Kounios J, Fleck J.I., Green D.L., Payne L., Stevenson J.L., Bowden E.M., Jung-Beeman M. **The origins of insight in resting-state brain activity.** Neuropsychologia. 2008. 46. 281-291.

Abstract

People can solve problems in more than one way. Two general strategies involve (A) methodical, conscious, search of problem-state transformations, and (B) sudden insight, with abrupt emergence of the solution into consciousness. This study elucidated the influence of initial resting brain-state on subjects' subsequent strategy choices. High-density electroencephalograms (EEGs) were recorded from subjects at rest who were subsequently directed to solve a series of anagrams. Subjects were divided into two groups based on the proportion of anagram solutions derived with self-reported insight versus search. Reaction time and accuracy results were consistent with different cognitive problem-solving strategies used for solving anagrams with versus without insight. Spectral analyses yielded group differences in resting-state EEG supporting hypotheses concerning insight-related attentional diffusion and right-lateralized hemispheric asymmetry. These results reveal a relationship between restingstate brain activity and problem-solving strategy, and, more generally, a dependence of event-related neural computations on the preceding resting
state.

Резюме

Люди могут решить задачи больше чем одним способом. Они вовлекают две общих стратегии (А) методическую, сознательную, состояние поиска преобразований задачи, и (В) внезапное понимание, с резким появлением решения в сознании. Это исследование объяснило влияние начального отдыха на состояние мозга и последующий выбор стратегии субъектов. Высокоплотные электроэнцефалограммы (ЭЭГ) были зарегистрированы от субъектов в покое, которые впоследствии были направленны решить ряд анаграмм. Субъекты были разделены на две группы, основанные на пропорции полученных решений анаграммы с инсайтом, о котором они сообщают, в отличие от перебора. Время реакции и результаты точности были согласованы с различными познавательными стратегиями, решающими задачу, используемыми для того, чтобы решать анаграммы в сравнении без инсайта. Спектральные анализы привели к различиям группы в период покоя, ЭЭГ поддерживает гипотезы относительно связанного с инсайтом относящегося к вниманию распространения и ассиметрии правого бокового полушария. Эти результаты показывают

отношения между периодом покоя мозговой деятельности и стратегией решения задачи, и, более широко, зависят от связанных с событием мозговых вычислений в предыдущем состоянии покоя.

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Table 1
Significant interactions from ANOVAs, separately for each EEG frequency band (I: insight factor; AP: anterior–posterior factor; DV: dorsal–ventral factor; H: hemisphere factor; E: eye-status)

Frequency band	Interaction	Significance
Delta	AP × I	$F[3,72]=3.756, p=.021$*
	AP × DV × I	$F[3,72]=3.173, p=.034$*
	E × H × I	$F[1,24]=3.645, p=.068$
	AP × H × I	$F[3,72]=2.852, p=.051$
	DV × H × I	$F[1,24]=4.843, p=.038$*
Theta	AP × I	$F[3,72]=3.619, p=.025$*
	AP × DV × I	$F[3,72]=2.434, p=.072$
	AP × H × I	$F[3,72]=3.098, p=.037$*
Low-alpha	AP × I	$F[3,72]=2.936, p=.049$*
	AP × DV × I	$F[3,72]=2.486, p=.067$
	AP × H × I	$F[3,72]=5.681, p=.003$**
High-alpha	AP × I	$F[3,72]=4.811, p=.004$**
	AP × H × I	$F[3,72]=3.457, p=.039$*
Beta-1	AP × I	$F[3,72]=7.011, p<.001$***
	E × AP × DV × I	$F[3,72]=2.492, p=.079$
Beta-2	AP × I	$F[3,72]=4.349, p=.007$**
Beta-3	E × DV × I	$F[1,24]=3.522, p=.073$
	E × AP × DV × H × I	$F[3,72]=3.209, p=.032$*
Gamma-1	E × DV × I	$F[1,24]=4.812, p=.038$*
Gamma-2	E × AP × I	$F[3,72]=2.360, p=.100$
	E × DV × I	$F[1,24]=7.888, p=.01$**
Gamma-3	E × DV × I	$F[1,24]=6.453, p=.018$*

*$p<.05$, **$p<.01$, and ***$p<.001$.

