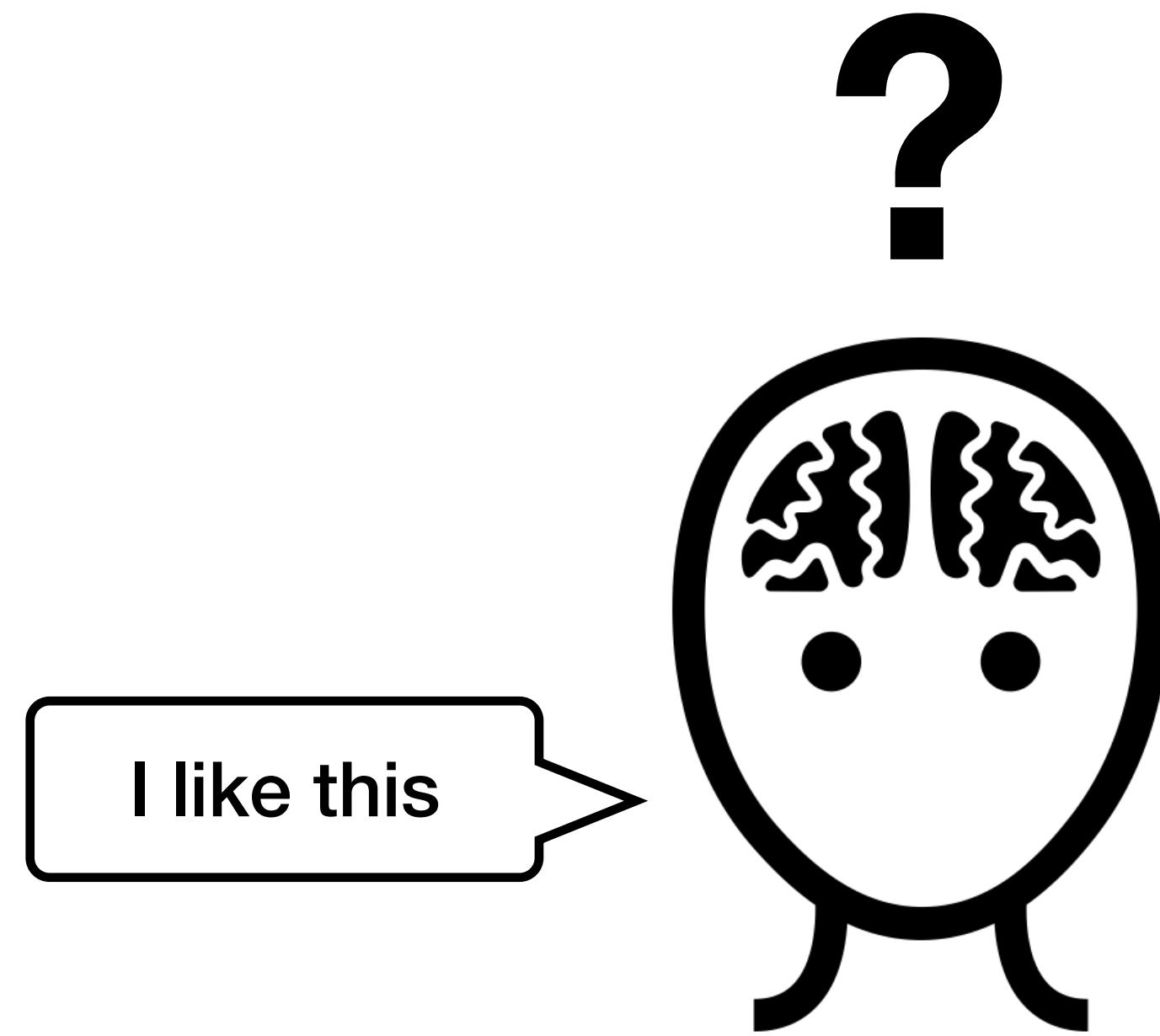
Prior works observe social influence by **behavioral** and **self-report** measures

*[Zhu 2010; Krishnan 2014; Stallen 2015]*



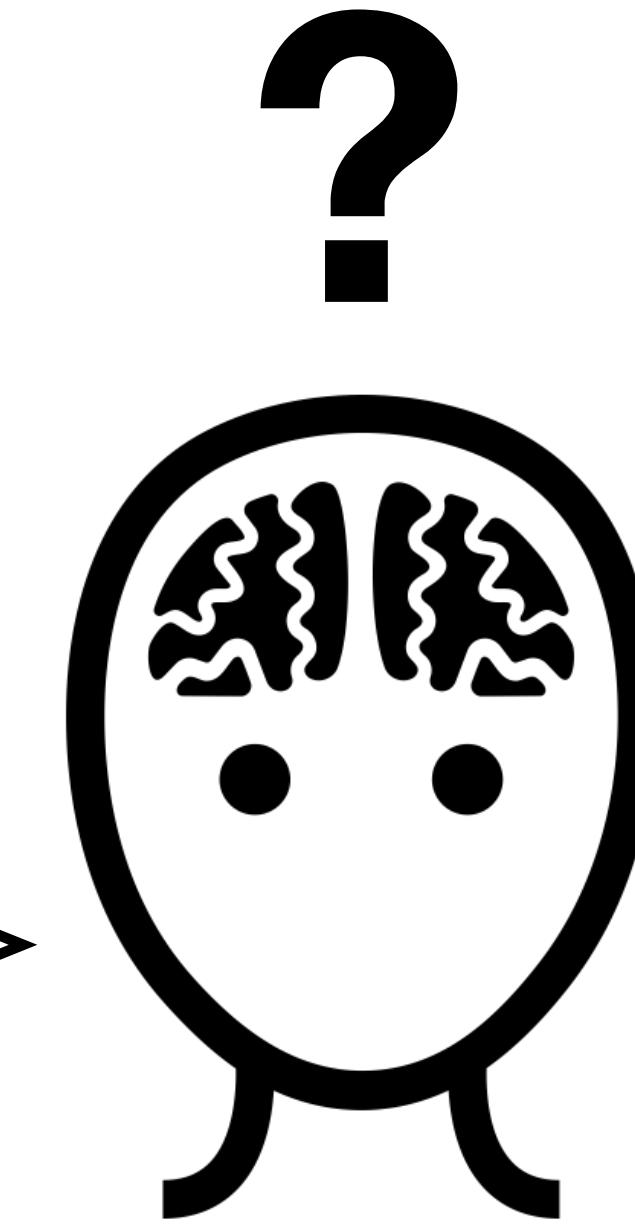
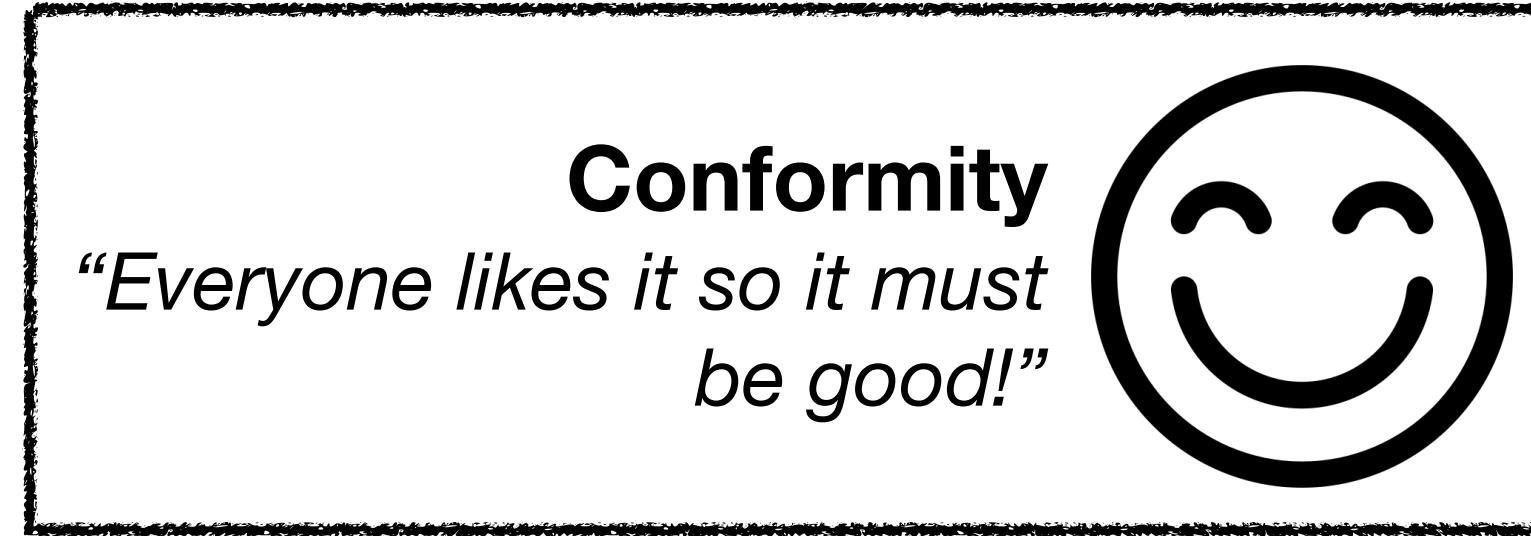
**Different cognitive process could lead to similar feedback**

*[Zhu 2010; Krishnan 2014; Stallen 2015]*



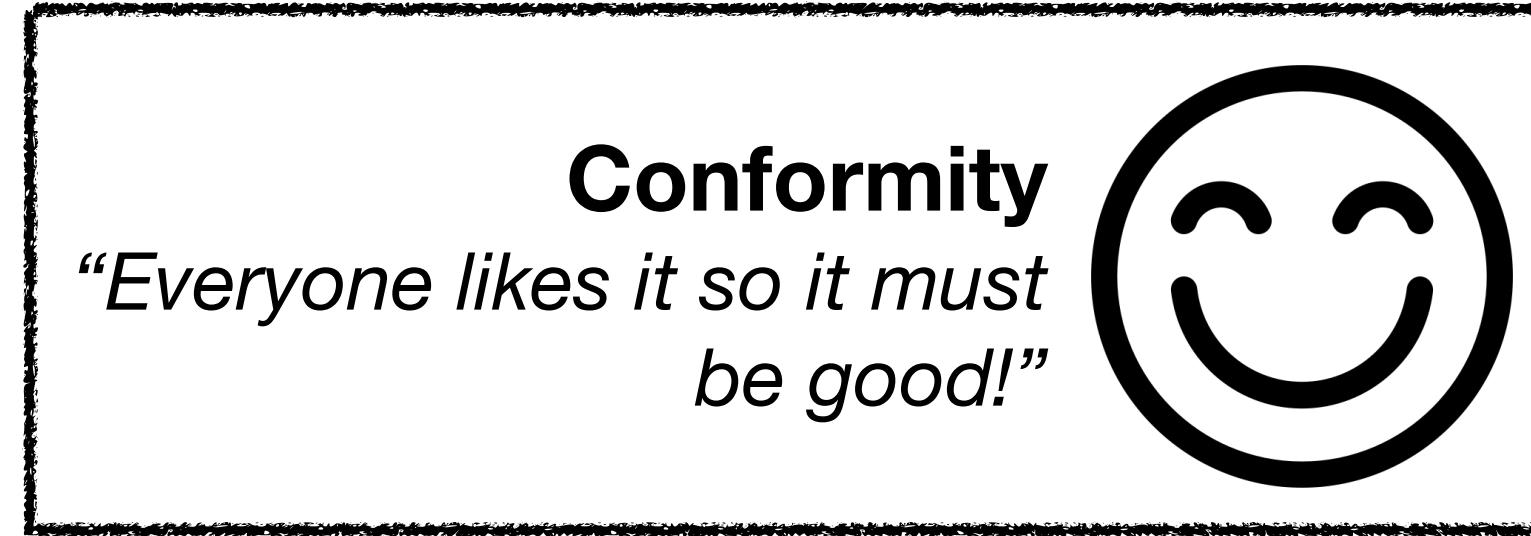
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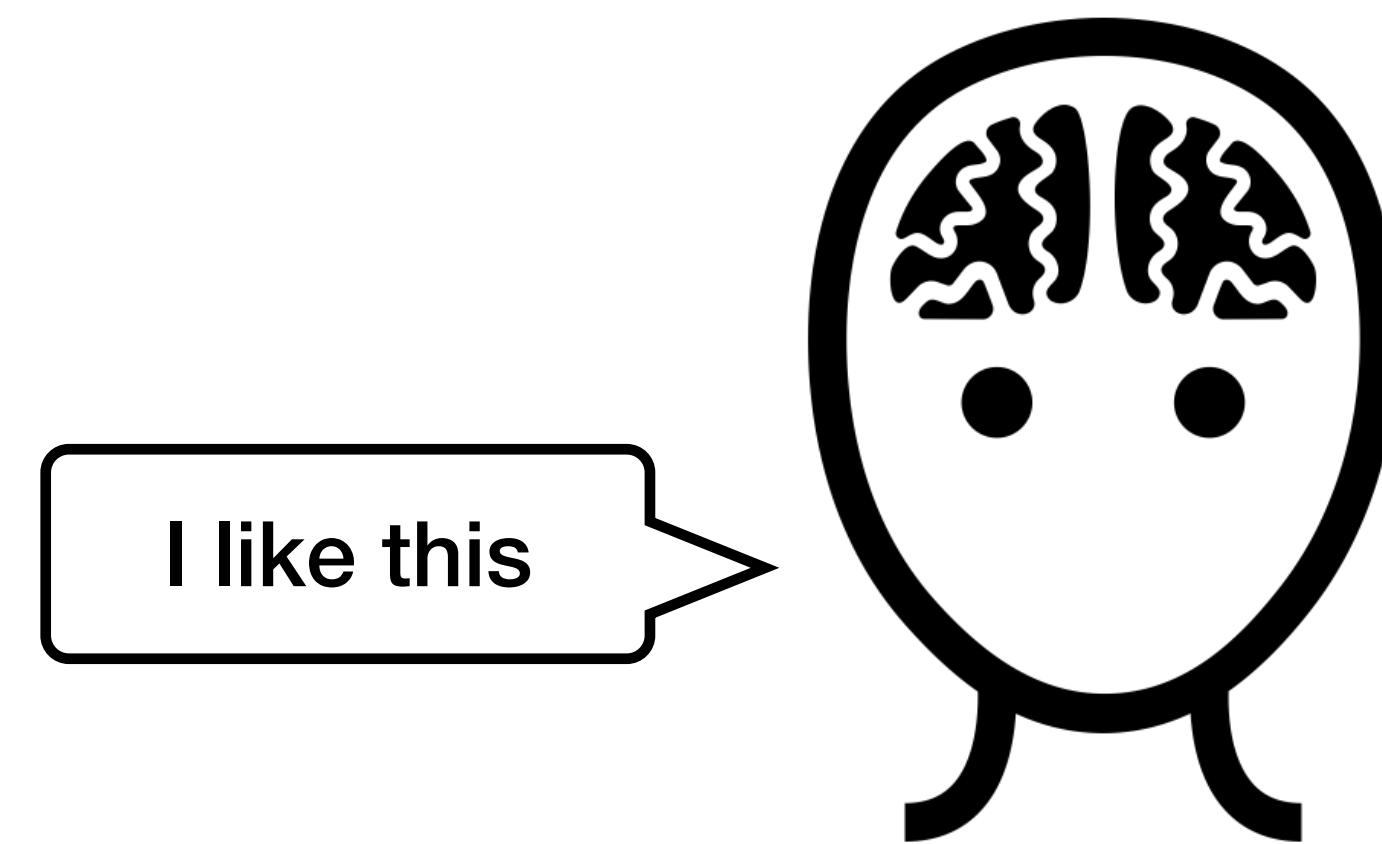


