

# Default mode network is associated with wise advising from the second- but not the third-person perspective

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## Article

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# Abstract

Advice-giving is an important way to share life experiences and promote wisdom in society. We hypothesized that resting-state Default Mode Network (DMN) activity should be associated with increased wisdom when advising from a self-related perspective due to the DMN's involvement in reflection of personal life experiences. In our study, 52 participants provided advice on various life dilemmas using either a second- or third-person perspective after receiving a resting-state functional MRI scan. The results showed that participants felt significantly smaller psychological distance from advising protagonists on life dilemmas from the second- than the third-person perspective. Additionally, the amplitude of low-frequency fluctuation (ALFF) in regions of the DMN (e.g., prefrontal cortex) was significantly correlated with metacognitive humility when advising from the second- but not the third-person perspective. Taken together, resting-state DMN activity may contribute to wise advising from a second-person perspective but not a third-person perspective, which involves greater self-distancing.

## Background

For centuries, wisdom has fascinated philosophers, anthropologists, educators, psychologists (1, 2), and recently neuroscientists (3). Wisdom has been described as a state one arrives at through greater learning and engagement of the world from life experiences (1, 2). On the other hand, the world is incredibly vast, diverse, ever-changing, and frequently defies expectations. As one learns to adapt to the uncertainty in the world, the meta-level features of wisdom arise including metacognitive humility – the awareness of one's limitation in knowledge and intelligence – and meta-level flexibility – a preference to remain open to alternative possibilities and changes. These meta-level features of wisdom contribute to adopting the perspective of others when providing advice on life dilemmas, i.e., imagining oneself experiencing the lives of the protagonists in the dilemmas and reasoning how they might see the world from their point of view (4). Indeed, metacognitive humility (MH), meta-level flexibility (MF), and perspective-taking (PT) are generally acknowledged as indicators of wisdom (2–5). Consequently, the "wise advising" paradigm investigates participants' MH, MF, and PT when advising protagonists in life dilemmas (6, 7).

Recently, an electroencephalogram (EEG) study found that resting-state neural oscillations in the frontal lobe were associated with wise advising from a second- ( $r > 0.36$ ) but not a third-person perspective (7). Resting-state brain activity may be crucial for wisdom. When one is not engaged in processing external information, the DMN of the brain is more likely to undertake internally focused tasks, including self-referential processing and constructive internal reflections, e.g., encoding and retrieving self-referential stimuli (8), using past experiences to plan for the future, flexible self-relevant simulations to anticipate and evaluate future events, taking others' perspectives (9), recalling personal memories and meaning-making (10). These processes are vital for wisdom development and performance (11, 12). For example, a functional MRI (fMRI) study showed that wiser individuals demonstrate greater engagement of brain regions within the DMN for moral-personal conditions (13).

On the other hand, advising from the second-person perspective should be more self-related than the third-person perspective. Previous research suggests that using the second-person pronoun "you" to refer to the self in communication is more prevalent in contexts requiring explicit self-control (14) and plays a crucial role in introspection (15) and making meaning from negative personal experiences (16). While the third-person perspective involves a distant observation of others, the second-person perspective implies a dynamic interaction with others (17–20). As shown by the previously mentioned EEG study, participants felt significantly less psychological distance from the protagonists when advising from a second- than a third-person perspective (7); wherein the psychological distance indicates the individuals' feeling that something is close or far away from the self (21).

Since the DMN is involved in reflection of personal life experiences and advising from the second-person perspective is more self-related, resting-state DMN activity should be more associated with wise advising from the second- than the third-person perspective. To test this hypothesis, we conducted an fMRI study to measure participants' resting-state ALFF – an fMRI method related to EEG power but with a greater spatial resolution (22) – prior to advising on various life dilemmas using either a second- or third-person perspective. Specifically, the DMN consists of the ventral medial prefrontal cortex (BA 10, 24, 32), posterior cingulate cortex (BA 23, 29, 30, 31), inferior parietal lobule (BA 39, 40), lateral temporal cortex (BA 21) and dorsal medial prefrontal cortex (BA 9, 10, 24, 32) (9, 23).

