Neural Correlates of Educational Engagement

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Introduction

- Previous research has shown that the neural reliability measured in a small group can be used to predict the behaviors of a large population[3 4]

- The amount of information retained from stimuli is closely related to the level of engagement with the stimuli.

- **Hypothesis**: The level of neural reliability evoked by educational stimuli, as measured via the inter-subject correlation (ISC) of electroencephalography (EEG), predicts both attentional engagement and learning.

Methodology

- EEG was recorded from 20 subjects while they watched short educational videos.

- The duration of the videos ranged from 142 - 388 s (247 ± 121.8 s).

- Video-related background knowledge and knowledge growth were measured before and after the videos using multiple choice questions.

- ISC components were derived by maximizing the correlation between the neural responses of different individuals (Figure 1)

- The correlation between each individual's evoked responses and their peers (ISC) was used as a metric for their relative attentional engagement with the stimuli.

- After the first video presentation, subjects watched the videos again while counting backwards from 1000 towards 0 in decrements of 7. This served as a distracting condition to assess the ISC's ability to discriminate between attentional states.

Results

- Subjects who exhibited high levels of ISC, also had high scores on the post-video test as could be seen in figure 2 (p= 0.01) and figure 3 (c=0.47 , p= 0.038).

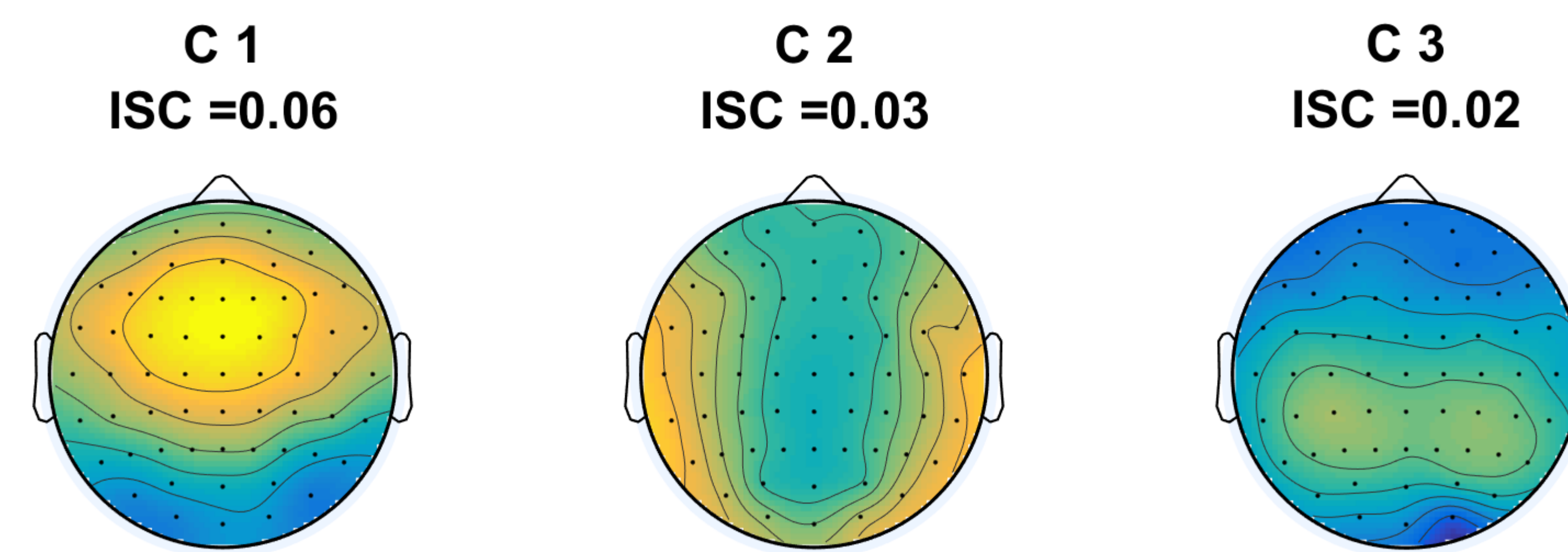- ISC was also able to distinguish the attentional state of subjects with perfect accuracy (Figure 4)

C 1 ISC =0.06   **C 2** ISC =0.03   **C 3** ISC =0.02

Figure 1: Scalp topographies for the top three ISC components (C1 – C3).