**Different cognitive process could lead to similar feedback**

[Zhu 2010; Krishnan 2014; Stallen 2015]



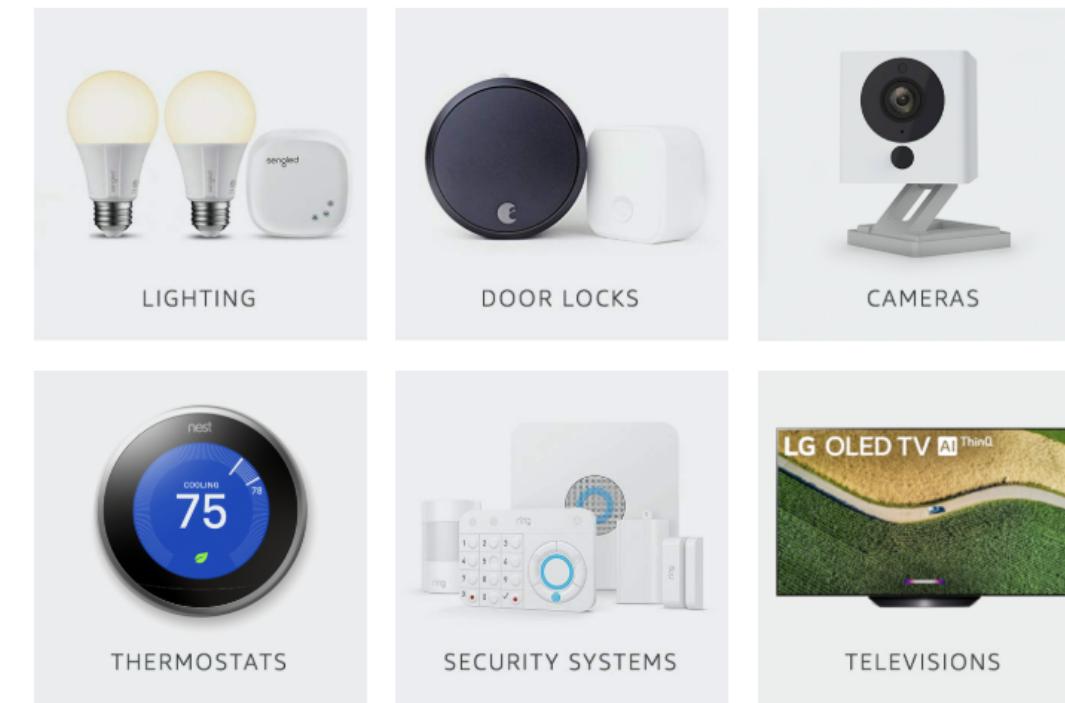
?



**Different cognitive process could lead to similar feedback**

[Zhu 2010; Krishnan 2014; Stallen 2015]

# Experiment Materials



## Customer reviews

★★★★★ 4.3 out of 5 ▾

15,938 customer ratings



### Top positive review

[See all 11,883 positive reviews ▾](#)



P. HOFFERMAN

★★★★★ Great camera for a great price!

May 9, 2018

### Top critical review

[See all 2,955 critical reviews ▾](#)



texase

★★★★★ Read User Agreement!!

December 13, 2018

## 90 products from Amazon

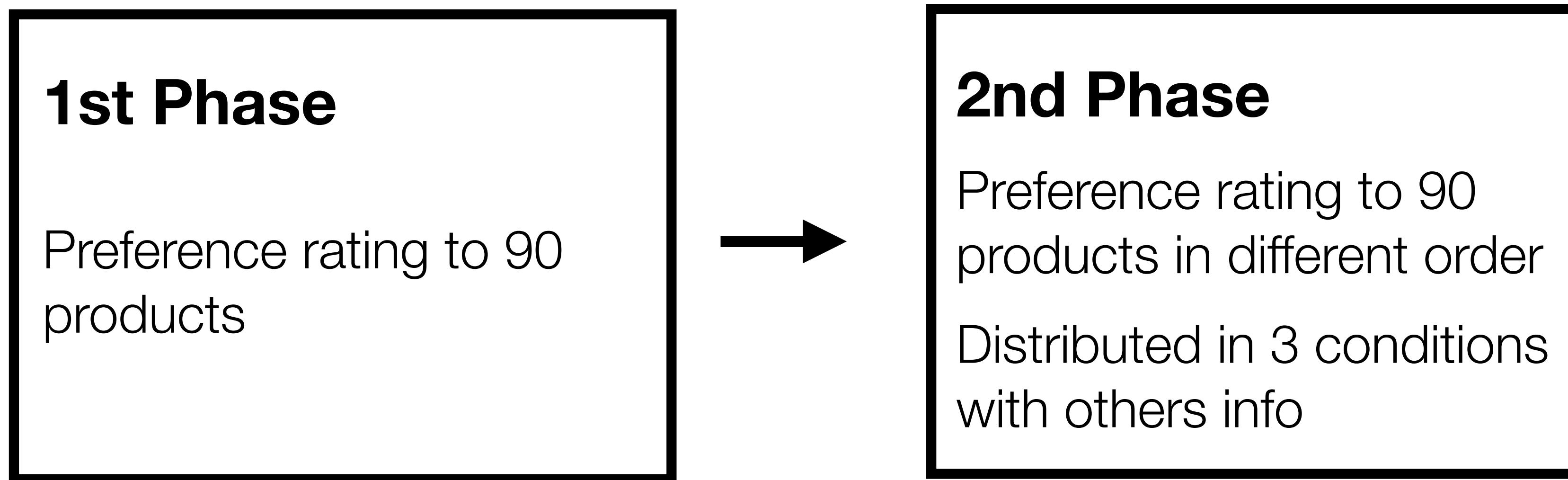
New smart home products to  
minimize branding effect

## Ratings Distribution

## Review Titles

*Top positive & critical  
review*

# Experiment Design



Compare **differences** in preference rating between two phases

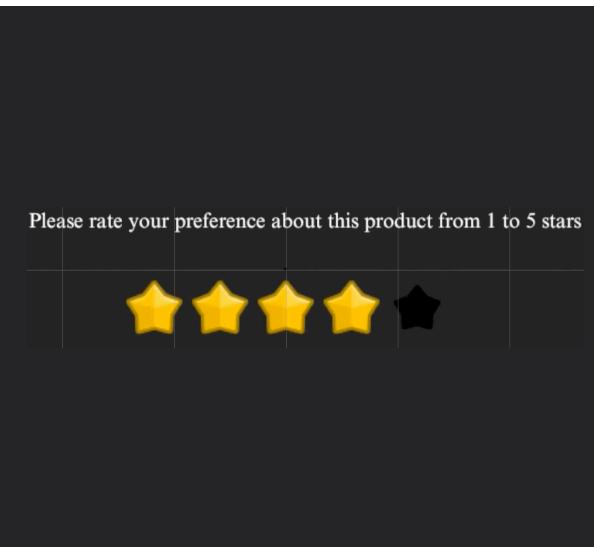
# Experiment Procedure - 1st Phase

*Product Information*



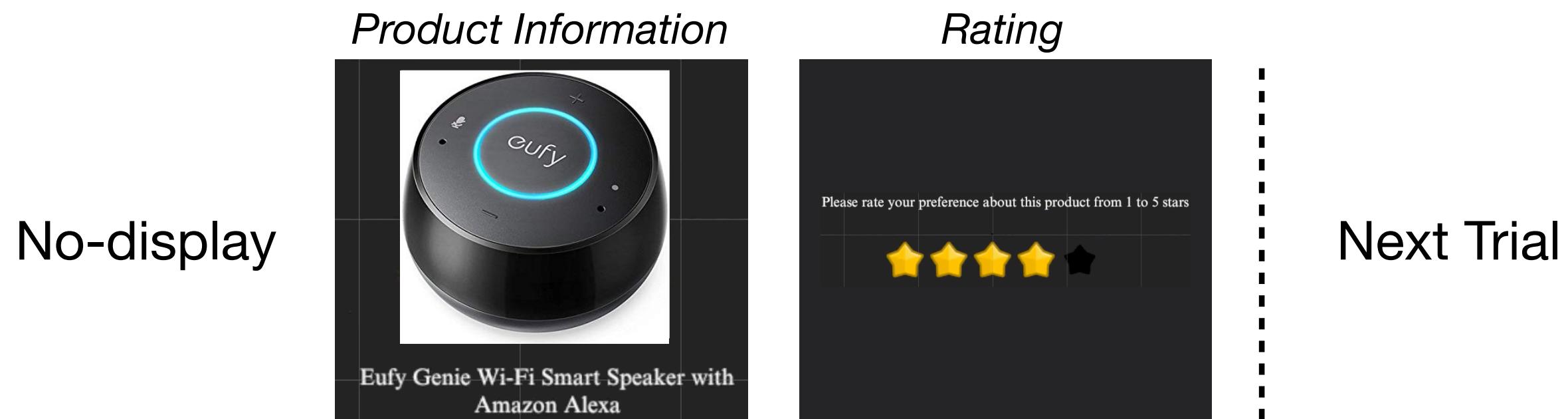
Eufy Genie Wi-Fi Smart Speaker with  
Amazon Alexa