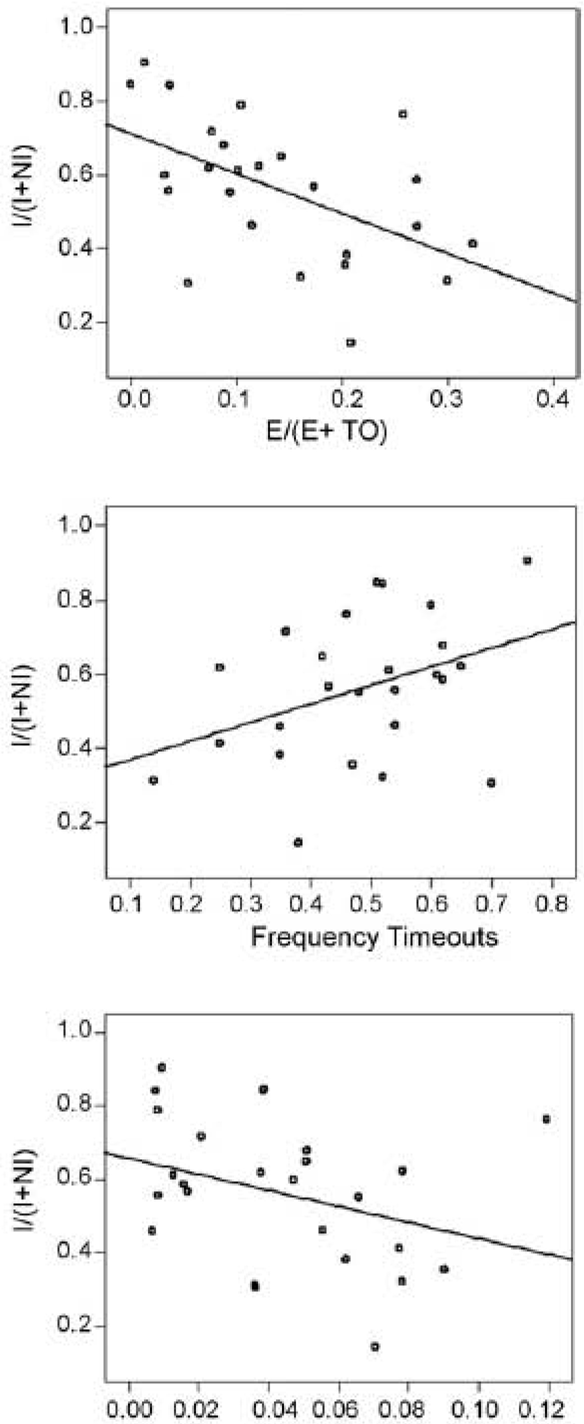

Fig. 1. Correlations between behavioral measures. Each circle represents an individual subject. Dotted lines represent best-fitting regression lines associated with correlations given in the text. (Top panel) Plot of relationship between proportion of correct solutions (i.e., insight plus noninsight [I + NI]) associated with insight, and proportion of unsolved trials (i.e., errors plus timeouts [E + TO]) on which a subject made an error response. (Middle panel) Plot of relationship between the proportion of correct solutions associated with insight (I/[I + N]) and the frequency (i.e., percentage) of trials on which a subject timed out without responding (TO). (Bottom panel) Plot of relationship between proportion of correct solutions associated with insight (I/[I + N]) and the ratio of the number of trials on which a subject made an error response (E) to the number of trials on which a subject made a correct response (I + NI).

