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# 2 Attitude to Lie and Personality Traits: A Near Infra-Red Spectroscopy Study

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## Introduction

There may be two kinds of lie: one is an impermissible, evil and bad lie, the other is a permissible, good lie. People often tell a bad, evil lie to pursue their own interests driving other persons into despair. A good lie is often told for other persons' interests making sacrifice of own interests. A good lie also includes a joke which has no relation to interests. But responses to a lie differ between people. Although a lie is permissible for a person, it may be impermissible for another person. The individual difference may be determined at least in part by personality traits.

Canli et al. (2002) first reported relation between brain activation and personality traits using functional magnetic resonance imaging (fMRI) of the brain. They found that amygdala response to happy faces correlates with a personality trait (extraversion, E). Person with higher E scores showed stronger amygdala activation to happy faces. It is of interest that happy faces do not produce statistically significant activation in the amygdala because of large individual differences.

In the present study, we presented sentences including permissible, good and impermissible, bad lies. We recorded prefrontal cortical responses to these sentences by near infra-red spectroscopy (NIRS). We also measured the 5 personality traits of participants by NEO-FFI, that is, neuroticism (N), extraversion, openness (O), agreeableness (A) and conscientiousness (C). Correlations between prefrontal activation to lies and the 5 personality traits were examined. There has been no neuroimaging study concerning the attitude to lies and personality traits.

Channels	Left		Midline						Right		
		1		2		3		4		ventral	
	5		6		7		8		9		
		10		11		12		13			
	14		15		16		17		18		
		19		20		21		22		dorsal	

Figure 1. NIRS 22 channels on the left and right hemisphere. The center of the probe is located on the midline.

Method

Participants

Thirteen (8 females and 5 males) right-handed undergraduate students participated in the experiment. Written informed consent was obtained from the participants. The experiment was approved by the Ethics Committee of Keio University.

Apparatus

The personality test used was NEO-FFI (Japanese edition). Prefrontal activation to sentences including lies was recorded by ETG-7000 (Hitachi Medical Co.). The NIRS probe was consisted of twenty-two channels symmetrically placed over the left and the right hemispheres (Figure 1). The probe covered the medial and lateral parts of the anterior prefrontal cortex. Changes in the concentrations of oxygenated hemoglobin (oxy-Hb) were analyzed, because changes in deoxygenated hemoglobin (deoxy-Hb) were small and susceptible to artifacts.

Procedure

Before the experiment, a total of 26 sentences including lies were presented to seventy undergraduates. They rated the latitude of the lies in the sentences in a five-point scale (1: easily permissible, 5: absolutely impermissible). Eight low scored permissible sentences and the 8 high scored impermissible sentences were selected for the neuroimaging (NIRS) experiment.

The 13 participants received the NEO-FFI test. Then, they moved to a sound proof experiment booth for the NIRS experiment. The participants read silently sentences including lies on a monitor and rated the latitude of the lies in the same five-point scale during prefrontal hemodynamic recording. The good, permissible and the bad, impermissible lie sentences were presented randomly. The sentences were presented for 20 s and a 10-s rest period was inserted between sentence pre-

Table 1. Scores of the 13 participants of the 5 personality traits.

	N	E	O	A	C
S1	36	31	16	43	22
S2	24	37	30	28	25
S3	47	23	44	24	20
S4	31	26	43	33	30
S5	28	33	36	36	27
S6	33	18	29	27	25
S7	30	17	42	26	34
S8	20	15	27	20	11
S9	43	18	34	27	11
S10	29	29	30	30	18
S11	30	22	32	26	24
S12	35	32	41	24	36
S13	30	32	31	42	29

sentations.

Differences in oxy-Hb between the 20-s sentence presentation (test) period and the rest (control) period were examined in the 22 channels of each participant. Oxy-Hb value in the control period was subtracted that from the test period. This oxy-Hb value was regarded as prefrontal response to sentences including lies. Correlation between the 5 personality traits and prefrontal responses was examined.

## Results

Table 1 shows 5 personality traits of the participants. We analyzed correlations between the 5 traits. The scores of E and A traits were positively correlated.

There is no statistically significant difference in oxy-Hb between the test and the control periods with and without FDR correction. Negative correlations were observed between prefrontal responses to good lie sentences and A and E traits in most of 22 channels: 19 channels for trait A and 16 channels for trait E. Other traits did not show the correlation. Figure 2 shows channels in which the correlation was observed for A and E traits. The distribution of correlation was similar for A and E traits in the right hemisphere, but it was different in the left hemisphere. Figure 3 shows examples of correlation between prefrontal responses to lie sentences and A and E traits.