*Rating*



Next Trial

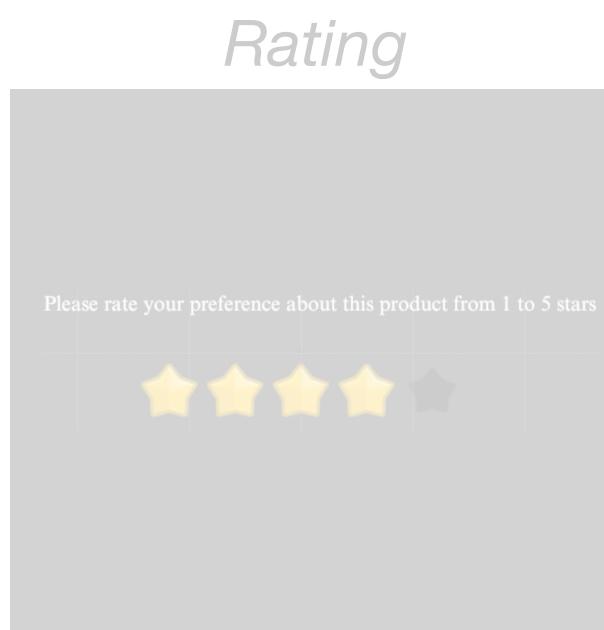
# Experiment Procedure - 2nd Phase



Next Trial

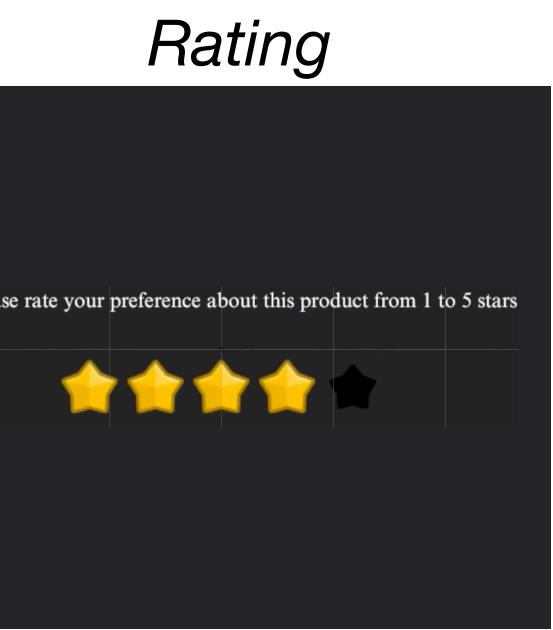
# Experiment Procedure - 2nd Phase

No-display



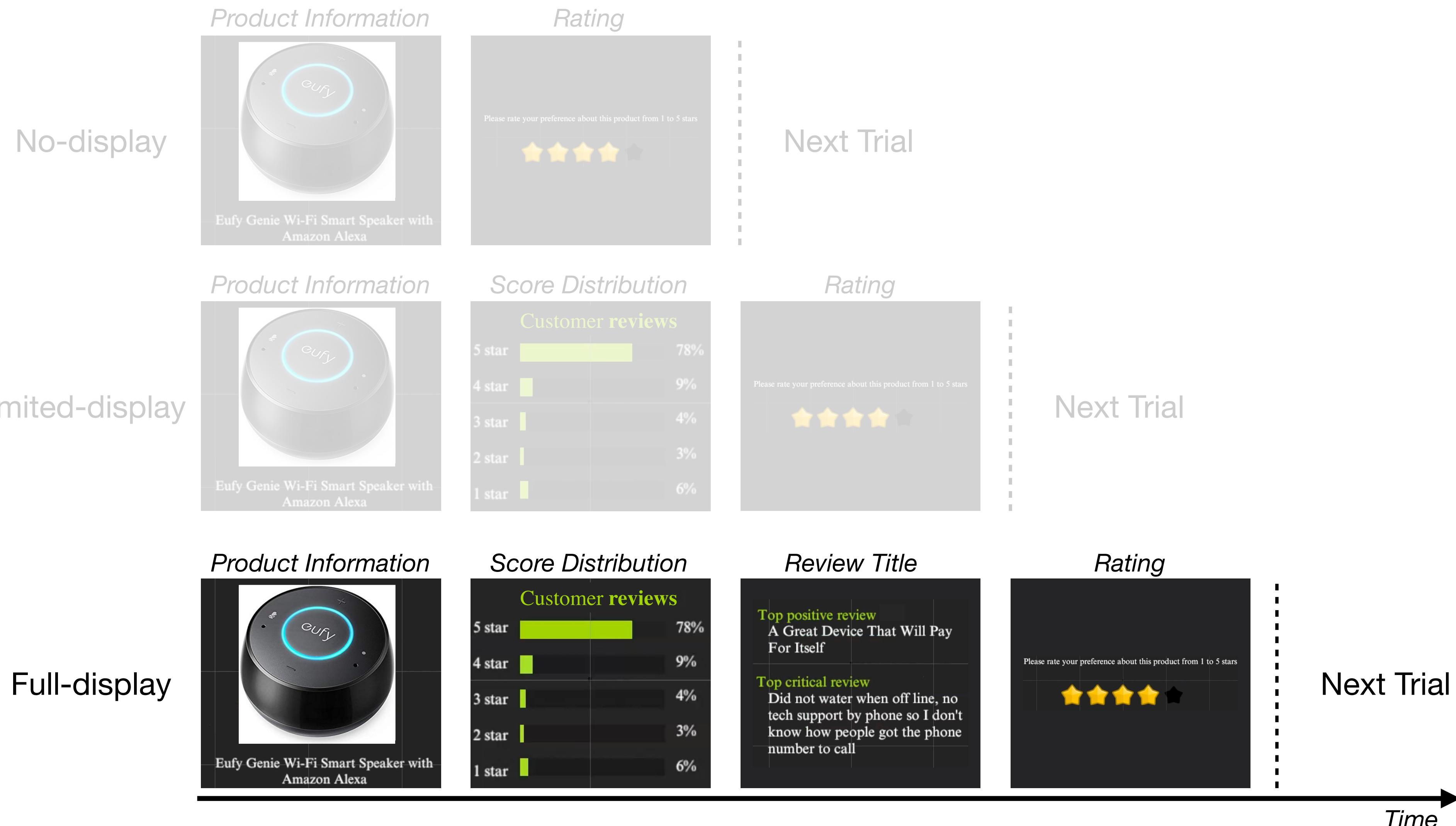
Next Trial

Limited-display

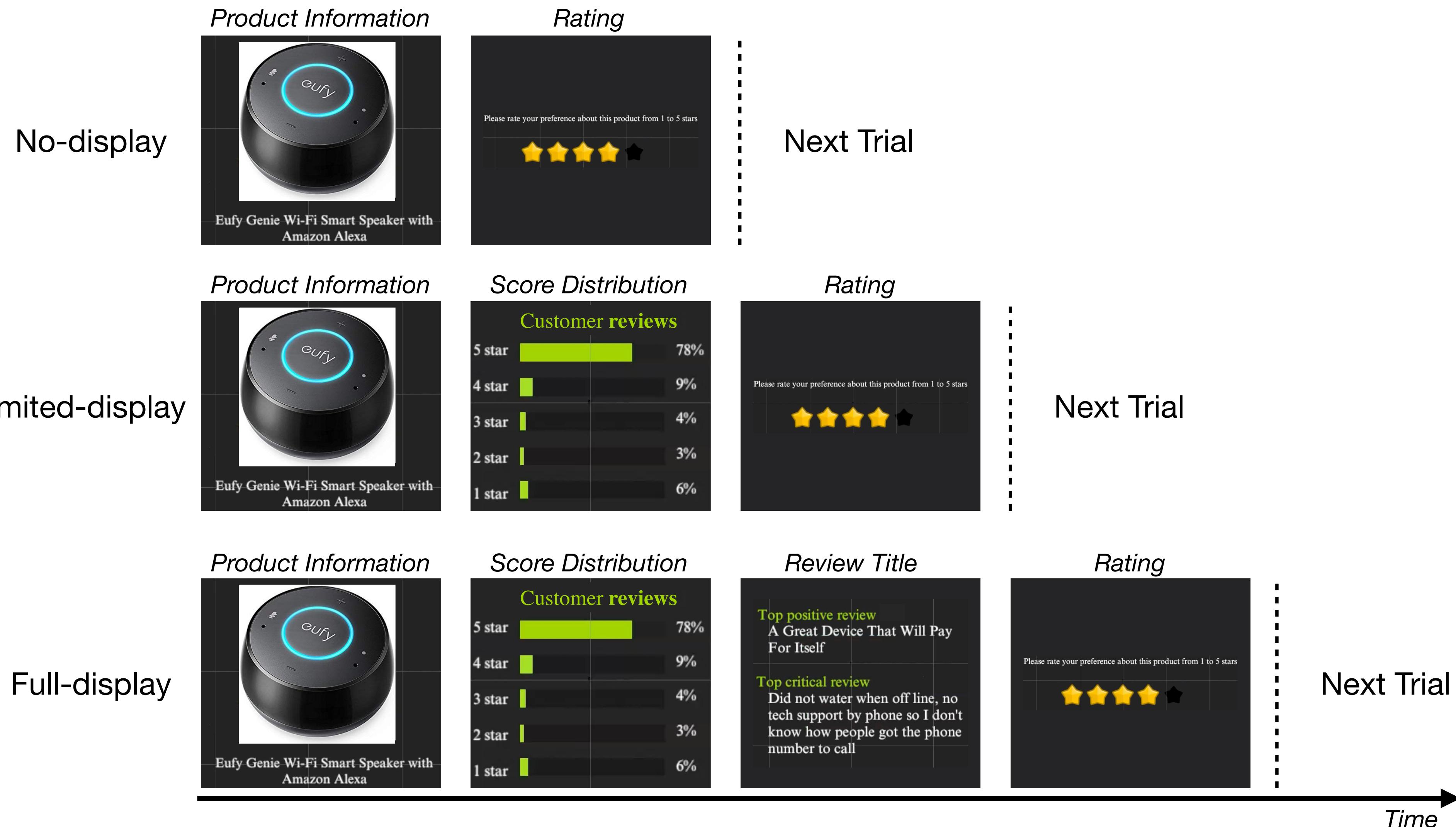


Next Trial

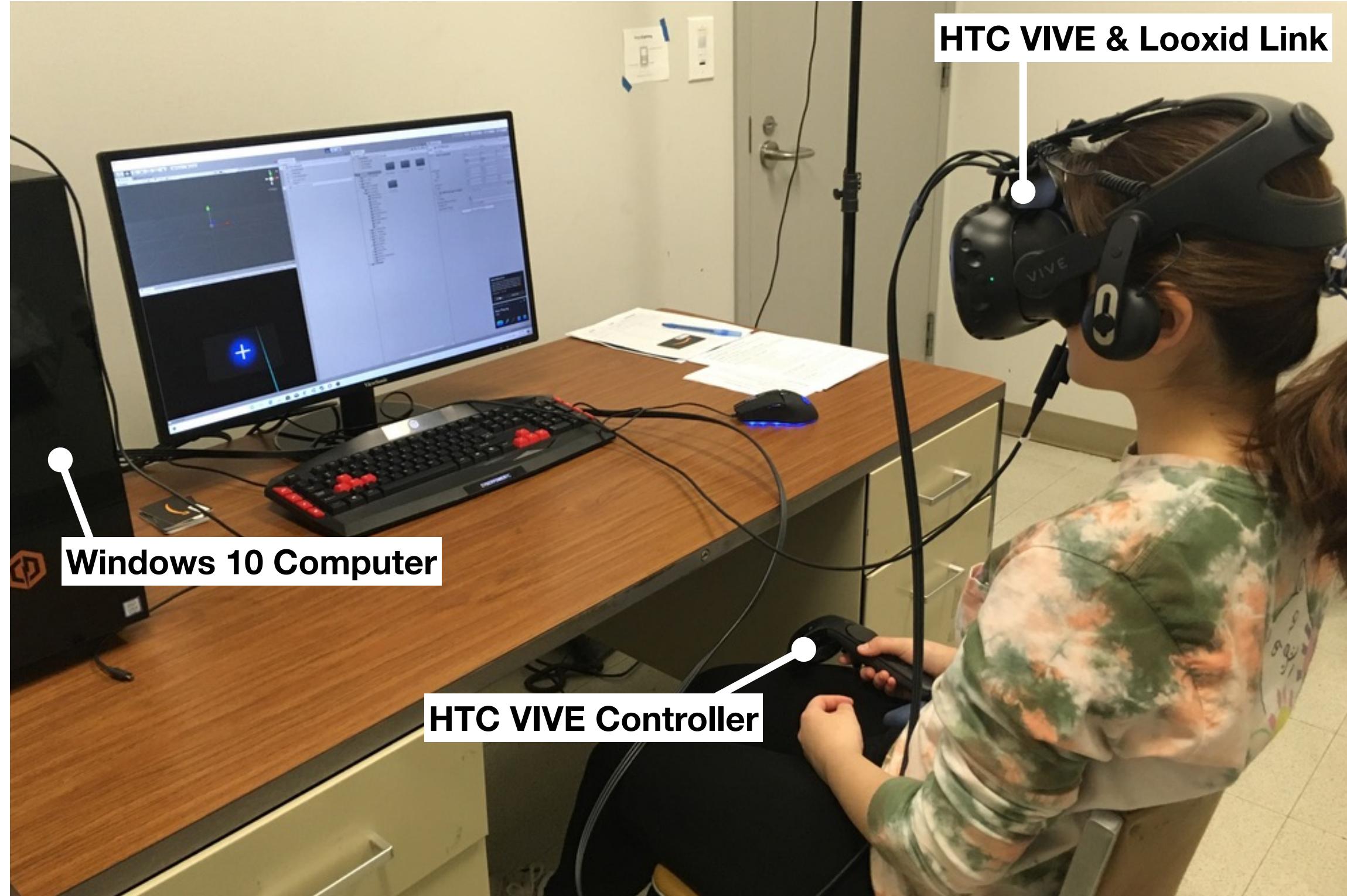
# Experiment Procedure - 2nd Phase



# Experiment Procedure - 2nd Phase



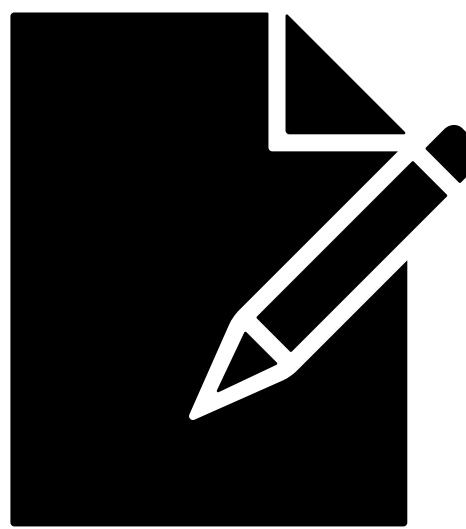
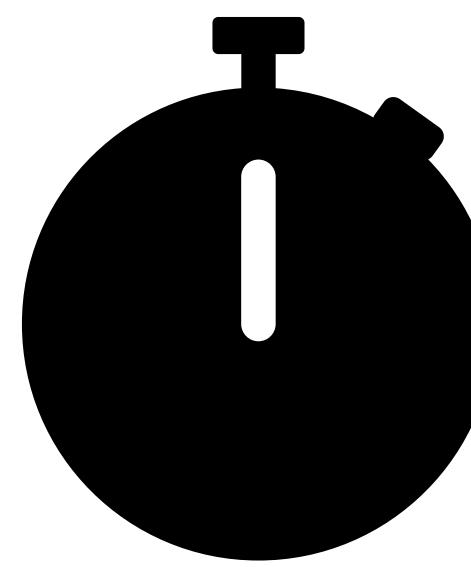
# Experiment