## Results

The wisdom performance and psychological distance for each perspective are shown in Table 1. Paired sample t-tests revealed no significant differences in any subcomponent of wisdom, although the psychological distance was significantly smaller when advising from a second than a third-person perspective. Moreover, MH was associated with the ALFF in the rostral ACC and left PFC within the DMN when advising from a second-person perspective (see Table 2 and Fig. 1 for details).

Additionally, we explored but found no significant correlation between functional connectivity within the DMN and wise advising. Finally, wisdom scores and ALFF within the whole brain revealed that PT from a second-person perspective was significantly correlated with ALFF in the precuneus and calcarine. Conversely, when advising from a third-person perspective, PT was associated with the bilateral precuneus and precentral gyrus. Furthermore, MH when advising from the third-person perspective was associated with the dorsal ACC.

## Discussion

The observed results supported our hypothesis. Wisdom performance at different psychological distances was associated with distinct brain regions during resting states. Specifically, resting-state DMN activity was associated with MH from the second- but not third-person perspective. Our results replicate findings from the previous EEG study demonstrating that resting-state neural oscillations in the frontal lobe are associated with MH from the second- but not the third-person perspective (7). Finally, one study

previously showed that reflecting on negative personal experiences from the first-person perspective was associated with greater activity in Medial PFC – an important region of the DMN – compared to the third-person perspective (24). Taken together, the DMN activity should be more related to self-referential processing involved in wisdom, i.e., MH, which refers to the self's limitation in knowledge.

Additionally, wise advising from each perspective is associated with resting-state activation in brain regions near DMN, such as the precuneus, which is related to directing attention to real or simulated movement in space (25). Our results replicate previous findings that wisdom is associated with the precuneus and lingual gyrus (13). Wise individuals should have robust brain systems supporting visual imagery and simulated movements between viewpoints, along with the awareness of the self and others. This is in line with a review of the neuroscience of wisdom that demonstrates similar brain regions underlie self-reflection (26).

MH for advising should be associated with the ACC. The ACC is responsible for controlling impulsivity (e.g., premeditation before decision-making) (27) and detecting errors and conflicts (28), which may support MH. Wisdom experts have consistently proposed that the ACC is responsible for dealing with uncertainty (26), an essential embodiment of MH. Additionally, we found that the rostral ACC was related to MH when advising from the second-person perspective, while the dorsal ACC was related to MH when advising from the third-person perspective. In contrast with the dorsal ACC, the rostral ACC is believed to be associated with more self-related processes such as reward-directed decision-making, as demonstrated by previous studies (29, 30). Taken together, the dorsal and rostral ACC may play different roles in wisdom performance from different psychological distances.

Overall, the present study has demonstrated a relationship between resting-state brain activity in distinct regions and wise advising from different perspectives. Specifically, the more self-related brain regions within the DMN were related to the more self-related wisdom, i.e., metacognitive humility.

## Declarations

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Conceptualization: CH

Methodology: YBZ, GD, CLH, RX

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Project administration: CH

Supervision: CH,

Writing – original draft: CH

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**Competing interests:** Authors declare that they have no competing interests.

### **Data and materials availability:**

Materials are available in the supplementary materials.

All data are available at:

[https://osf.io/dhpey/?view\\_only=388920cd5052489fb3a73ef4a63bf015](https://osf.io/dhpey/?view_only=388920cd5052489fb3a73ef4a63bf015)

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\*References are only cited in the Supplemental Materials

## Tables

**Table 1. Wisdom and psychological distances when advising from different perspectives and paired-sample t-test results**

<i>Variable</i>	<i>2<sup>nd</sup> (M±SD)</i>	<i>3<sup>rd</sup> (M±SD)</i>	<i>t</i>	<i>95% CI</i>	<i>p</i>
Metacognitive humility	0.394±0.550	0.414±0.524	-0.221	-0.194, 0.156	0.826
Meta-level flexibility	1.298±0.839	1.260±0.825	0.375	-0.168, 0.244	0.709
perspective-taking	0.635±0.701	0.457±0.583	1.840	-0.016, 0.372	0.072
psychological distance	2.442±1.211	2.913±1.115	-2.418	-0.862, -0.080	0.019