Post Test Score vs ISC (p =0.010567)
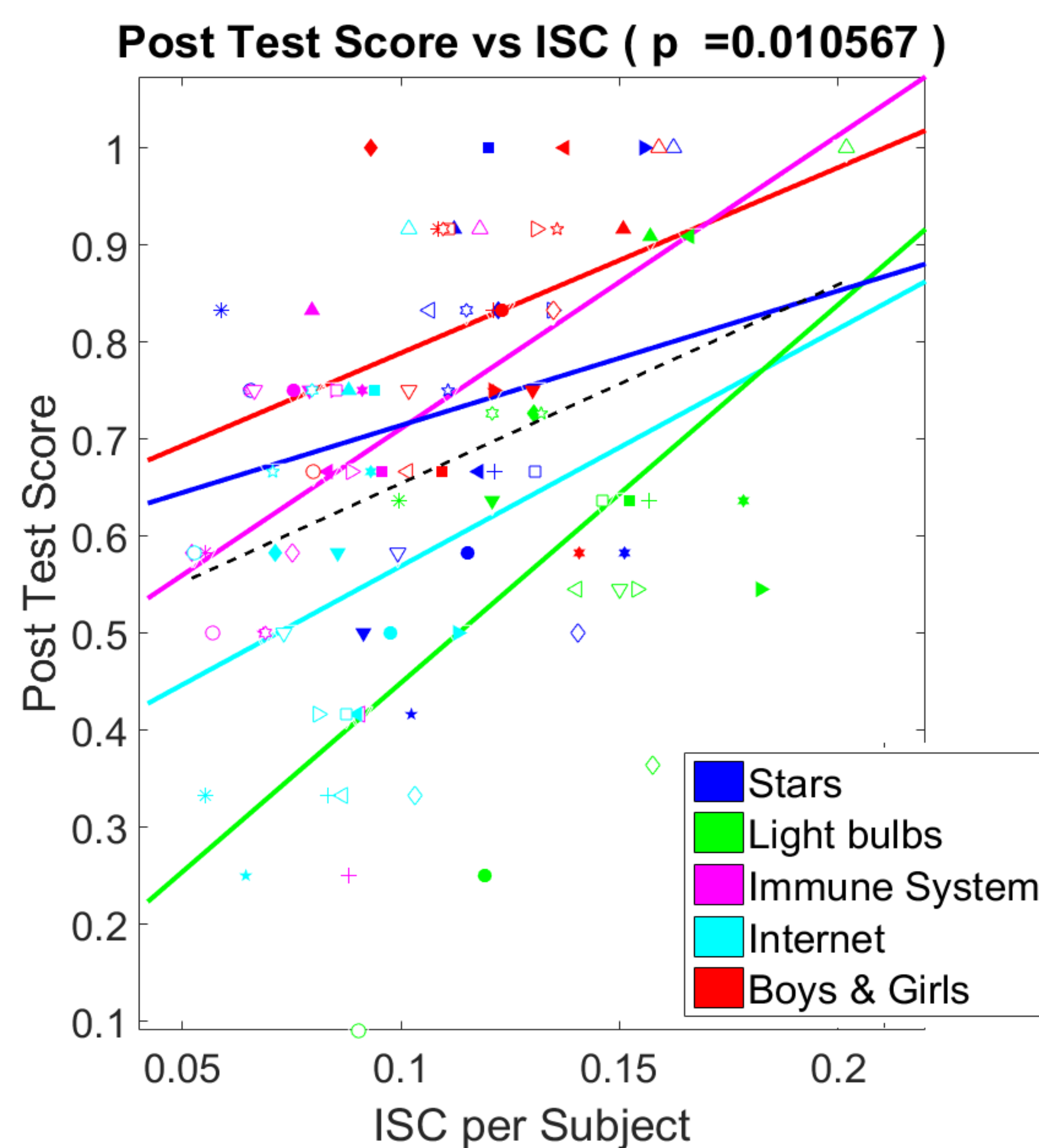
Legend: Stars; Light bulbs; Immune System; Internet; Boys & Girls