**30 participants**  
15 males & 15 females; age: 20-29

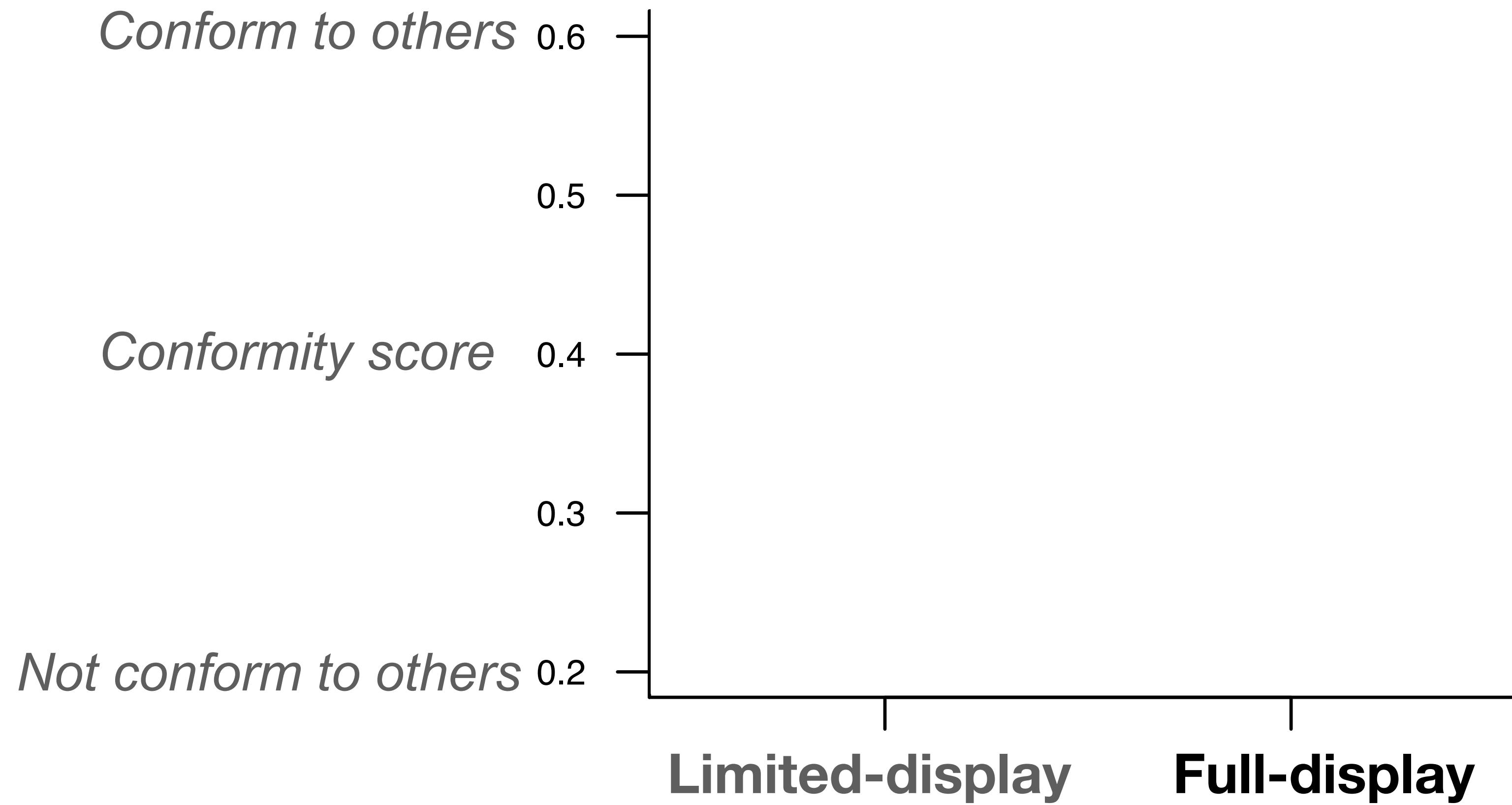


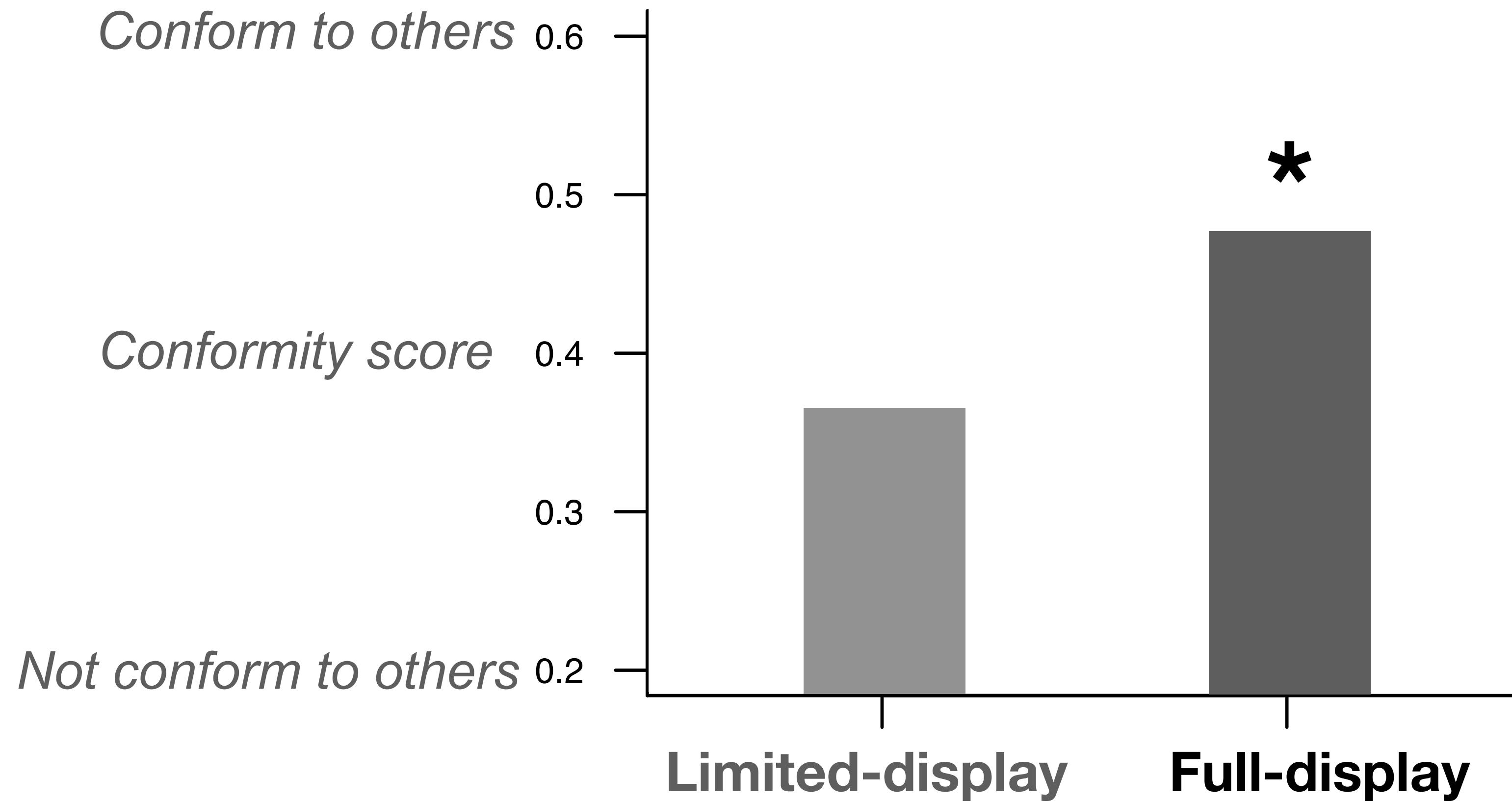
*Electroencephalography*

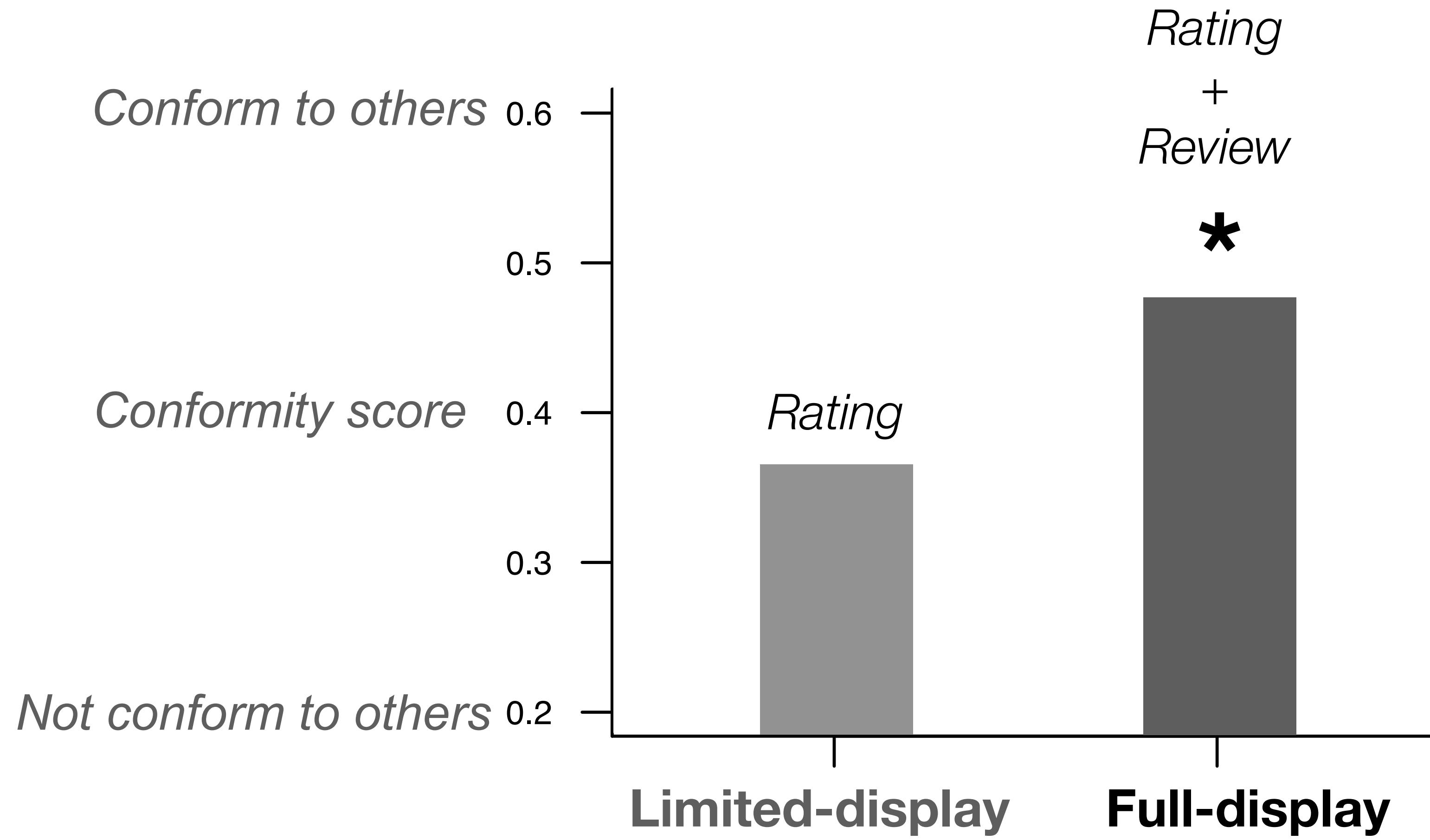


# Results

Preference Ratings





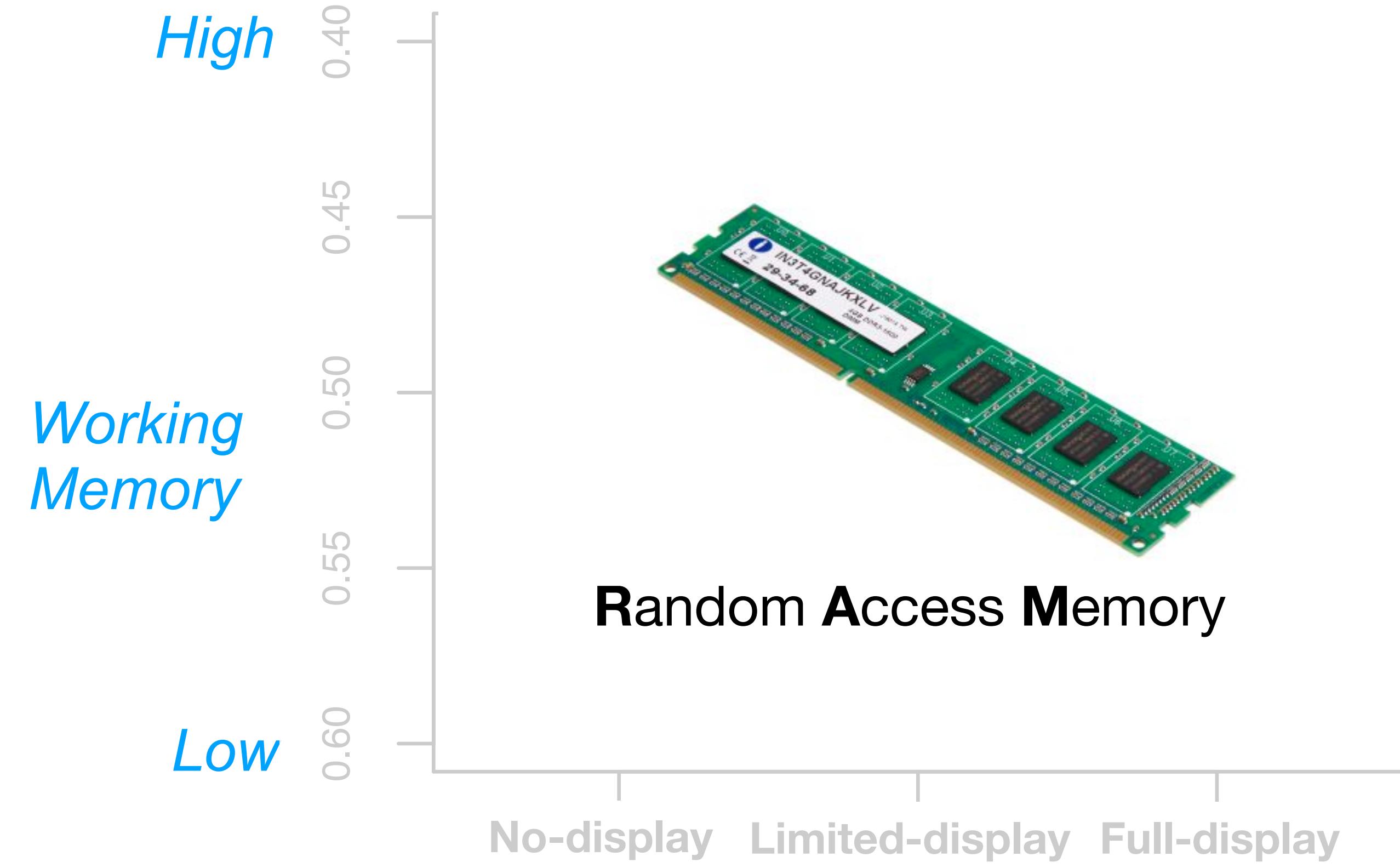


**Change** preference **toward others'** preference after seeing review + rating

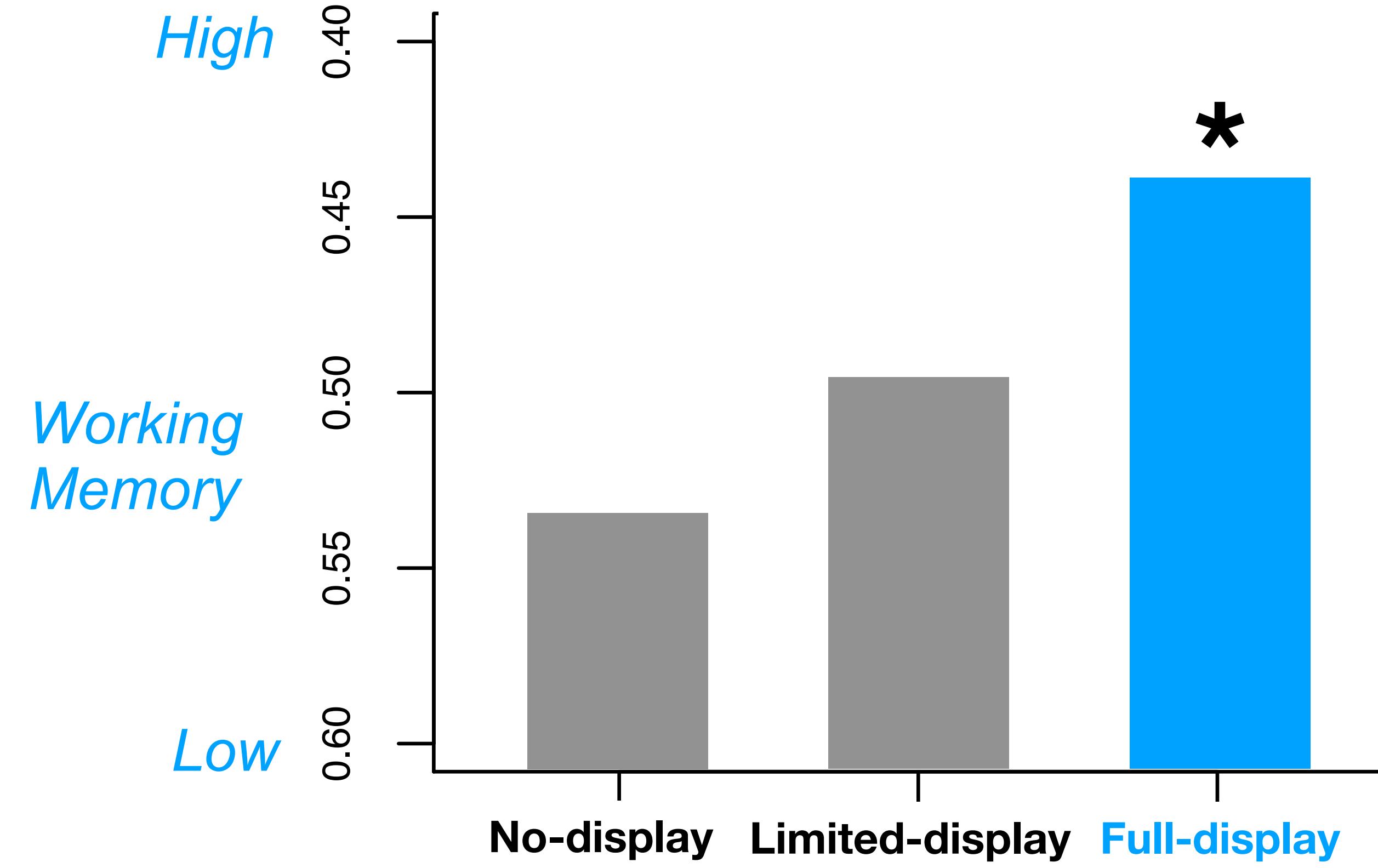