(Note:  $N = 52$ ;  $CI$ : confidence interval;  $2^{nd}$ : second-person perspective;  $3^{rd}$ : third-person perspective)

**Table 2. Associations between wisdom and resting-state ALFF**

<i>wisdom</i>	<i>regions</i>	<i>t</i>	<i>voxels (N)</i>	<i>coordinate</i>
$2^{nd}$ -MH <sup>a</sup>	PFC	0.555	15	-9,39,27
$2^{nd}$ -MH <sup>a</sup>	rostral ACC	0.574	14	6,42,27
$2^{nd}$ -PT <sup>a</sup>	precuneus	0.614	52	-3, -39,63
$2^{nd}$ -PT <sup>a</sup>	calcarine	0.626	51	15,-66,18
$3^{rd}$ -PT <sup>b</sup>	left precuneus	0.525	30	-12,-45,12
$3^{rd}$ -PT <sup>b</sup>	right precuneus	0.575	40	9,-45,9
$3^{rd}$ -PT <sup>b</sup>	precentral gyrus	0.57	34	15,-24,57
$3^{rd}$ -MH <sup>a</sup>	dorsal ACC	0.601	57	0,24,27

(Note,  $N$ : number;  $2^{nd}$ : the second-person perspective;  $3^{rd}$ : the third-person perspective; a: Gauss random field (GRF) correction, two-tailed; b: GRF correction, one-tailed.)

## Figures

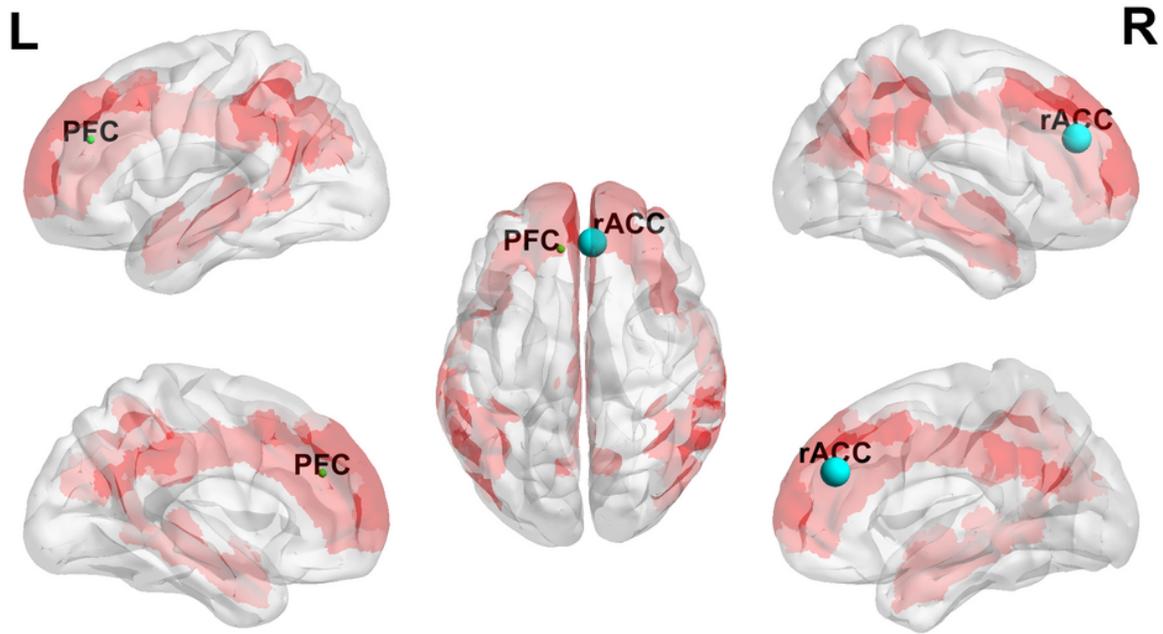


Figure 1

Significant correlation between resting-state ALFF within the DMN and metacognitive humility when advising from the second-person perspective (Note: the size of the ball indicates t value; brain regions in red represent the DMN mask).

