



Dual functional near-infrared spectroscopy (2): An application in face-to-face conversation

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Objective:

Conversation can be affected by a variety of psychiatric conditions such as psychosis, depression, autism, some personality traits, and especially social anxiety. However, the gender difference is a most powerful demographic variable and the related gender-specific brain responses should be examined in non-clinical population. Thus, we attempted to use two unconstrained near-infrared spectroscopy (NIRS) instruments for male/male or female/female pairs of talking healthy subjects. We investigated the gender difference of the relationships between social anxiety and the prefrontal responses measured by NIRS during face-to-face conversation.

Methods:

Subjects:

Fifty healthy right-handed Japanese subjects without any history of psychiatric disorders and psychological traumas participated.

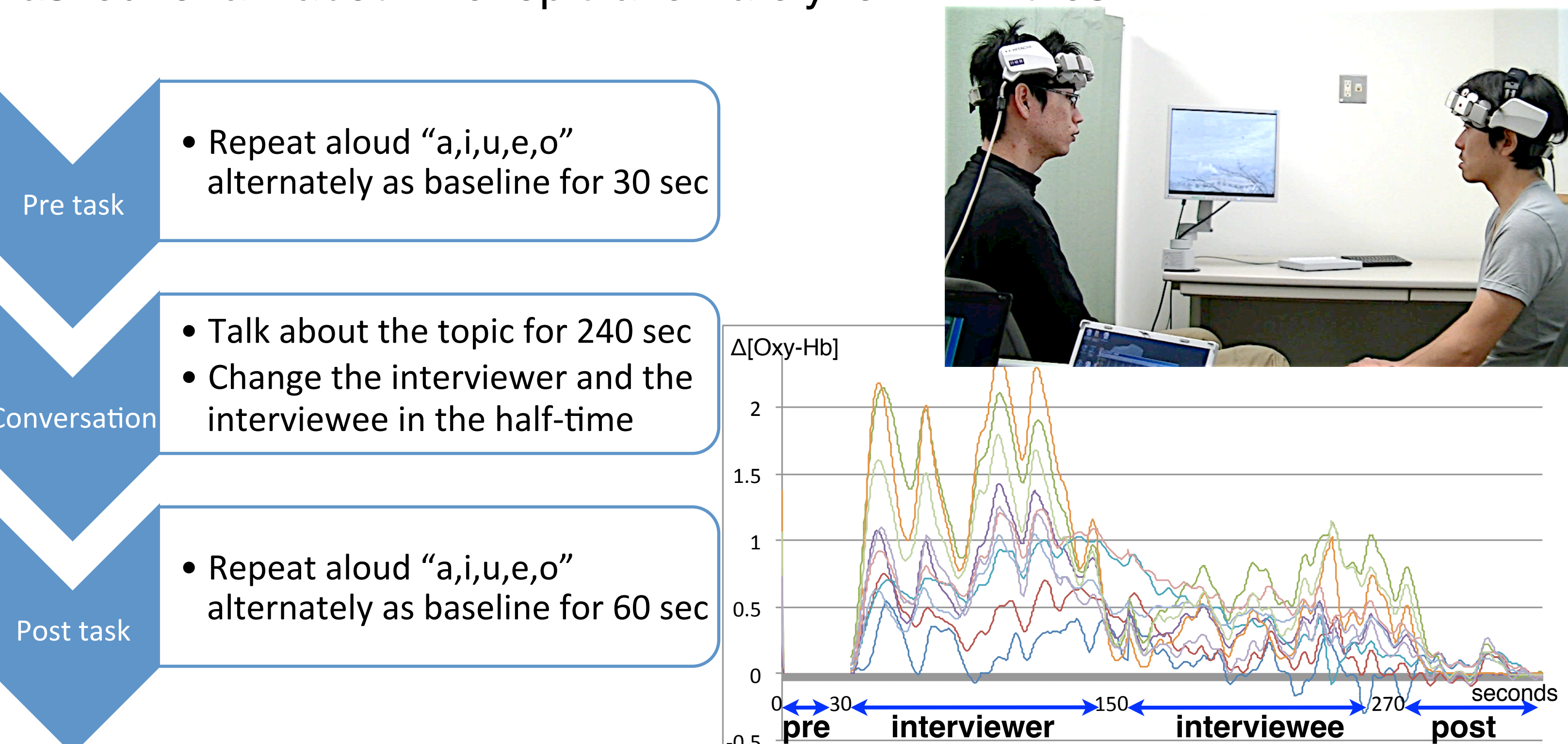
To assess the individual differences, we use the following self-rated questionnaires (Japanese version): LSAS for social anxiety, IES-R for post-traumatic symptoms, K10 for depressive and anxiety symptoms, AQ for autistic traits and NEO-FFI for personality style.

This study has been approved by the ethics committee of Niigata University School of Medicine and Dental Sciences, and all subjects have provided written informed consent.