# Results

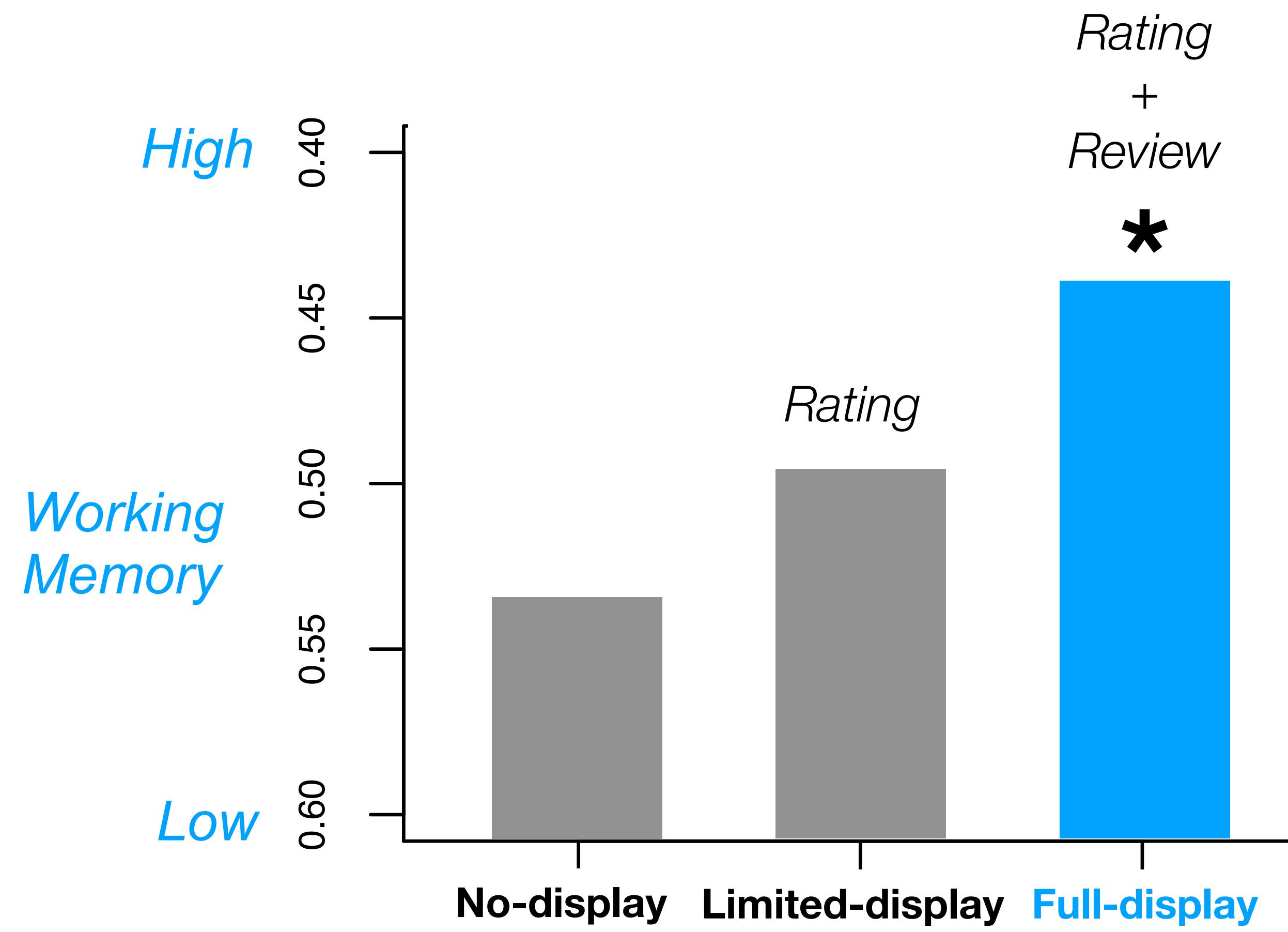
## Cognitive (EEG) Responses

<b>Index</b>	<b>Feature</b>	<b>Frequency</b>	<b>Location</b>
Attention	Alpha Theta Ratio	Alpha Power/Theta Power	AF3, AF4
Working Memory	Average Upper Alpha Power	Average of Upper Alpha Power	AF3, AF4
Emotional Valence	Spectral Asymmetry Index (SASI)	$\text{SASI} = \frac{\text{Beta Power} - \text{Theta Power}}{\text{Beta Power} + \text{Theta Power}}$	Fp1, AF7, AF3, AF4

