

# Association between visual deprivation and elevated Cosmo: a functional study

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**Knights of the Zodiac have used Cosmo-related combat techniques for centuries. We use functional neuroimaging to investigate the neural underpinnings of the Cosmo. We find Cosmo-specific cortical regions in the mid-ortho-occipital gyrus and in the claustrum. We also find that visual deprivation is associated with cross-modal engagement of visual areas for cosmal activity. We discuss the implications for the understanding of sensory deprivation and cosmological neuroscience in general.**

Cosmo | visual deprivation | neural correlates | Saints

## Introduction

The Cosmo (sometimes called the “seventh sense”) is a vital energy existing in all live beings (1). The Saints have for centuries burned their Cosmo in battles to protect Athena and the world. Since the discovery of the brain regions involved in cosmological processing (2), it has quickly attracted the attention of neuroscientists. While a lot is known about the effect of burning Cosmo on pain tolerance (3), self-control (4) and attention (5), little is understood about the receptors for the vital energy or the neural mechanisms underlying the cognitive and physical effects of Cosmo.

One technique, made famous by Saints from the Buddhist tradition, involves using sensory deprivation to elevate their Cosmo. Typically, this is achieved by closing their eyes to accumulate energy, which can later be released through what’s been called an “explosion” (6). Despite the multiple reports of the power of such techniques (e.g. in the battle of the Sanctuary, REF), experimental evidence that it actually elevates the Cosmo is lacking.

To test the hypothesis that voluntary visual deprivation increases activation in Cosmo-associated brain areas, we had 20 Knights of the Zodiac undergo a simple task of timed opening and closing of the eyes, while monitored under functional brain imaging.

## Methods

**Subjects.** Twenty healthy volunteers (2 female, 18 male; mean age  $28.5 \pm 54.7$  years, age range 13–261 years) were recruited through a partnership with the Graad Foundation. Their Cloths were of Gold ( $n = 6$ ), Silver ( $n = 5$ ) and Bronze ( $n = 9$ ). All subjects were right-handed, had normal vision (except for one Bronze subject who had been blind for a period), were not currently taking medications affecting the CNS and had no history of neurological or psychiatric illness except for recurrent head trauma. Saint Cloths were removed prior to the MRI scanning. All subjects gave their written consent prior to participation. The study was approved by the Ethical Review Board of the International Research Institute of Athens.

**Data acquisition.** All scans were acquired using a 7 T GE scanner (MR9990, General Electric Medical Systems). Each functional scan was 10 min in length and acquired with the same parameters. Subjects were instructed to relax and lie still. For each condition, subjects were additionally instructed to either keep their eyes open or closed, while trying or not trying to elevate their Cosmo, amounting to four separate conditions: Open/Elevated Cosmo, Closed/Elevated Cosmo, Open/Baseline Cosmo and Closed/Baseline Cosmo. Subjects were allowed to blink if necessary. T1-weighted structural images were acquired before the functional images using a three-dimensional MPRAGE sequence. Images were preprocessed to correct for the influence of subject motion and then aligned to the anatomical scans.

Resting-state fMRI data was acquired using a multi-slice 2D gradient-echo EPI sequence. Each run was 17 minutes long. We used a region of interest (ROI) based approach. Two ROIs, or seeds, with radiuses of 4 mm were generated based on the coordinates described originally (2) - in the mid-ortho-occipital gyrus and in the claustrum (also referred to as paracosmal cortex and precosmus, respectively) - as well as seeds for visual areas. We also did a whole brain contrast analysis for the Elevated Cosmo vs Baseline Cosmo conditions, with eyes Open.

**Analysis.** Analyses were performed by computing contrasts per subject and then using these to calculate one-sample t-test values at every voxel. For all analyses, the significance level was set to  $P < 0.001$ , which we corrected for multiple comparisons (7). One subject did not complete the task because he refused to follow the instructions to open his eyes during the task, “for our own safety,” in his words. Another subject interrupted the task because he reported feeling the presence of the goddess Athena during the tasks, whose influence prevented him from keeping his Cosmo at low levels.

## Results

In our fMRI analysis, the comparison between the Open/Elevated Cosmo and Open/Baseline Cosmo conditions replicated the original findings (2), where the elevation of the Cosmo is associated with predominant activations of the paracosmal cortex and precosmus (**Figure 1**).

The comparison between the Open/Elevated Cosmo condition and the Closed/Elevated Cosmo condition showed the effect of temporary and voluntary visual deprivation in the ac-

MS, YI and GP designed the study. MS & YI performed the experiments. MS & YI analyzed the data. MS, YI & GP wrote manuscript.

The authors declare no conflict of interest.

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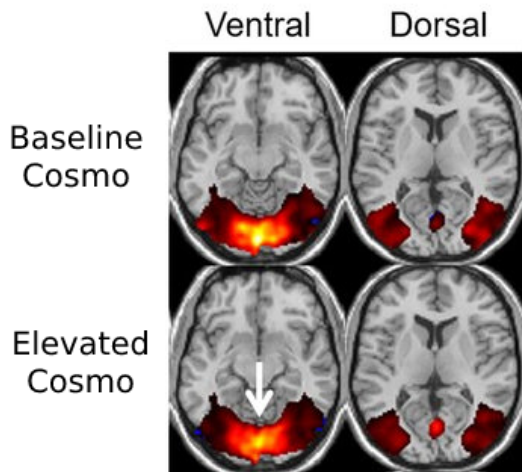


Fig. 1. Activation of the cosmal areas from the contrast analysis of Cosmo Elevation vs Baseline conditions.

tivation of the same Cosmo-related areas (**Figure 2 - Cosmo areas**). Moreover, we find that visual areas are also engaged in Cosmo-processing in the visual deprivation conditions (**Figure 2 - Visual areas**).