	Total subjects (n=50)	male (n=26)	female (n=24)	p-value (t-test)
Age (mean±SD)	22.5±3.1	23.8±3.3	21.1±2.2	.0011
LSAS (Liebowitz Social Anxiety Scale) (mean±SD)	37.2±19.9	35.7±20.1	38.9±20.0	n.s.
IES-R (Impact of Event Scale-Revised) (mean±SD)	8.6±10.2	8.2±11.3	9.0±9.0	n.s.
K10 (mean±SD)	5.1±5.0	3.8±3.9	6.4±5.7	n.s.
AQ (Autism-spectrum Quotient) (mean±SD)	19.5±6.7	19.2±5.9	19.8±7.5	n.s.
NEO-FFI				
Neuroticism	46.9±11.9	46.7±13.2	47.2±10.7	n.s.
Extraversion	52.1±9.1	53.1±7.9	50.9±10.3	n.s.
Openness	47.5±10.5	48.4±10.6	46.6±10.5	n.s.
Agreeableness	57.4±9.1	57.4±9.5	57.5±9.0	n.s.
Conscientiousness	53.6±11.5	56.2±12.6	50.8±9.7	n.s.

Face-to-face conversation task:

After viewing the 4-minutes video clip of the 2011 Great East Japan Earthquake as a common topic, a pair of subjects seated face to face was asked to talk about the topic alternately for 4 minutes.



NIRS measurements and data processing:

The relative changes of oxygenated hemoglobin concentration ($\Delta[\text{Oxy-Hb}]$) in prefrontal cortices of two subjects were simultaneously measured with 10-channel WOT-100 (HITACHI) attached foreheads, sampling time is 0.2 sec. Baseline correction was made by using linear fitting based on the two baseline data, i.e. the mean $[\text{Oxy-Hb}]$ across the last 10seconds-data in the pre-task and post-task baseline.

We adopt the laterality index (Left-Right/Left+Right) of the average $\Delta[\text{Oxy-Hb}]$ across 4 channels for each hemisphere as the main index.

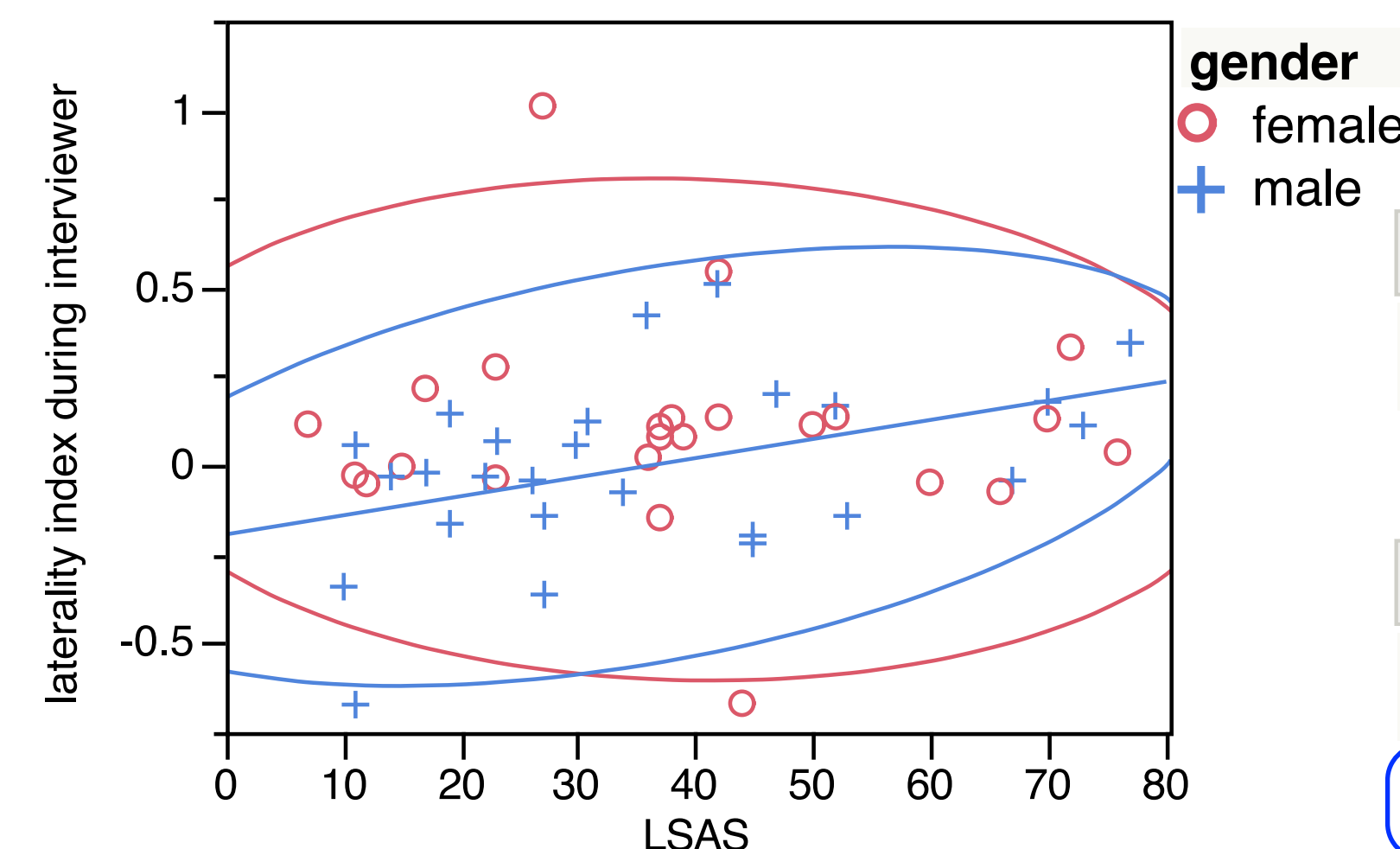
Statistical analyses:

