

Does the Layered Voice Analysis enable us to evaluate depression and anxiety symptom?

Researchers

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- Introduction

We usually use self-administered mental questionnaires for evaluation of depression and anxiety but have always required easy and objective biologic index too. Recently Nemesysco, Israel, developed LVA technology that can evaluate mental conditions from the human voice. Nemesysco says that it is possible to comprehensively determine speakers' mental conditions using such technology, no matter what people speak about and LVA products have been already distributed in the world but there are no sufficient academic papers yet in the scientific field.

- Purpose

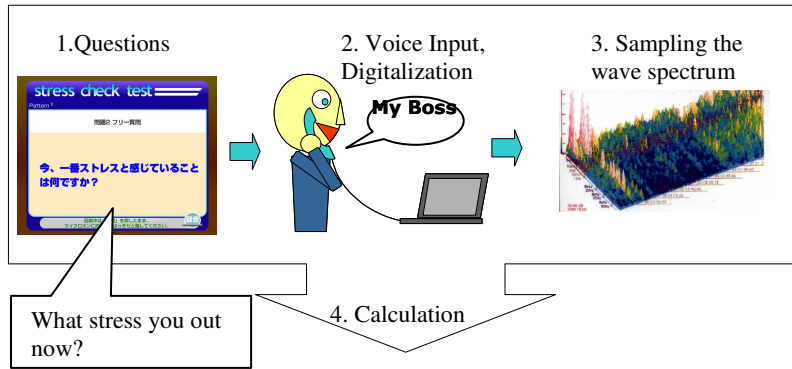
To study utility of LVA in assessing both depression and anxiety symptom.

- Method

1. Subjects are 106 healthy people given informed consents: 48 males and 58 females.
2. Mental questionnaires; POMS, STAI, CES-D, saliva amylase tests, blood-pressure and pulse measurements. Then, 10 questions were given to each subject. Subjects' answering voices to the questions were recorded in WAV files.
3. We analyzed all of the voice data using LVA and evaluated reliabilities and correlativity of 22 parameters statistically.
4. Such study is subject to Tsukuba University Human Science Ethic Committee approvals.

- LVA

Technology that estimates a speaker's mental condition comprehensively by sampling voice wave spectrums on the millisecond time scales, analyzing the waves with the traditional acoustic analysis techniques and the unique analysis technologies, and calculating various parameters.



Parameters		Meanings
Basic Parameters	SPT (emotional load)	represents the basic emotional condition. This numeric value increases with emotional stress and excitation.
	SPJ (cognitive load)	represents the basic cognitive condition; global cognitive activities such as perception, thinking. This numeric value increases with cognitive conflict and cognitive stress.
	JQ (comprehensive stress)	represents the comprehensive stress condition; physically, psychologically. This numeric value increases with anxiety and stress.
	AVJ (thinking load)	represents the basic thinking condition, associated with speech. This increases with inhibition of thought and tension.
Secondary Parameters	CHL (motivation)	represents interest and motivation. This increases due to attention and concentration to speech.
	Fflic (emotional variability)	represents embarrassment and conflict levels. This measures variability of agitation in voice.
	Fmain (concentration)	represents levels of concentration and tension.
	Fx (number of thinking subject)	represents number of subject in thinking process.
	LJ (imagination· memory)	represents levels of memory and imagination. This increases in dementia or schizophrenia.
	SOS	represents instantaneous levels of interest and motivation during speaking.
	Uncertain	represents a lack of confidence and uncertainty in speech.
	Excited	represents level of excitation.
	SAF (attention· affection)	represents levels of attention and affection to speakers and speech contents. This is increased by sexual excitation too.
	Energy (cheerful level)	represents levels of cheerfulness and passion in speech.
	BrainPower (arousal level)	represents levels of arousal and brain activity.
	EmoCogRatio (emotional strength)	represents emotional strength compared with thinking activity.
	IJQ (general stress)	suggests general stress.
	mJQ (mind stress)	suggests sever stress.
	hJQ (critical stress)	suggests stress which is led from a sense of crisis.
	JQcl (psychophysical stress)	suggests comprehensive stress in mental and physical conditions.
	AVJcl (thinking stress)	suggests thinking stress in speech.
	Mecl (emotional stress)	suggests instantaneous interest and motivation in speech.

