Engaging narratives evoke similar brainwaves and lead to similar perception of time

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Introduction

- It is said that we lose track of time - that “time flies” - when we are engrossed in a story.
- How does engagement with the story cause this distorted perception of time, and what are its neural correlates?

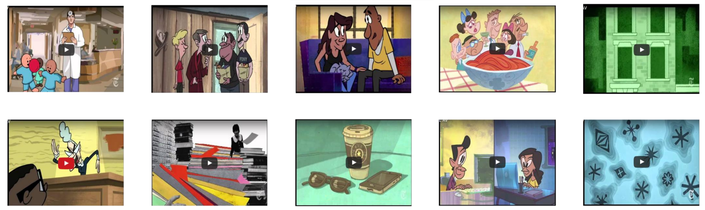
Experimental measure of engagement behavior

Real-world

Experimental

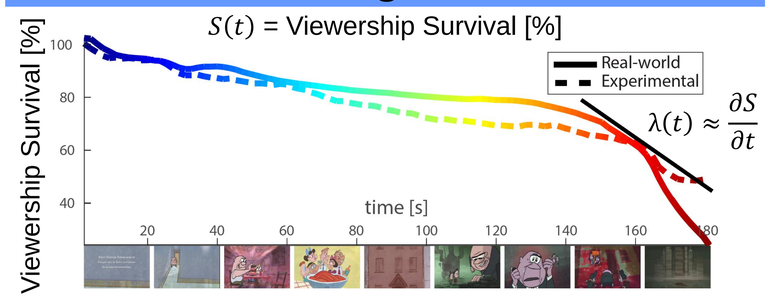
Data collected in **~ 2 years**

Data collected in **~ 1 hour**



Engagement as committed or “surviving” viewers

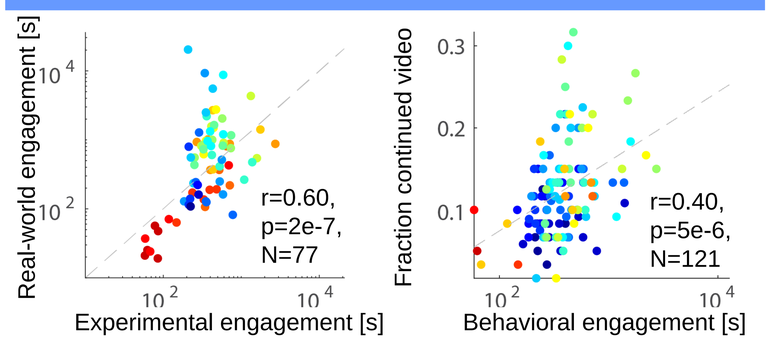
$S(t)$ = Viewership Survival [%]



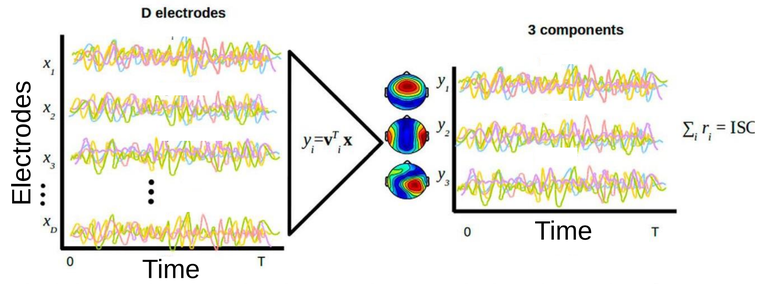
$\lambda(t)$ = Hazard [1/s]: $\lambda(t) = -\frac{1}{S(t)}\frac{\partial S(t)}{\partial t} \approx \frac{1}{S(t)}\frac{S(t) - S(t+\Delta t)}{\Delta t}$

$E(t)$ = Engagement [s]: $E(t) = \frac{1}{\lambda(t)}$

Behavioral engagement in “experimental” cohort mimics “real-world” behavior.