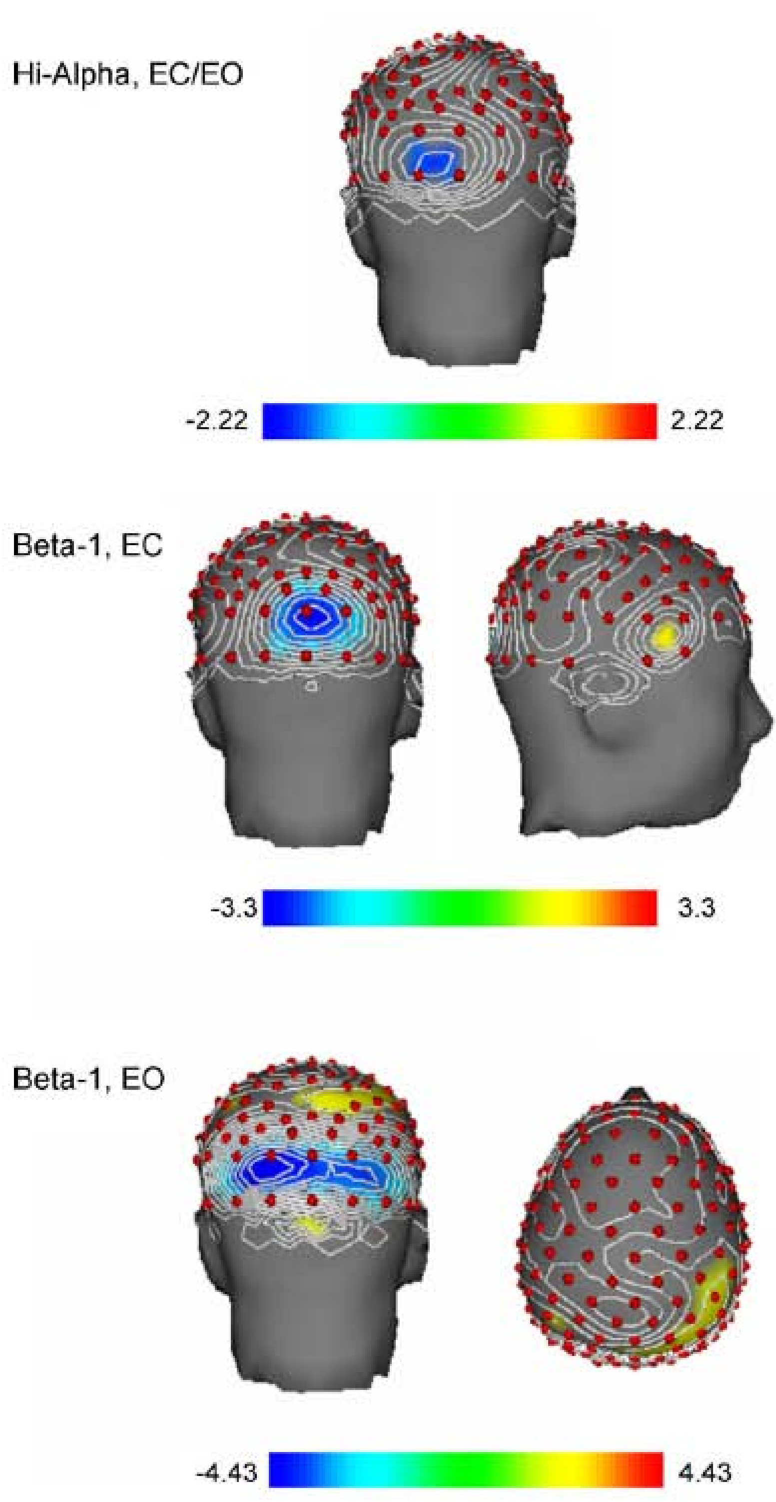

Fig. 2. Topographic maps of *t*-scores of EEG-power comparisons (high-insight group minus low-insight group) for the high-alpha (top panel), beta-1 eyes-closed (EC, middle panel), and beta-1 eyes-open (EC, bottom panel) frequency bands. The red end of the *t*-score scale represents scalp regions in which EEG power for the high-insight group is significantly greater than EEG power for the low-insight group. Blue values represent scalp areas in which the low-insight group has greater power than the high-insight group. Colored regions on the topographic maps represent the top and bottom 5% of the *t*-score distribution. Red dots on the maps indicate positions of the electrodes. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of the article.)