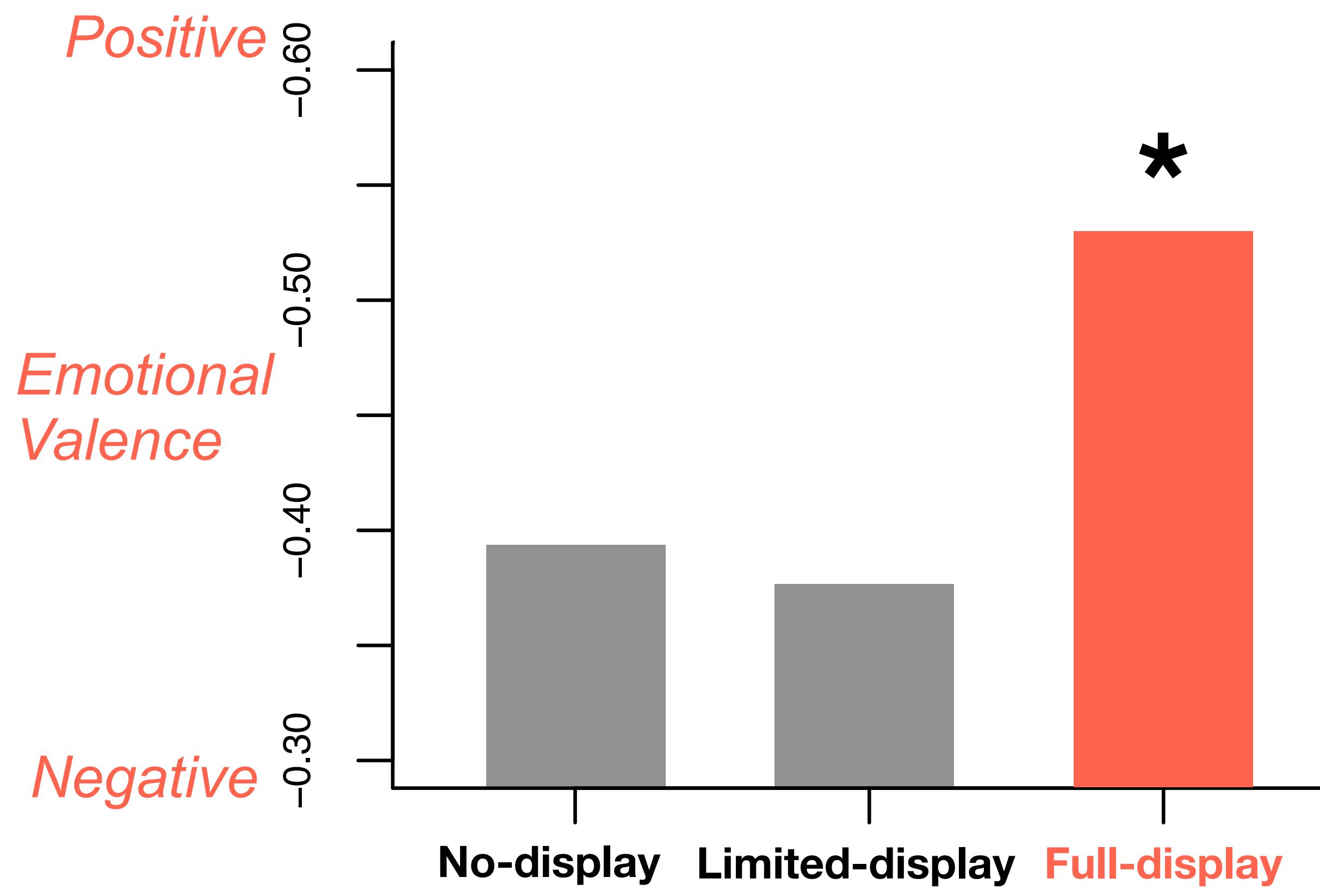


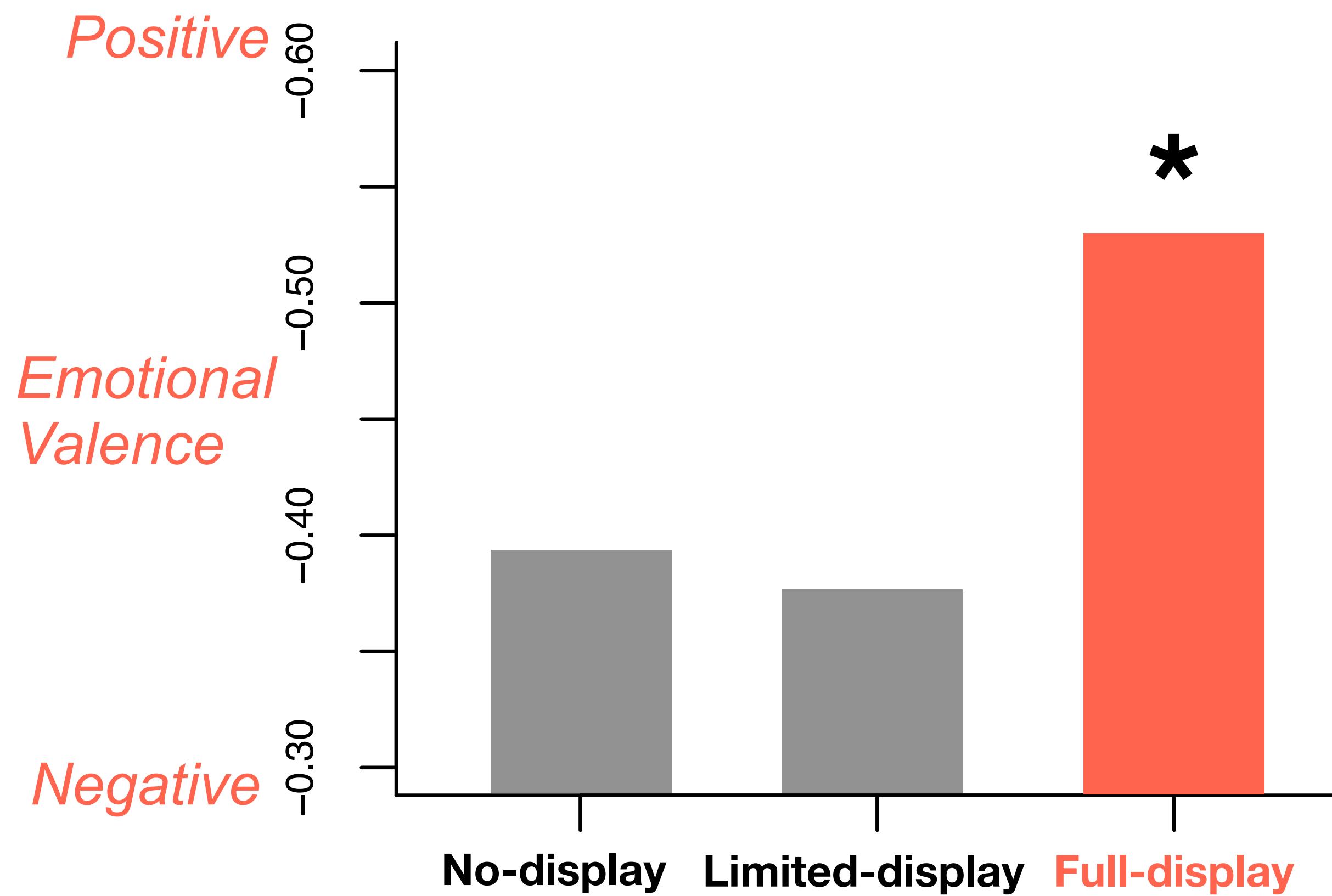
**Working Memory:** encoding new information for later cognitive operation





Conditions with more **social information** trigger more **memory operations**

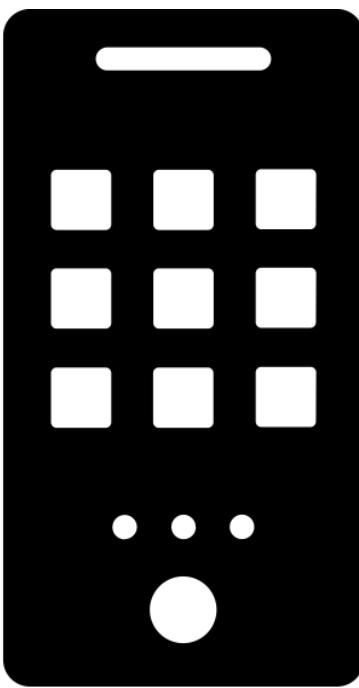




**Positive** feelings are associated with **stronger social conformity**  
[Trautmann-Lengsfeld 2013]

# Design Implications

# Design Implications



Created by Luiz Carvalho  
from the Noun Project

Mood Tracker App



Smart watch



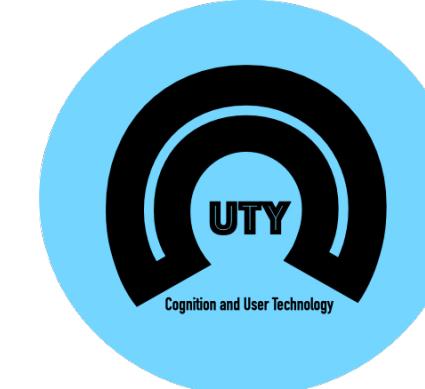
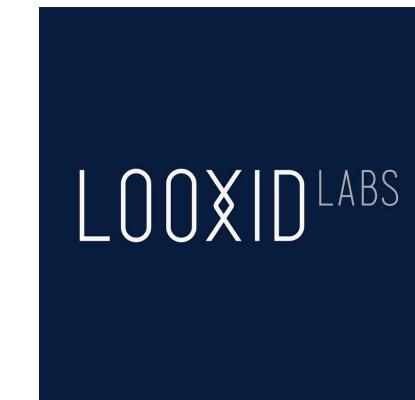
Portable EEG

# Acknowledgment

**Anonymous Reviewers**  
For insightful comments

**Looxid Lab**  
Technical Support

## Understanding Social Influence in Collective Product Ratings Using Behavioral and Cognitive Metrics

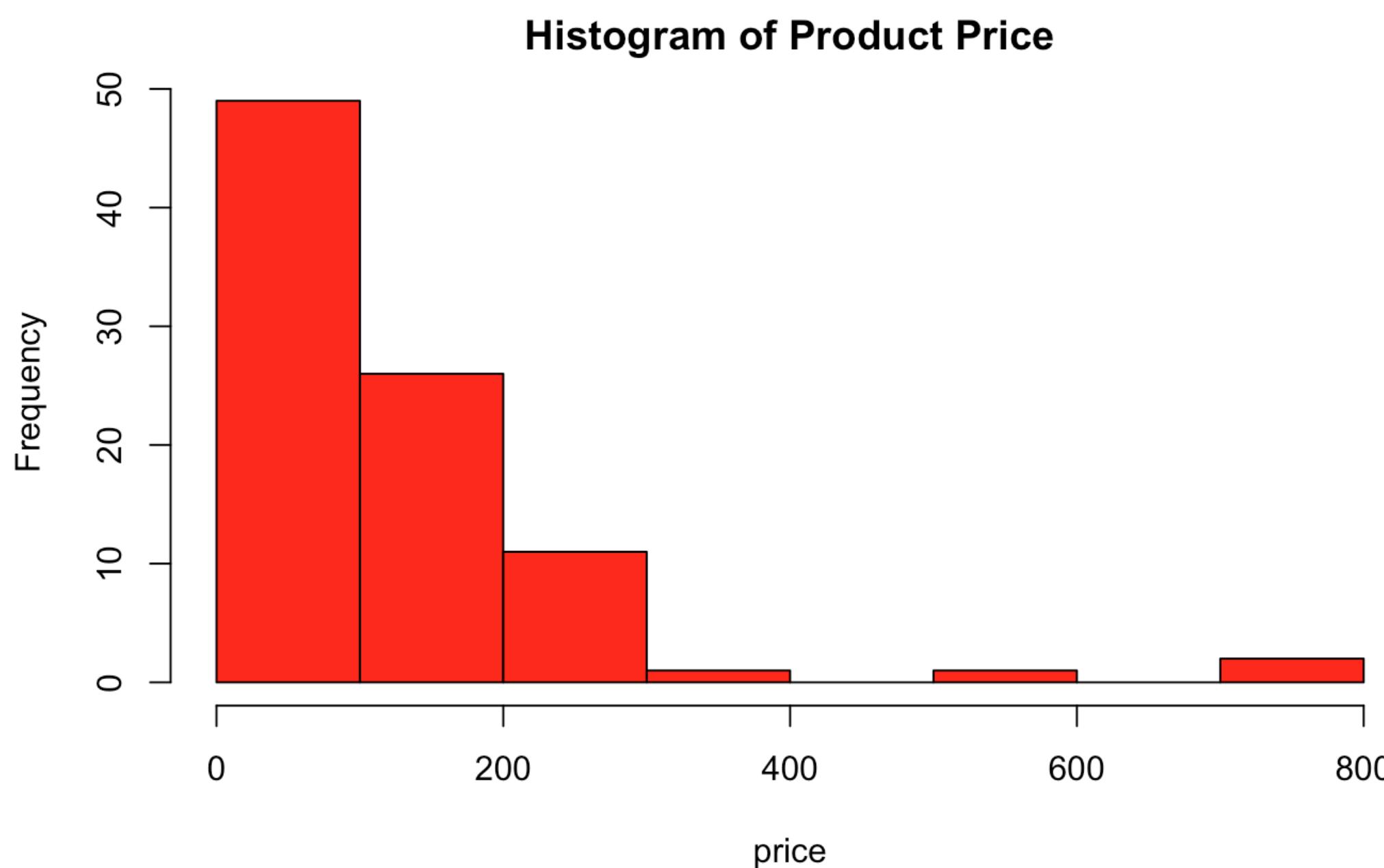
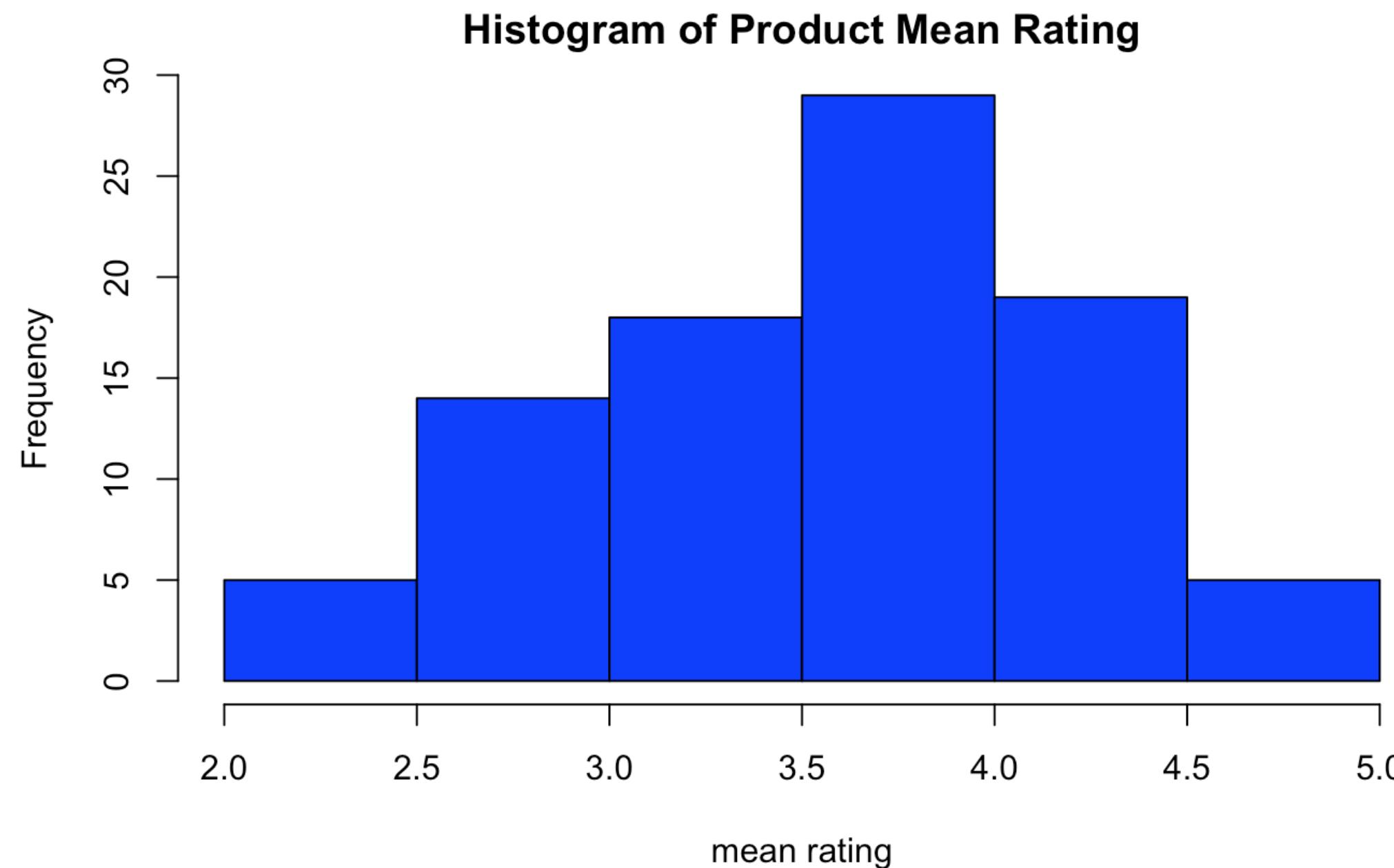