Figure 2 : A generalized linear mixed model relating subjects' ISC during each video to their post-video test score.
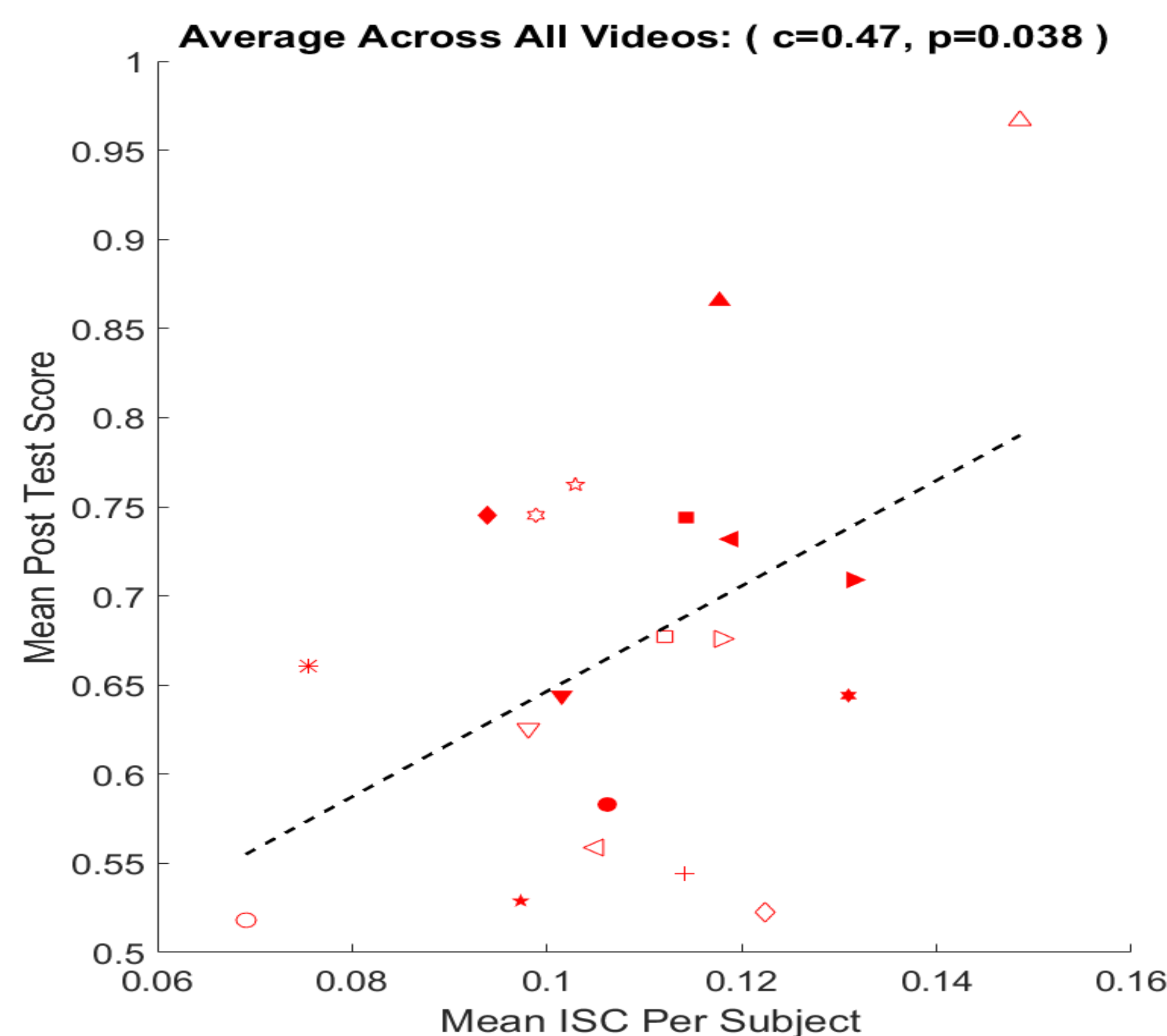
Average Across All Videos: (c=0.47, p=0.038)