In only 4 channels, correlations were statistically significant between personality scores and prefrontal responses to bad, evil lies: N (Channel 16), E (Channel 14), A (Channel 22) and C (Channel 21) traits, respectively. These channels located in the dorsal part of the anterior prefrontal cortex. Only N trait showed a positive correlation.

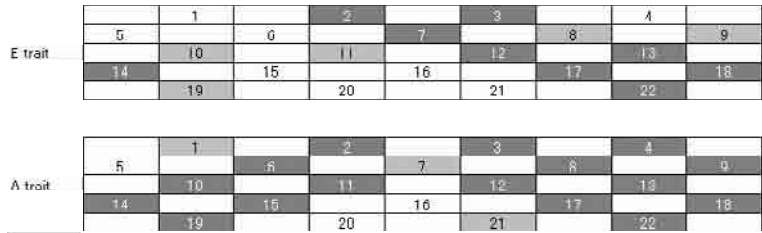


Figure 2. Channels showed statistically significant correlation between personality traits and prefrontal responses to permissible, good lie sentences. Upper: E trait, lower: A trait. Dark gray:  $p < 0.01$ , light gray:  $p < 0.05$ .

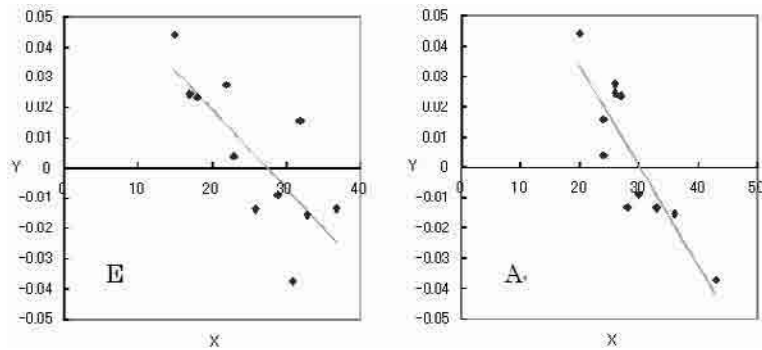


Figure 3. Examples of the correlation between personality traits (x-axis) and prefrontal responses (y-axis) to permissible, good lie sentences observed in Channel 2. Left: E trait (Correlation coefficient -0.7742,  $p = 0.0052$ ), right: A trait (Correlation coefficient -0.8698,  $p = 0.0005$ ).

## Discussion

We found personality traits A and E measured by NEO-FFT negatively correlate with prefrontal activation measured by NIRS in many channels. Personality traits A and E are ‘social’ traits. Persons with high A and E scores do not feel difficulty in communicating with other people. They easily empathize and sympathize with other people.

Thus, it is expected that scores of personality traits A and E would show correlation with prefrontal responses to sentences including lies. The results met our expectation. But why all correlations were negative? That is, participants with high E or A scores decreased prefrontal responses to permissible, good lies. It may be not necessary for these participants to activate the prefrontal cortex, because the lie content of the sentences may be natural and a matter of course for them. On the

other hand, participants with low E or A scores may feel conflict between to tell a lie (even if it is a good) and to tell the truth. This conflict may activate the prefrontal cortex.

It is not clear why we found only a few correlations for bad, evil lies. These lies are definitely impermissible and evil, thus it may be too natural for the participants to activate the prefrontal cortex, and it may be difficult to differentiate the participants with diverse personality traits.

In the previous experiment (Kojima et al., 2008), we showed that the scores of personality traits N, E and C correlated with prefrontal responses to emotional pictures. Correlations were observed in channels in the ventral parts of the right hemisphere for N and dorsal parts of the left hemisphere for E. However, the greatest number of correlation was observed for C trait. The scores of C trait positively correlated with both pleasant and aversive pictures. The correlations were widely distributed over the anterior prefrontal cortex. It is suggested that persons with high C scores control emotional events effectively.

## References

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## Appendix

Followings are examples of good and bad lies, respectively.

- **Permissible, good lie:** A city of Japan was hit by a strong earthquake. Many houses were broken. All members of a family in a broken house died except for a 5-year-old youngest daughter. She waked up on the bed of a hospital. She asked a nurse to see her mother. The nurse did not tell the truth and said that it may be difficult for her mother to come, because she was wounded.
- **Impermissible, bad lie:** Ichiro loved Hanako, but Taro also loved Hanako. Ichiro told Hanako about Taro's bad rumor (gossip) to tear them apart. But the rumor was not the truth.