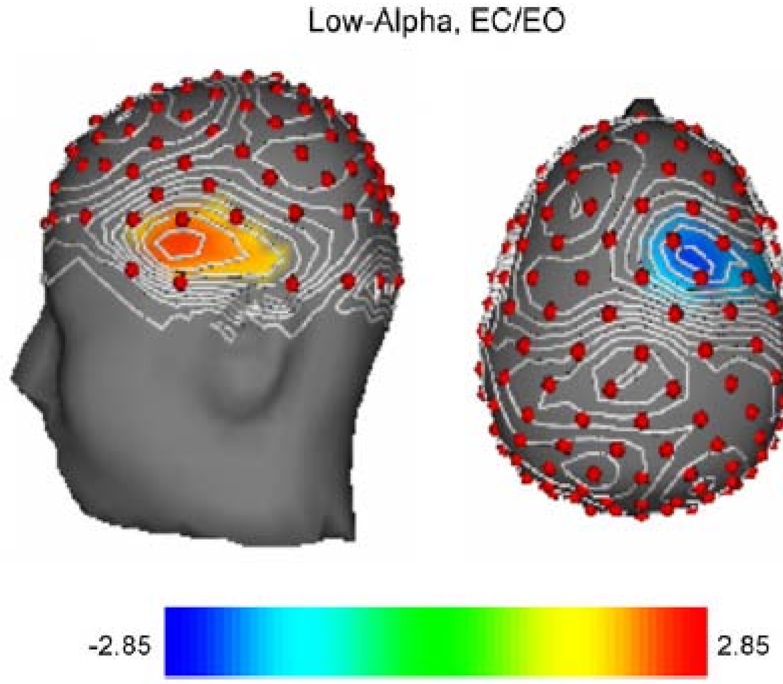

Fig. 3. Topographic map of *t*-scores of EEG-power comparisons (high-insight group minus low-insight group) for the low-alpha frequency band. This figure uses the same conventions used in Fig. 2.