A subsequent analysis reinforced this finding by showing that there is a correlation between the Cosmo level that the Saints can achieve and the level of activation in the corresponding brain regions in the eyes Closed conditions (**Figure 3**). We were surprised by the high variation for the Bronze Saints in the Elevated Cosmo conditions (**Figure 3**, bronze bars). This is explained by some of the subjects achieving a very high Cosmo level - comparable to those of the Gold Saints. It is our understanding that this is not typical for Bronze Saints and should be particular to our sample, not representative.

### Discussion

We show for the first time that the closing of the eyes increases the activation of areas associated to Cosmo-processing, which suggests a neural basis for the ancient technique used by the Saints. We also reveal that this occurs by recruiting areas beyond the precosmus and paracosmal cortex. Our results suggest that, by using visual deprivation, Silver and Bronze Saints might achieve activations of Cosmo regions comparable to that of Gold Saints. Surprisingly, we also found a cross-modal response - visual areas seem to be recruited for Cosmo activity when eyes are closed.

This raises new questions: does the deprivation of other senses have the same effect? Is the effect cumulative, i.e. does deprivation of more than one sense simultaneously cause an even larger effect? Is the mechanism the same for chronic voluntary deprivation? Our outliers also suggest avenues for future study, indicating a role for a strong belief in Greek goddess Athena in Cosmo elevation.

One limitation of this study is that it did not check the effects of cosmos directly, only the activation of the area. Moreover, the study lacks ecological validity: the seventh sense is normally used in battle, where the patterns of brain activation are likely to be different from what we investigated in the controlled conditions of the laboratory. Further studies with other methods could overcome these limitations.

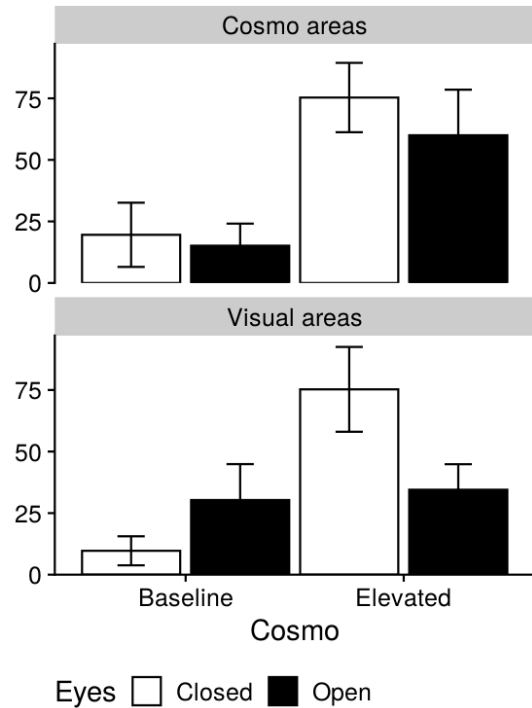


Fig. 2. Comparison between the activation of Cosmal or Visual areas across conditions.

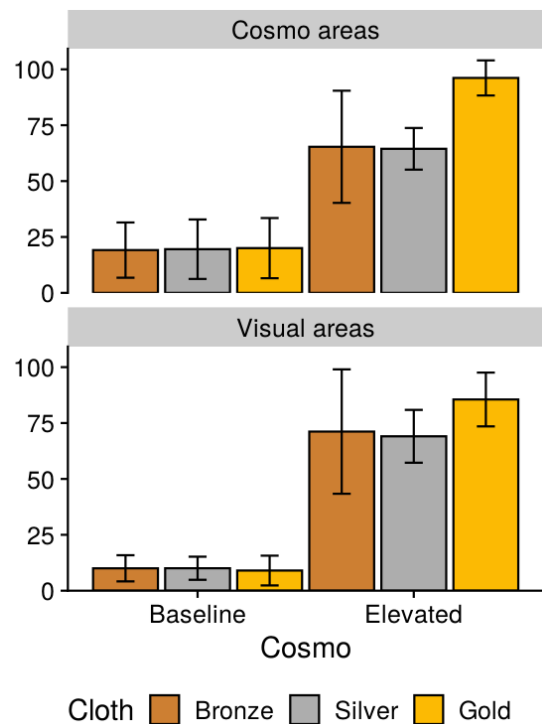


Fig. 3. Comparison between the activation of cosmal or visual areas across conditions, by type of Cloth, in the Eyes Closed condition.

This study helps explain how visual deprivation acts as a mediator of the activation of the paracosmal cortex and precosmos for Cosmo-related activity, emphasizing the previously unknown role of visual areas in Cosmo. While this is an important contribution, much remains unknown and we hope to have inspired a fruitful avenue for future research.

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