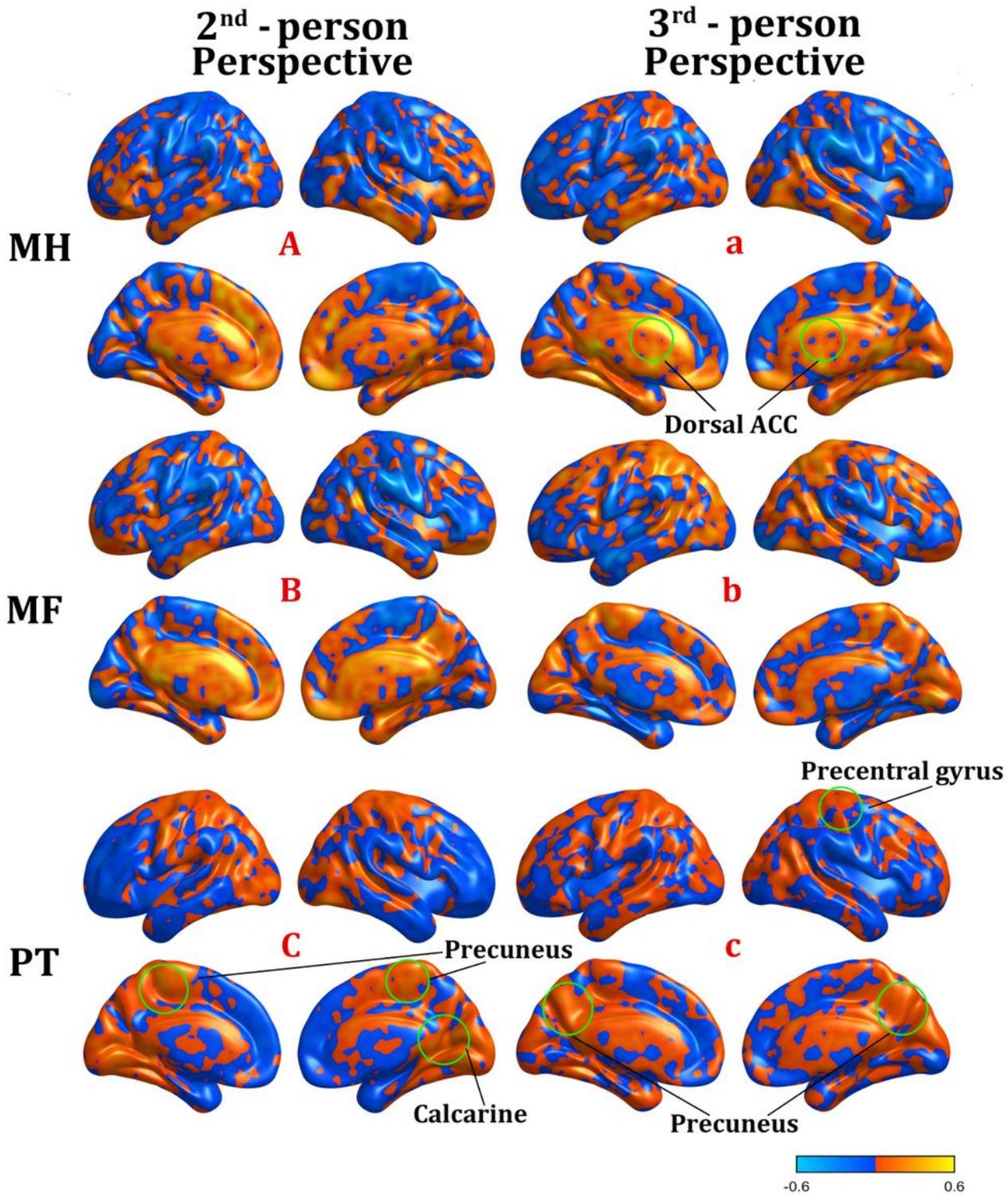


Figure 2

Significant correlation between resting-state ALFF within the whole brain and wisdom performance when advising from different perspectives.

## Supplementary Files

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