

Differences in brain activation in holistic and analytical thinkers elicited by watching a movie on moral dilemma

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Introduction

Individuals exhibit different thinking styles when perceiving time or objects as well as social situations.

- **Analytical thinkers** tend to emphasize the meaning of single objects and focus on them at the expense of context. Analytical thinkers view themselves as separate from social others with focusing on self-direction, autonomy, and self-expression.

- **Holistic thinkers** view objects more context-dependent and emphasize relationships and similarities with focusing on harmony and connection (Nisbett and Masuda, 2003, Nisbett and Miyamoto, 2005, Markus and Kitayama, 1991).

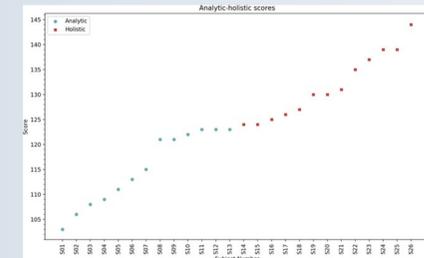
Culture shapes how we perceive reality: Holistic and analytical thinking have been associated with different surroundings: Eastern-culture people view objects more holistically, whereas Western-culture people view objects more analytically. However, these modes are not mutually exclusive, as each individual has these styles to varying degrees.

We studied whether participants, who have different thinking styles but live within the same culture, exhibit differential brain activity when viewing a drama movie.

Hypothesis: Differences between analytical and holistic thinkers in brain activity and eye gaze patterns in visual brain areas as well as regions associated with processing of social interactions, mentalizing and self-reflection.

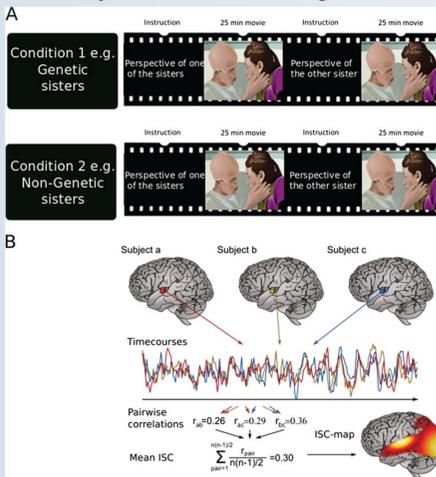
Methods

Scores and classification into analytical and holistic participants.



26 healthy female participants (mean age 26y) answered a 24-item questionnaire (Choi et al., 2007) to assess their thinking style on a bipolar analytical-holistic dimension. Participants were divided into groups with a cut-off at median score (123) resulting in 13 holistic and 13 analytical participants, respectively.

Inter-subject correlation during movie watching in fMRI



A: All subjects viewed a 25-minute version of the movie "My sister's keeper" four times. They were instructed to assume the movie protagonists to be genetic or non-genetic sisters and to take the perspective of first one and then the other sister (results of these aspects published in Bacha-Trams et al. 2017 and Bacha-Trams et al. 2020).

B: Temporal inter-subject correlation (ISC) matrices were calculated over subjects for each voxel (Hasson et al. 2004, Jääskeläinen 2008, Kauppi 2010).

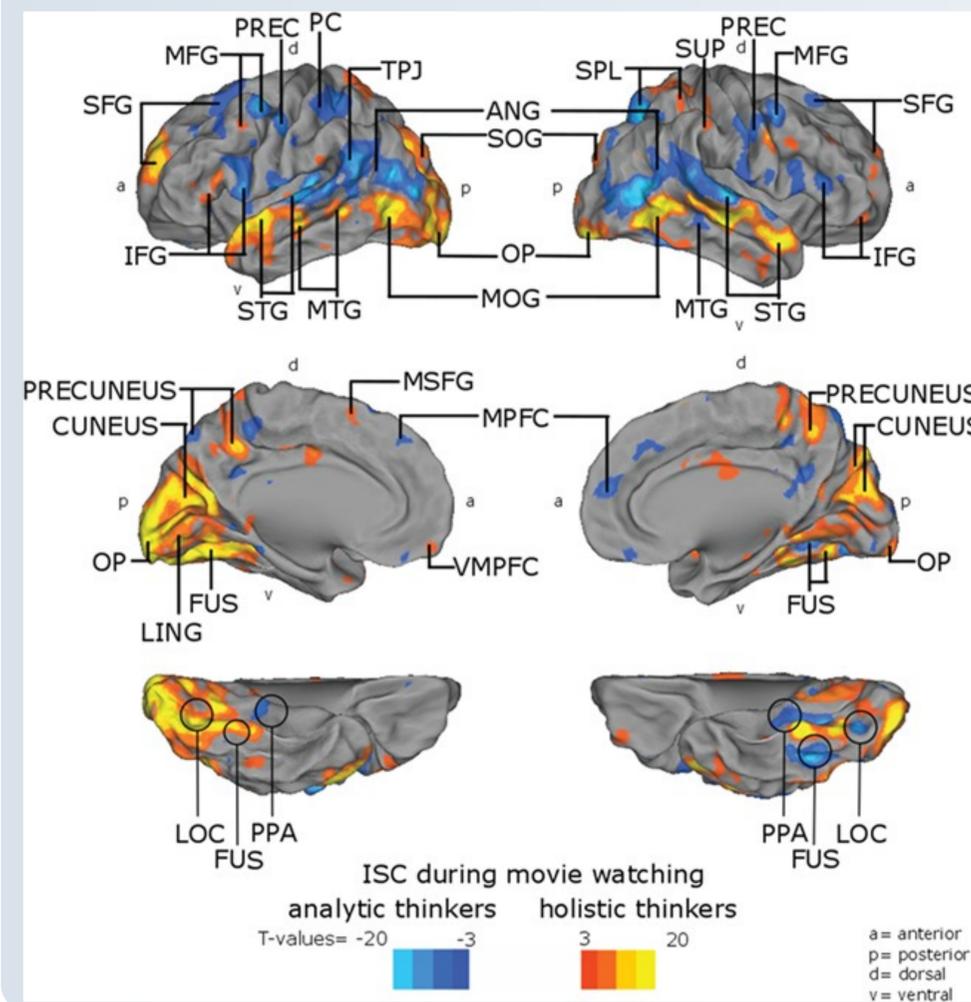
Imaging: Siemens 3T fMRI, EPI sequence, TR 2s, 64x64 matrix, 3.4x3.4mm resolution, 35 slices (4mm thickness, 1mm gap). 712 volumes were acquired.