# **Supplementary**

# Control the factors of extreme overall rating & price

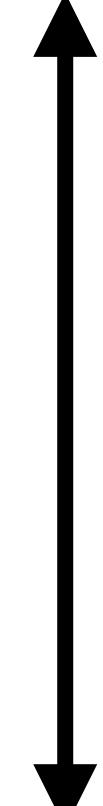
---

- Mean rating=3.63; SD=0.61
- Mean Price: 128.9\$; 90% of products in price range 0-400\$



# Conformity Score

$$= \frac{2nd \text{ rating} - 1st \text{ rating}}{\text{mean of others' ratings} - 1st \text{ rating}}$$

1st rating	mean of others' ratings	2nd rating	<b>conformity score</b>	Conform to others
4	2.7	1	<b>2.3</b>	

# Conformity Score

$$= \frac{2nd \text{ rating} - 1st \text{ rating}}{\text{mean of others' ratings} - 1st \text{ rating}}$$

1st rating	mean of others' ratings	2nd rating	conformity score	Conform to others
4	2.7	1	2.3	
1	4.4	1	0	

# Conformity Score

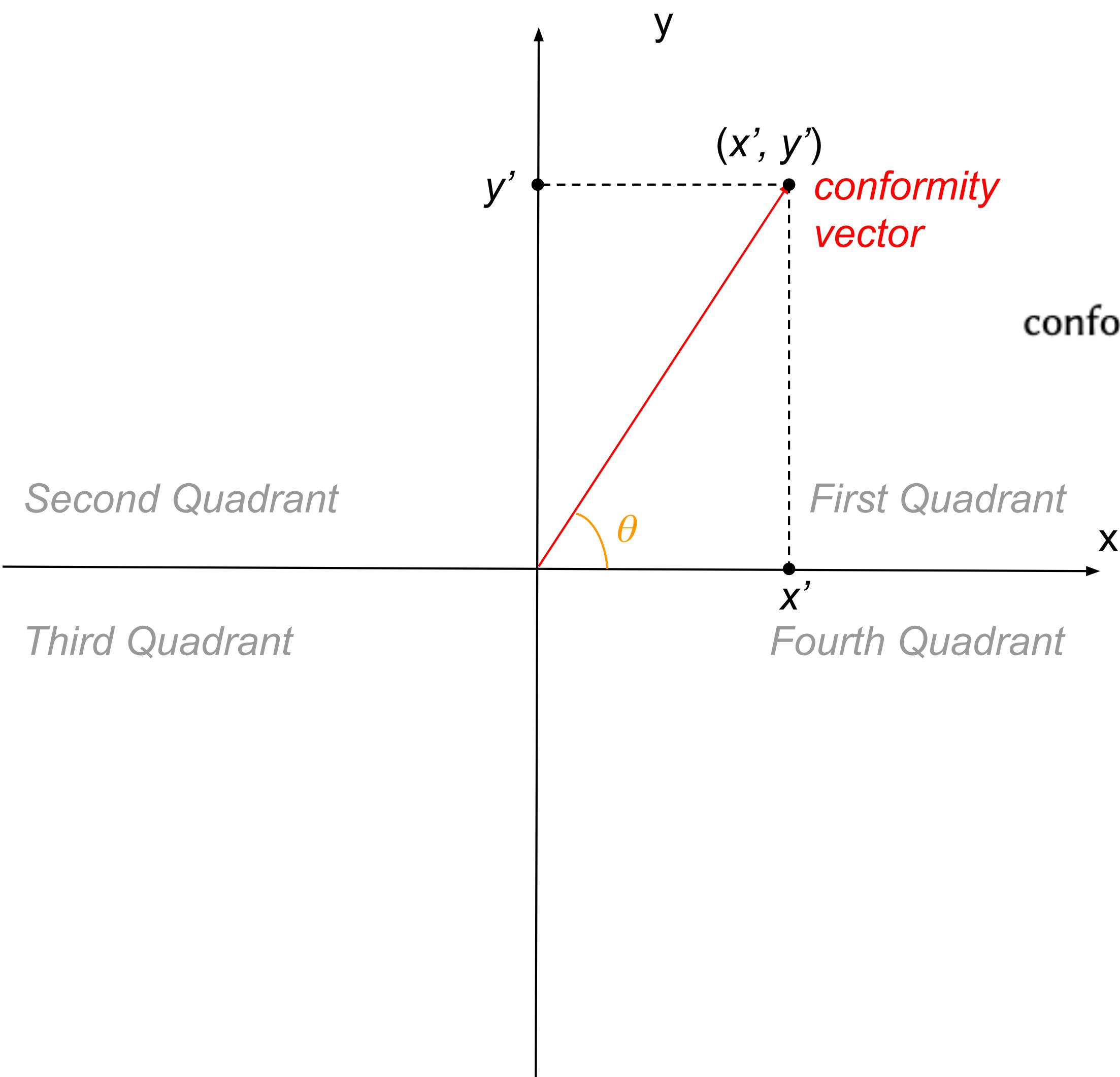
$$= \frac{2\text{nd rating} - 1\text{st rating}}{\text{mean of others' ratings} - 1\text{st rating}}$$

1st rating	mean of others' ratings	2nd rating	conformity score
4	2.7	1	2.3
1	4.4	1	0
3	2.1	5	-2

Conform to others



Not Conform to others



$x' = \text{mean of social ratings} - \text{individual's first rating}$

$y' = \text{individual's second rating} - \text{individual's first rating.}$

conformity score =  $\tan\theta = \frac{\text{individual's second rating} - \text{individual's first rating}}{\text{mean of social ratings} - \text{individual's first rating}}$