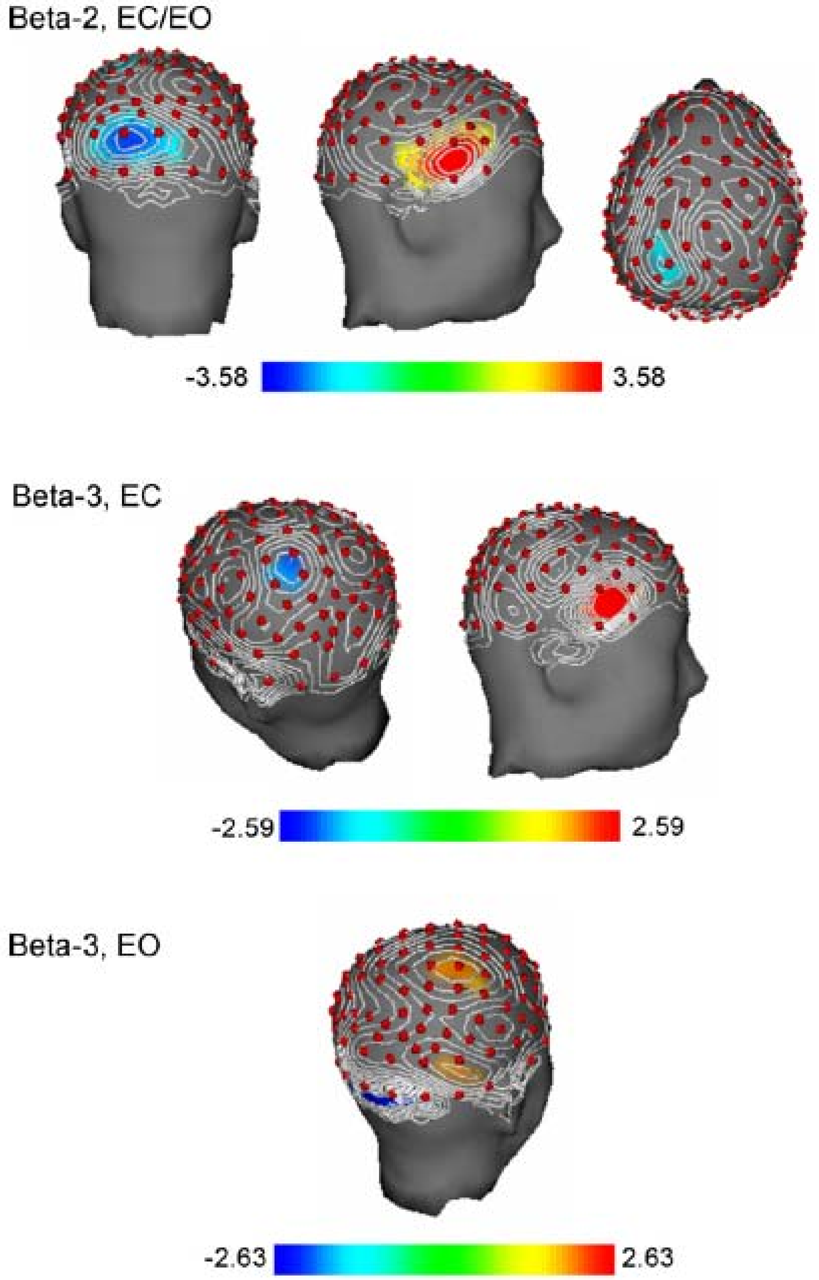

Fig. 4. Topographic maps of *t*-scores of EEG-power comparisons (high-insight group minus low-insight group) for the beta-2 EC/EO (eyes closed and open, top panel), beta-3 eyes-closed (EC, middle panel), and beta-3 eyes-open (EO, bottom panel) frequency bands. This figure uses the same conventions used in Fig. 2.

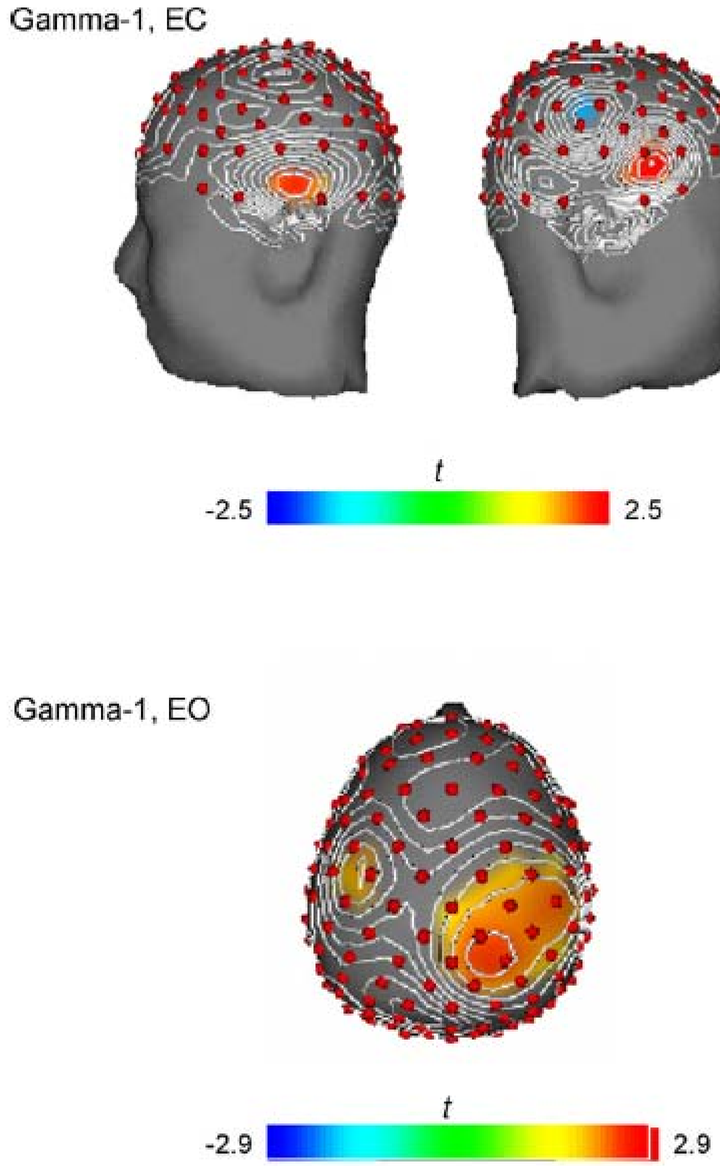

Fig. 5. Topographic maps of *t*-scores of EEG-power comparisons (high-insight group minus low-insight group) for the gamma-1 eyes-closed (EC, top panel) and gamma-1 eyes-open (EO, bottom panel) frequency bands. This figure uses the same conventions used in Fig. 2.