All statistical analyses were performed with SAS JMP10 and the statistical significance level was set at 5%.

Results:

Pearson's correlation analyses:

Only in male, LSAS were significantly correlated positively with the laterality index during the interviewer ($r=0.43$, $p=0.03$).



Correlation gender=="female"				
Variable	Mean	Std Dev	Correlation	Signif. Prob
LSAS	38.875	19.99633	-0.05308	0.8054
laterality index	0.100695	0.288363		

Correlation gender=="male"				
Variable	Mean	Std Dev	Correlation	Signif. Prob
LSAS	35.69231	20.06942	0.426359	0.0299*
laterality index	-0.00312	0.252174		

Multiple regression analyses:

Summary of Fit	
RSquare	0.500427
RSquare Adj	0.40527
Root Mean Square Error	0.194473
Mean of Response	-0.00312
Observations (or Sum Wgts)	26
AICc	-0.49499
BIC	2.632533

Analysis of Variance				
Source	DF	Sum of Squares	Mean Square	F Ratio
Model	4	0.7955742	0.198894	5.2590
Error	21	0.7942177	0.037820	
C. Total	25	1.5897919		
				Prob > F
				0.0043*

Parameter Estimates						
Term	Estimate	Std Error	t Ratio	Prob> t	Std Beta	VIF
Intercept	0.319197	0.365879	0.87	0.3928	0	
LSAS	0.0068913	0.0021	3.28	0.0036*	0.548446	1.1745247
AQ	-0.01722	0.007129	-2.42	0.0249*	-0.40268	1.168143
E	-0.014817	0.005429	-2.73	0.0126*	-0.46185	1.2035868
A	0.0095592	0.004463	2.14	0.0441*	0.358351	1.1766617

Discussion:

- ✓ The higher social anxiety, the more predominant the left prefrontal cortices activity during interviewer only in male.
- Patients with social anxiety disorder showed hyperactivity in the amygdalae, parahippocampal gyrus, fusiform gyrus, globus pallidus, insula, inferior frontal gyrus, and superior temporal gyrus. (A.Etkin, T.Wager. 2007. Meta-analyses)
- While the amygdala region was activated by the stressful public speaking task, the failure to activate cortical areas could indicate that top-down inhibitory influences corresponding to self regulatory processes are compromised in social anxiety disorder. (M.Tillfors et al. 2001. PET study)
- Males showed more lateralization of emotional activity, by contrast, females showed more brainstem activation. (T. Wager et al. 2003. Meta-analyses)
- ✓ The lower AQ, the lower Extraversion and the higher Agreeableness is also the same result in male.
- Genetic factors that influence individual variation in low extraversion and high neuroticism appear to account entirely for the genetic liability to social phobia. (O.Bienvenu et al. 2007. Twin study)
- The frontopolar activity during conversation negatively correlated with Cooperativeness assessed using the Temperament and Character Inventory. And the left superior temporal sulcus activity negatively correlated with AQ, especially in males. (M.Suda et al. 2010, 2011. NIRS study)
- ✓ Regarding the content, between-male conversations might be solution-dominant, while between-female conversations might be sympathy-dominant, yielding to the hemispheric gender differences.

Limitation:

- ✓ The sample size is small.
- ✓ The lack of clarity as to whether differences in activation patterns represent pathological manifestations or compensatory responses.
- ✓ Because of evaluating social anxiety in the healthy subjects, it's not clear whether current results could apply to social anxiety disorder patients.

Conclusion:

- ✓ The result of present study about relationships between social anxiety and right frontal hypo-activation during social anxiety-provoking situation in male is consistent to the previous study.
- ✓ The content analysis of conversation may be useful to validate this interpretation of the hemispheric gender difference.