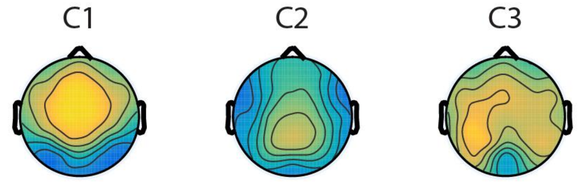
Inter-subject correlation in EEG as a measure of “neural engagement”



Find the optimal projections $\boldsymbol{v}$ that maximize the ratio of between-subject covariance over within subject covariance:

$$R_w^{-1} R_b v_i = v_i r_i$$

Spatial distribution of the three EEG components with maximal inter-subject correlation



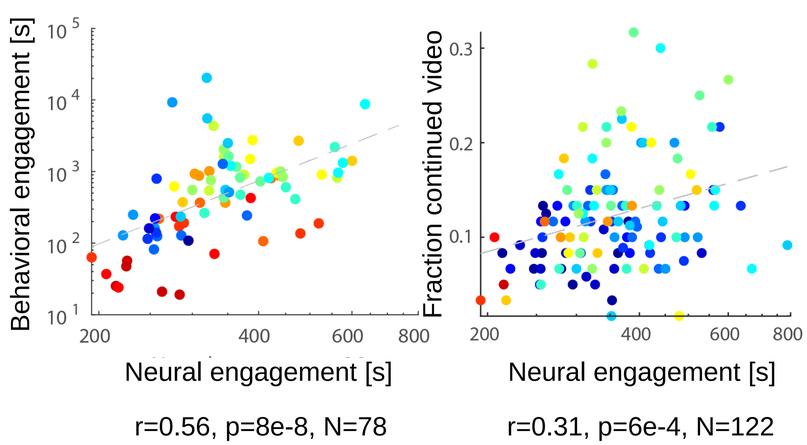
Neural engagement predicts behavioral engagement

“Neural Engagement” ≈ (Baseline Engagement) x (“ISC”):

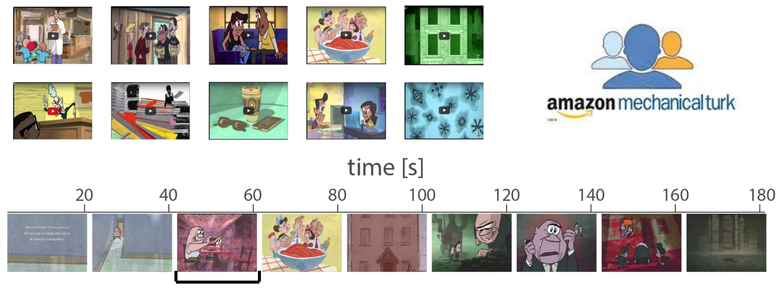
$$\widehat{E}(t) = E_0 \gamma(t)$$

$$\gamma(t) = exp\left[\sum_{i=1}^{3} \beta_i y_i(t)\right] = \prod_{i=1}^{3} \gamma_i(t)$$

Train parameters on experimental behavioral engagement…
Test parameters on real-world behavioral engagement



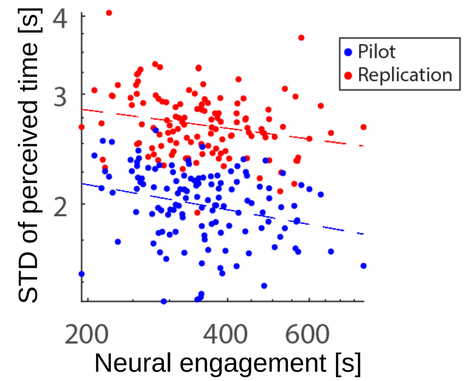
Does engagement alter time perception?



How much time has elapsed?

“Time flies when you’re having fun.”

Correlated brains perceive time more uniformly



Pilot: r=-0.27, p=0.0009, N=129
Replication: r=-0.23, p=0.05

Conclusions

- Engagement can be objectively quantified in terms of time commitment.
- The inter-subject correlation of evoked brain responses predicts behavioral engagement.
- Similar neural processing correlates with similar time perception.

References

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