Eye tracking

Using an eyelink 1000 eye tracker with sampling rate = 1000 Hz, spatial accuracy better than 0.5°, and a 0.01° resolution in the pupil-tracking, saccades were detected with a velocity threshold of 30 degrees/s and an acceleration threshold of 4000 degrees/s².

Results

Inter-subject correlation in analytical and holistic thinkers

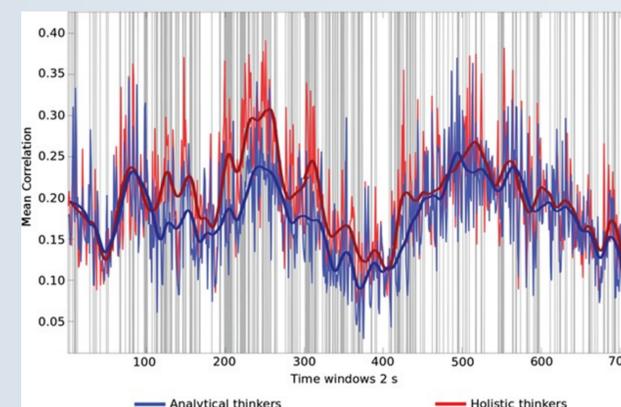


Holistic thinkers showed significant ISC in more extensive cortical areas than analytical thinkers, suggesting that they perceived the movie more similarly.

Holistic thinkers' ISC were higher in occipital, prefrontal and temporal cortices. Higher ISC in analytical thinkers was observed in right-hemisphere fusiform gyrus, temporoparietal junction and frontal cortex.

Warm colors indicate brain areas of significantly higher ISC in holistic thinkers and cold colors for analytical thinkers.

Eye gaze analysis



The mean eye gaze patterns were more similar in holistic than analytical participants.

A total of 36% (gray) of all time windows showed significantly different eye gaze patterns between groups; 84% of these correlations were higher in holistic vs analytical thinkers.

Eye gaze patterns for the holistic group (red) and the analytical group (blue) over the time course of the movie presentation with time windows of 2 s.

Conclusions

Overall, our results point out that there were robust differences in how analytical and holistic participants processed the movie (see Bacha-Trams et al. 2018 for more details).

A larger extent of cortex shows stronger ISC in holistic vs analytical participants with shared cultural background when they were watching a movie depicting a social moral dilemma.

- Areas showing high correlation in holistic thinkers as prefrontal cortex (VMPFC, DMPFC, DLPFC) and occipital pole are associated with moral processing, self-reflection and control of eye movements (Moll et al., 2003, Decety and Wheatley, 2015, Petit and Haxby, 1999).

- Areas showing high correlation in holistic thinkers as parietal and temporal cortices are associated with object and motion processing as well as intentional and emotional mentalizing (Takahama et al., 2010, George and Conty, 2008, Atique et al., 2011, Fehr et al., 2014).

- Since these results were obtained in participants with similar cultural background, they are less prone to confounds by other possible cultural differences as e.g. industrialization, demotrisation, genetic and linguistic background (Whorf 1956, Madden et al., 2000, Thierry et al., 2009).

More similar brain activity and eye gaze patterns in holistic participants, suggest that holistic thinkers performed the task more similarly, following the ongoing moral dilemma, while analytical participants focus on smaller details as specific objects and gazes between the movie characters during movie viewing and are thus more individual in perceiving the movie.

Outlook

As this study was performed solely in one (the Finnish) culture, it remains open if similar results would be found across cultures. A cross-cultural study is currently performed to investigate if it is rather the thinking style or the actual culture that has a greater role in the present findings.

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