Second Quadrant

Third Quadrant

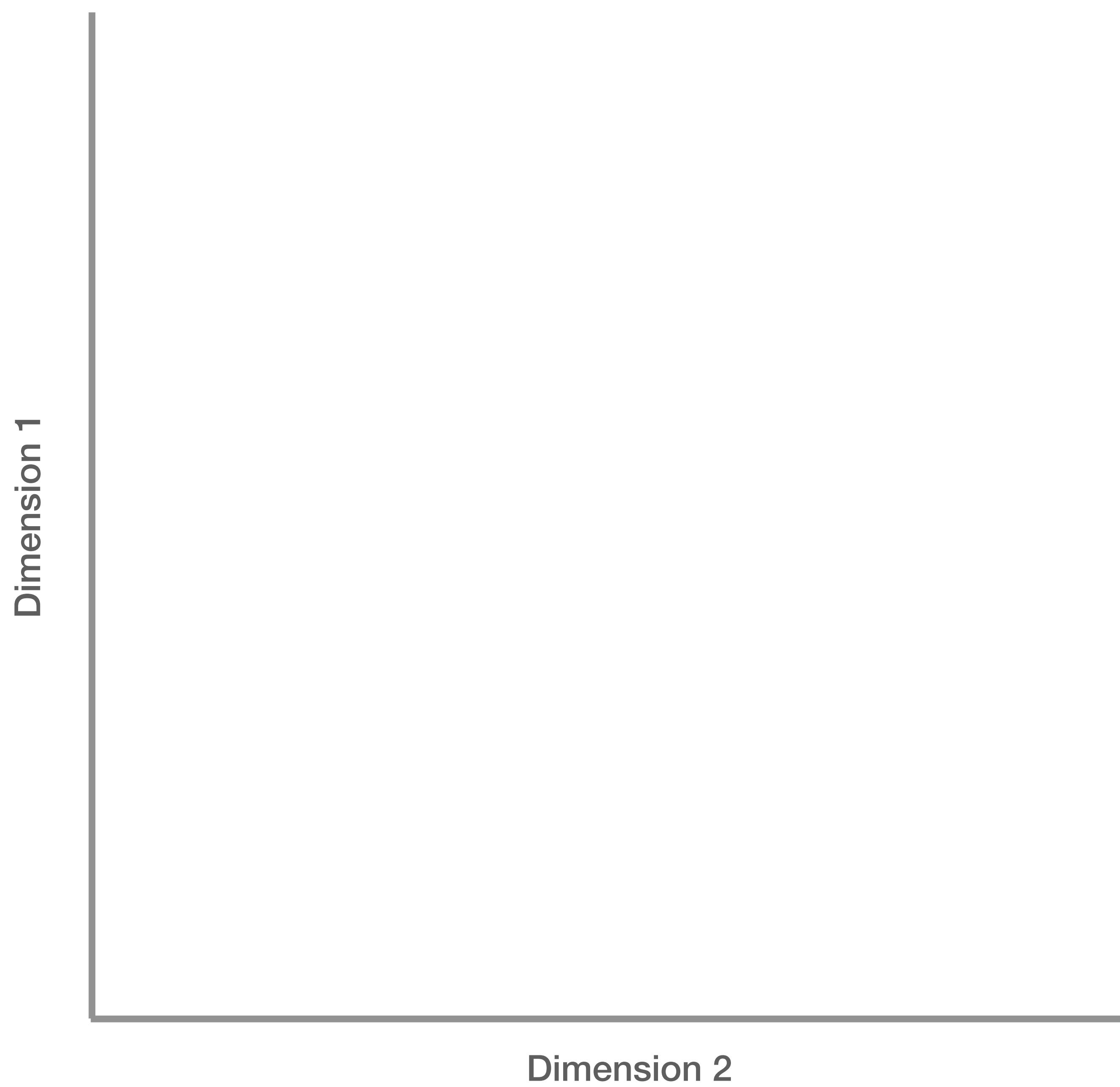
First Quadrant

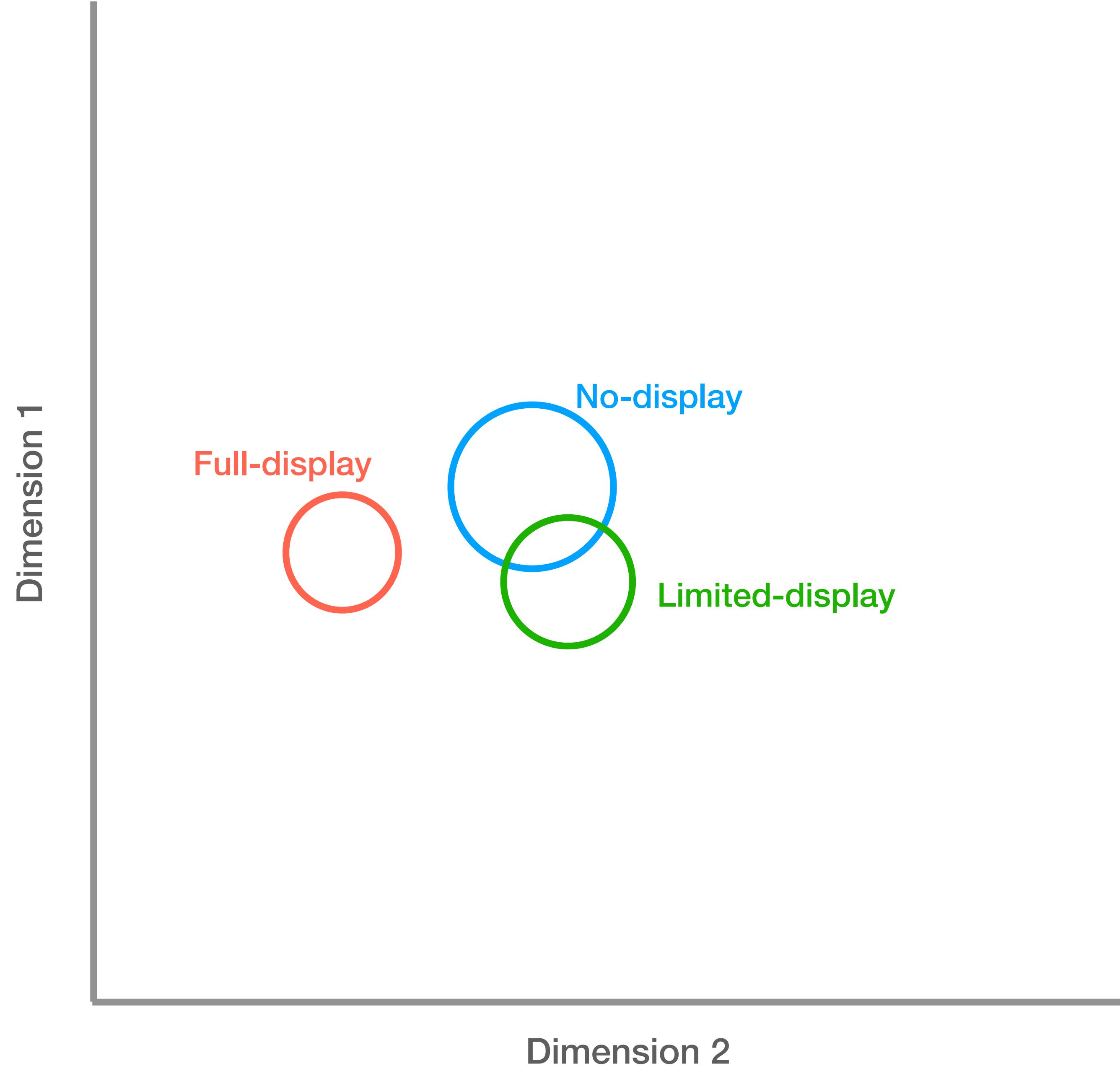
Fourth Quadrant

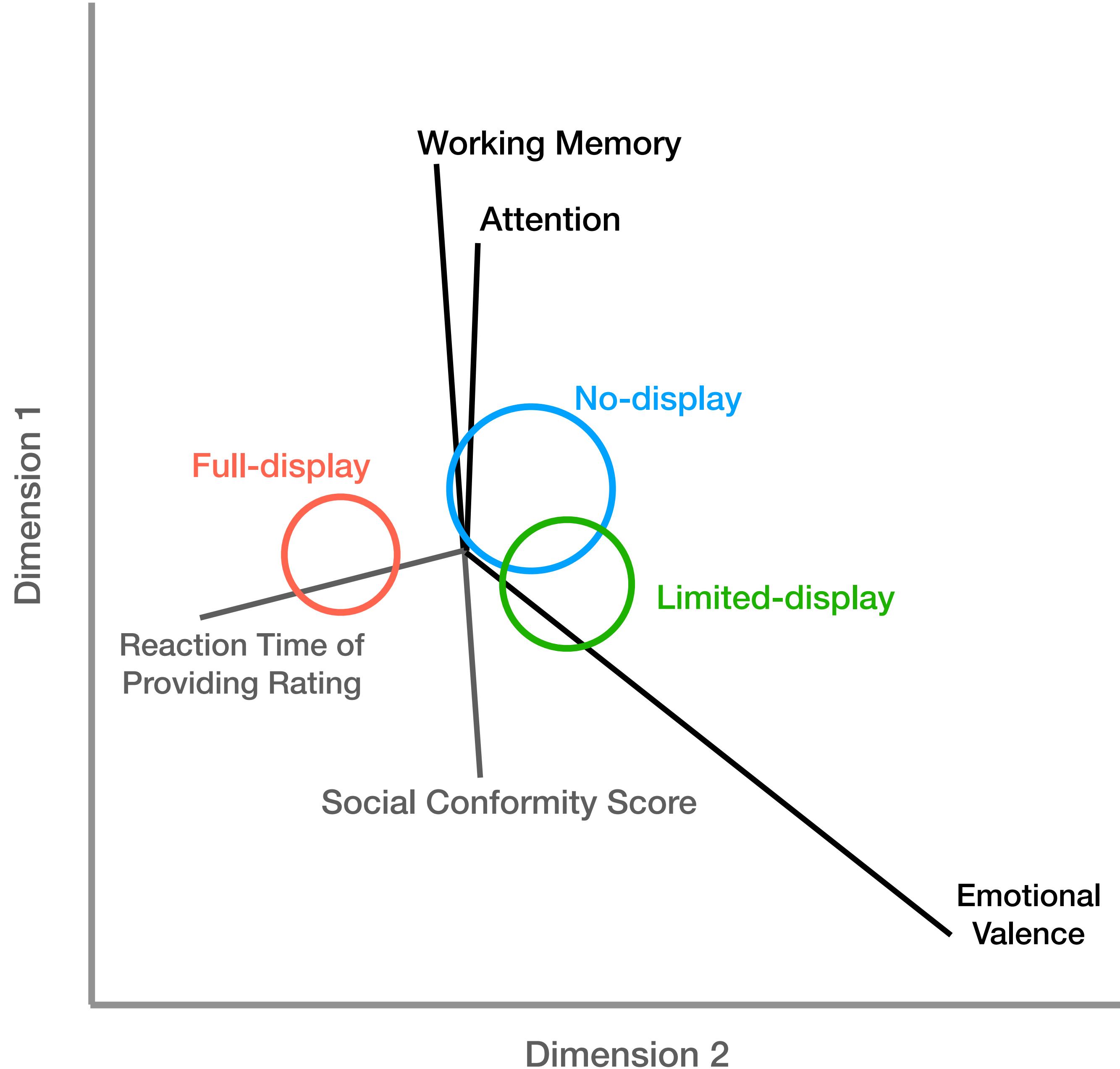
1st rating	mean of others' ratings	2nd rating	conformity score
4	2.7	1	2.3
1	4.4	1	0
3	2.1	5	-2

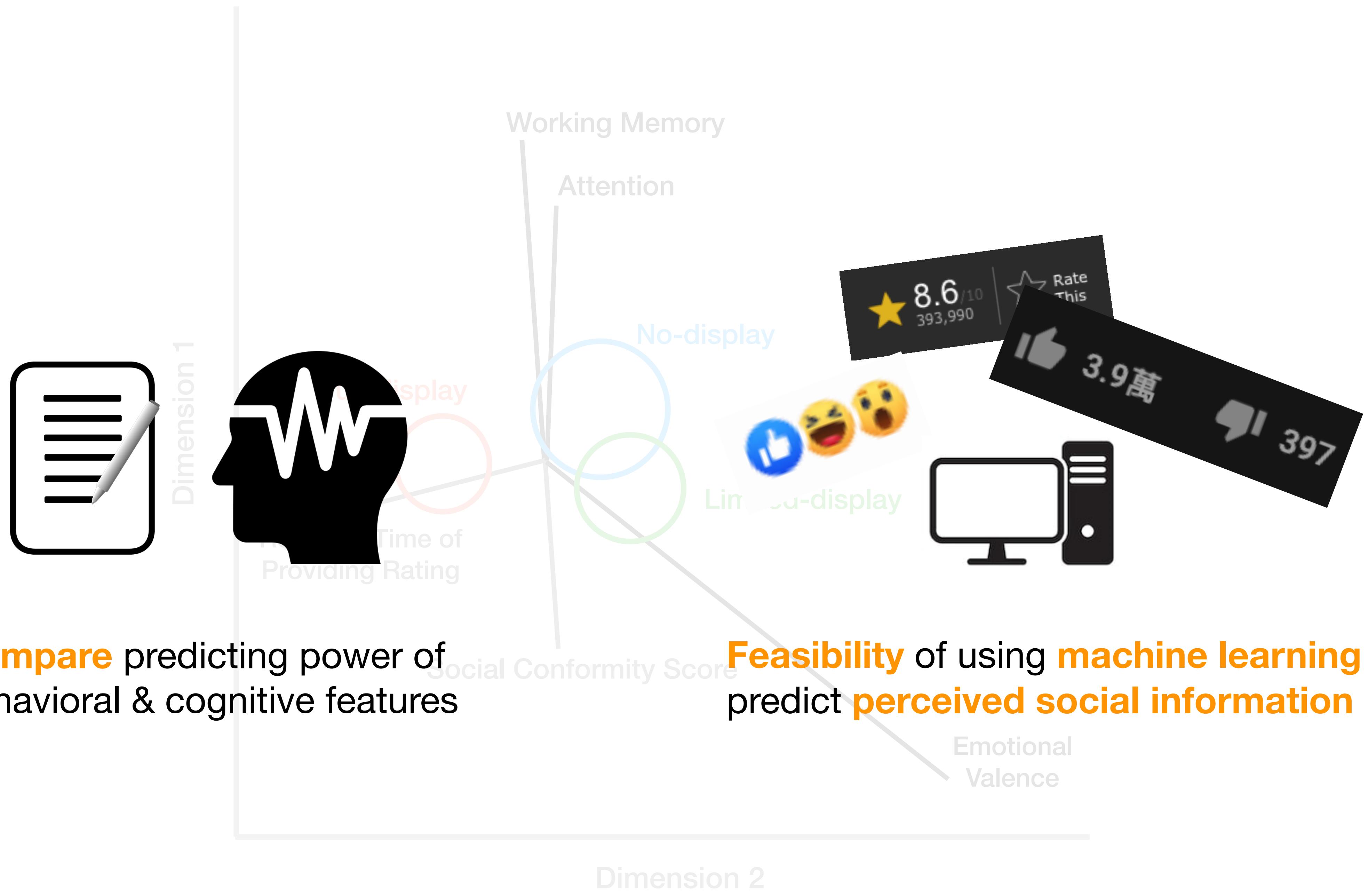
# Predictive Analysis

Use behavioral and cognitive responses to **predict** display type of others' opinion  
*Full-display, Limited-display, No-display*







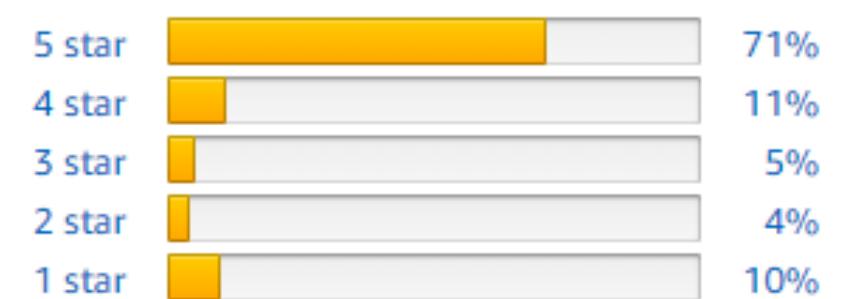


# Compare predicting power of behavioral & cognitive features

# Feasibility of using machine learning to predict perceived social information

# Discussion

## Rating + Review



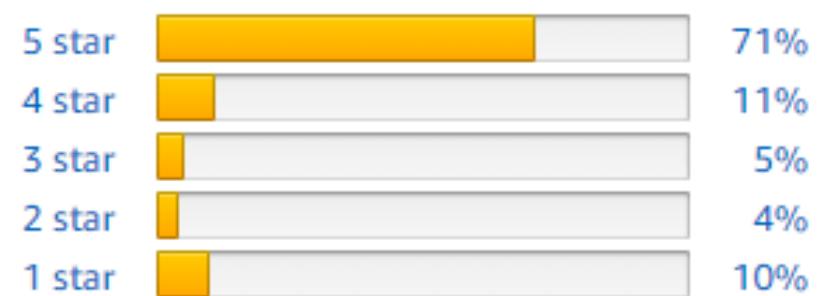
+

*“Great camera for a great price!”*



**Strong  
Social conformity**

## Rating + Review



+

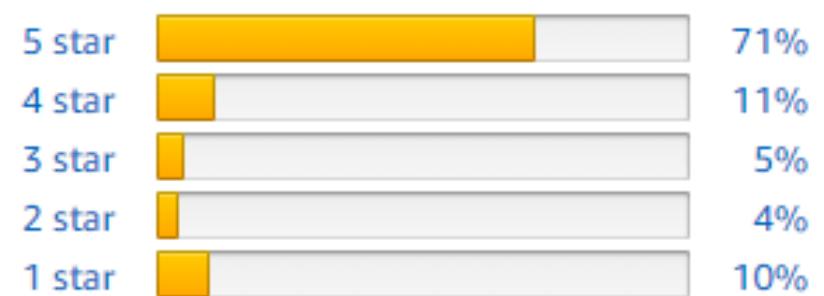
*“Great camera for a great price!”*



**Strong  
Social conformity**

**Reinforcement Learning**

## Rating + Review



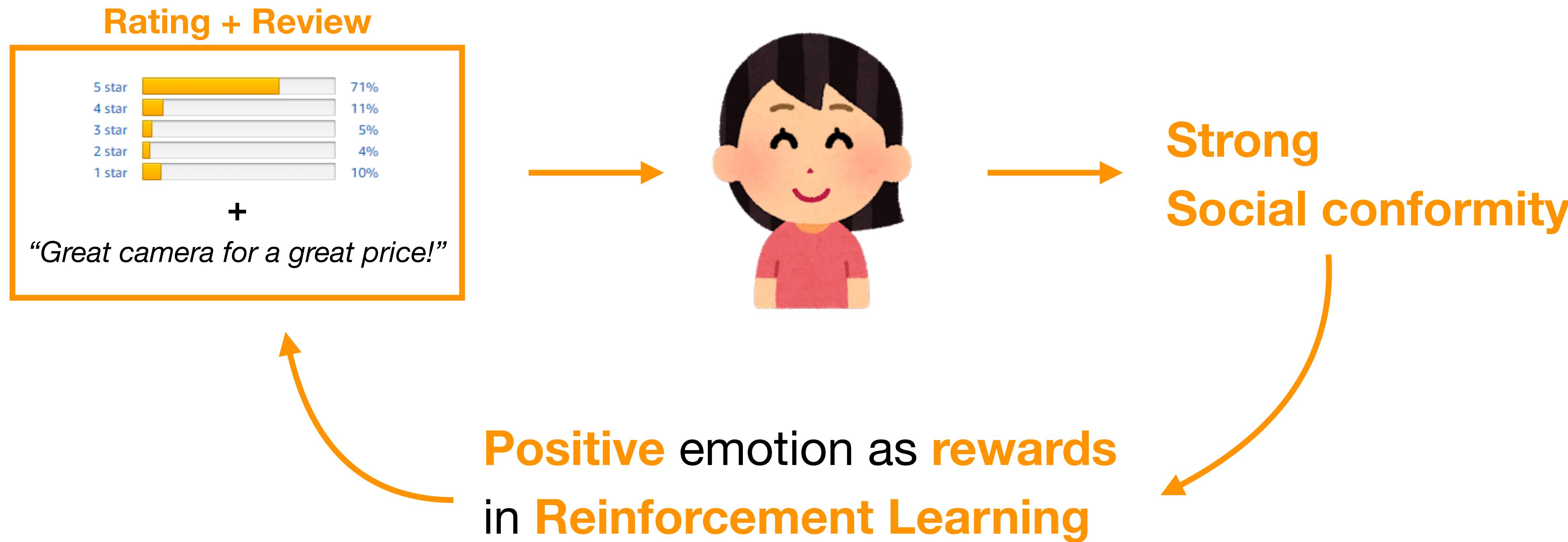
+  
“Great camera for a great price!”



**Strong  
Social conformity**

**Positive emotion as rewards  
in Reinforcement Learning**

# Conforming to others as a means to get rewards



# Conforming to others as a means to get rewards