Figure 3: The relationship between each subject's ISC across all videos and their performance on the post-video tests.
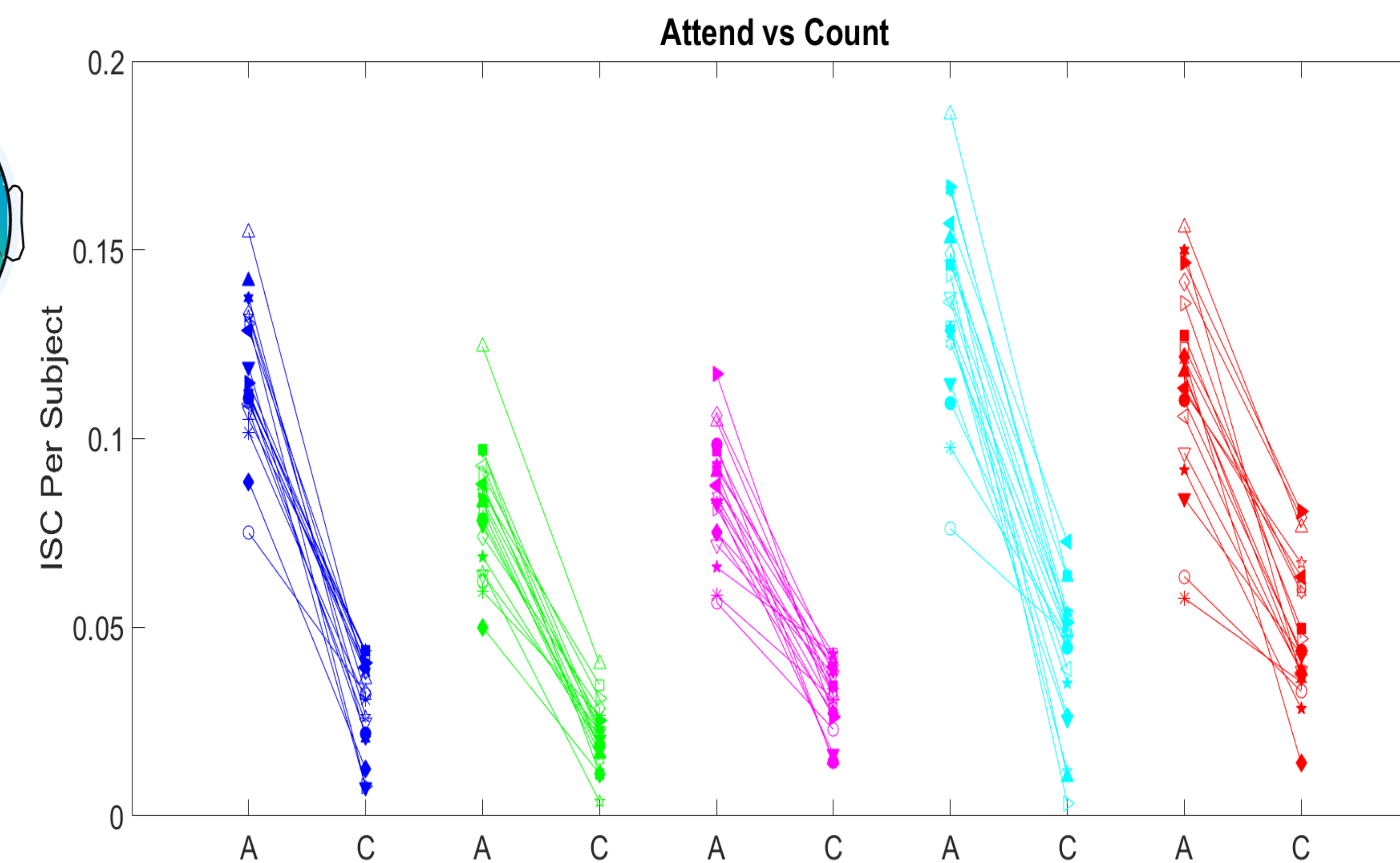
Attend vs Count

Figure 4 : ISC can perfectly discriminate attentional state between Attend (A) and Count (C) conditions for all 5 videos.

Discussion

- ISC may be considered as a biomarker of the stimulus-related attentional mechanisms necessary to achieve comprehension.

- In the future, ISC may be used as a metric when designing and assessing educational content and presentation style.

References

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