# Resting-state theta oscillations and reward sensitivity in risk taking

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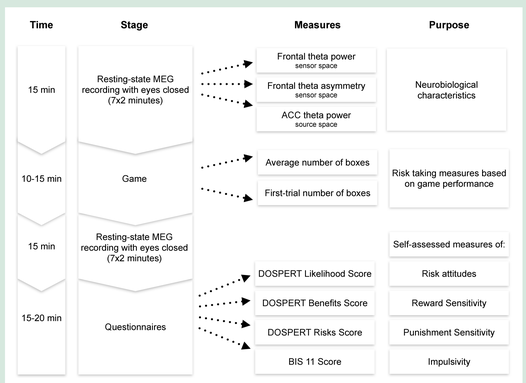
## Background

Previous risk-taking studies have considered resting-state frontal theta asymmetry in mostly or purely female samples. However, it was shown that males and females do not differ in frontal asymmetries, but they do differ in risk taking. Which neural trait could explain risk attitudes in a mixed sample?

## Methods

We studied if frontal theta asymmetry correlated with risk taking in a sample containing both males (20) and females (15). We suggested frontal theta power as an alternative neural trait to explain risk attitudes among males and females. Following previous research, we also considered theta power localised to anterior cingulate cortex (ACC). Participants completed the Bomb Risk Elicitation Task (BRET), which allowed us to measure risk taking during an economic game. The Domain-Specific Risk-Taking Scale (DOSPERT) was used to measure self-assessed risk attitudes as well as reward and punishment sensitivities. In addition, the Barratt Impulsiveness Scale (BIS11) was included to quantify impulsiveness. To obtain neurobiological measures, we used magnetoencephalography (MEG) acquired prior to task completion, while participants were at rest. For statistical inference we used Spearman's correlations, Mann-Whitney U-tests, regression analysis and structural equations modelling.

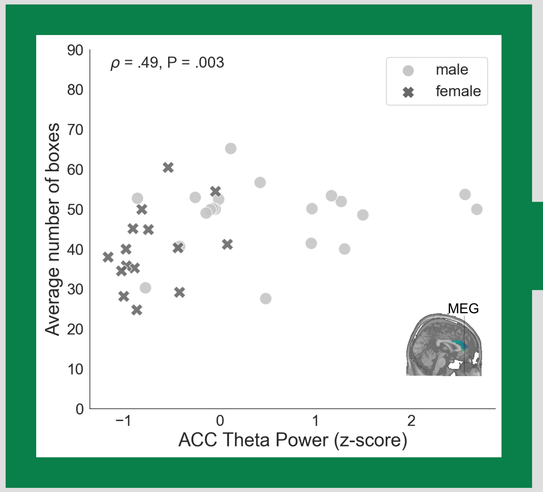


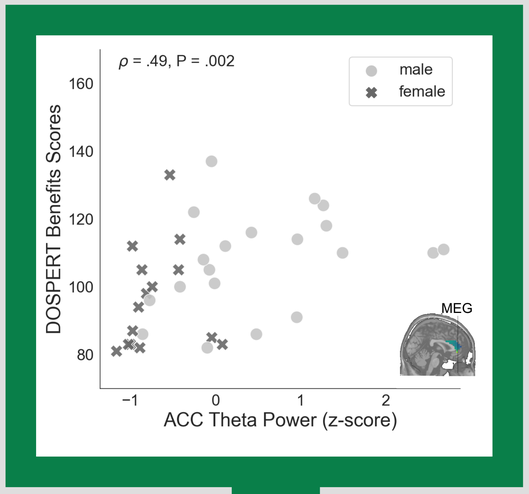

## Conclusion

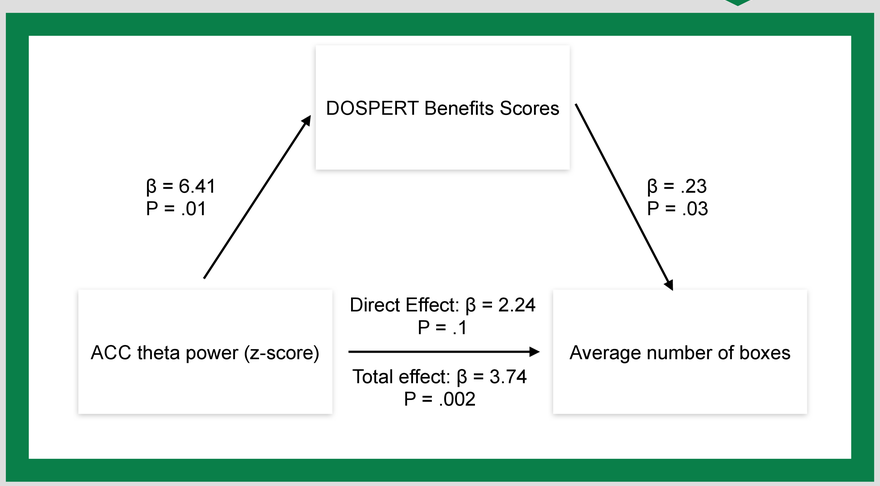
Sex-related differences in risk taking arise due to lower reward sensitivity in females as compared to males. Our findings indicate that when sex differences according to a specific risk-taking measure are pronounced, the ACC theta power significantly correlates with risk taking in the sample containing both males and females.

## Results

### Resting-state **theta oscillations in ACC** are associated with **reward sensitivity** and, consequently, **risk taking.**




### This may be the mechanism that contributes to **sex differences** in risk attitudes.

Theta oscillations in the anterior cingulate cortex (ACC) significantly correlated with average risk taking in the incentivised game and also with self-assessed reward sensitivity (DOSPERT benefits) in the sample containing participants of both sexes. DOSPERT benefits scores mediated the effects of resting-state ACC theta oscillations on average risk taking in the game. Males had significantly higher ACC theta power than females (Mann-Whitney U-test P = 0.000006).

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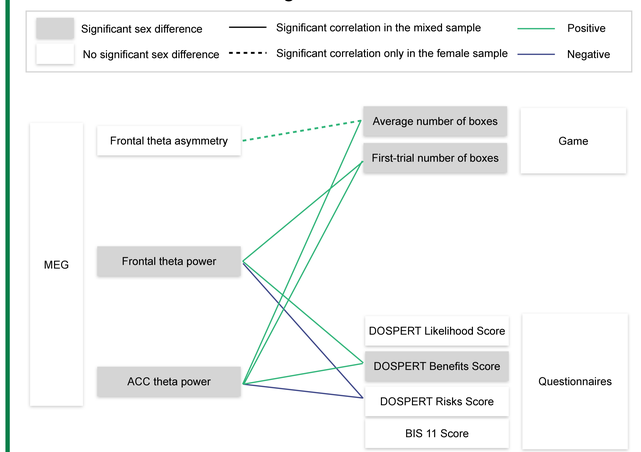
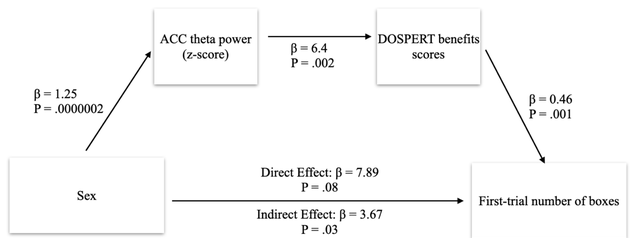
### Visualisation of main findings




Restricted structural equation model for sequential meditation of effects of sex on risk taking (significant indirect effect)




Non-parametric statistical clustering shows significant (alpha 0.05) clusters of correlation between theta power at sensor locations (white-dot markers) and behavioural measures