Outcome 1. Basic Attribute

- Age: 32.8±8.3 yrs.old
(male 34.1±9.1, female 31.6±7.5, P>0.05)
- Occupation: 47 office workers, 14 students, 12 medical experts, 7 part-time workers, 26 others.

Outcome 2. Reliability.

Outcome 3. Correlation with gender difference and age

Parameter	Cronbach's alpha
SPT	0.88
SPJ	0.86
JQ	0.75
AVJ	0.74
CHL	0.82
Fflic	0.73
Fmain	0.73
Fx	0.70
LJ	0.67
Uncertain	0.83
Excited	0.68
Energy	0.90
BrainPower	0.82
EmoCogRatio	0.83
IJQ	0.85
mJQ	0.68
JQcl	0.81
AVJcl	0.78
SOS	0.19
SAF	0.54

alpha>0.6

Parameter	Sex	Average	SD	t(gender difference)	r(age correlation)
SPT	F	505.06	64.35	-0.98	-0.29
	M	519.29	78.15		
SPJ	F	121.87	23.08	-7.07	0.34
	M	156.80	25.59		
JQ	F	11.83	2.53	-5.45	0.26
	M	14.69	2.66		
AVJ	F	384.61	43.23	-6.54	0.20
	M	439.92	40.79		
CHL	F	-25.44	9.59	3.36	-0.30
	M	-32.32	10.59		
Fflic	F	2.55	0.84	-5.07	0.00
	M	3.38	0.78		
Fmain	F	34.69	5.24	10.01	-0.11
	M	25.90	3.44		
Fx	F	2.73	0.85	-6.11	0.00
	M	3.77	0.83		
LJ	F	3.23	1.13	-7.04	0.10
	M	4.90	1.22		
Uncertain	F	10.16	2.50	-6.39	0.31
	M	13.07	2.03		
Excited	F	18.68	3.15	3.60	-0.22
	M	16.83	1.88		
Energy	F	8.99	2.76	4.72	-0.35
	M	6.11	3.22		
BrainPower	F	620.26	50.26	-3.66	-0.12
	M	667.65	73.79		
EmoCogRatio	F	107.51	22.26	3.03	-0.30
	M	93.00	24.84		
IJQ	F	179.77	33.18	-6.69	0.36
	M	226.69	36.02		
mJQ	F	7.07	3.73	-5.92	0.16
	M	12.07	4.52		
JQcl	F	41.85	4.19	-5.61	0.34
	M	46.60	4.20		
AVJcl	F	671.18	77.32	-5.70	0.27

P<0.01
 P<0.05

Outcome 4. Correlations with other parameters (Pearson's correlation r)

Parameter	Psychological Index								Physiological Index			
	STAI		POMS						CES-D	Blood Pressure		Pulse
	trait anxiety	state anxiety	tension	depression	anger	active	tiredness	confusion		Systole	Diastole	
SPT	0.18	0.14	0.29	0.18	-0.01	-0.07	0.10	0.14	0.04	0.16	0.10	0.08
SPJ	-0.20	-0.11	-0.30	-0.19	-0.12	-0.09	-0.15	-0.29	-0.16	0.23	0.18	-0.06
JQ	-0.16	-0.12	-0.26	-0.13	-0.14	-0.17	-0.12	-0.29	-0.09	0.16	0.11	-0.11
AVJ	-0.25	-0.24	-0.27	-0.21	-0.22	-0.07	-0.17	-0.31	-0.16	0.20	0.12	-0.12
CHL	0.26	0.22	0.34	0.24	0.13	0.01	0.17	0.28	0.13	-0.06	-0.04	0.12
Fflic	-0.10	-0.09	0.10	0.02	-0.01	-0.05	0.06	-0.13	-0.01	0.26	0.17	-0.15
Fmain	0.13	0.10	-0.01	0.06	0.12	0.09	0.04	0.16	0.08	-0.37	-0.22	0.10
Fx	-0.09	-0.07	0.10	0.00	-0.03	-0.06	0.03	-0.09	0.00	0.27	0.15	-0.11
LJ	-0.18	-0.15	-0.14	-0.11	-0.20	-0.06	-0.14	-0.26	-0.14	0.19	0.10	-0.11
Uncertain	-0.19	-0.09	-0.27	-0.20	-0.10	-0.05	-0.10	-0.30	-0.18	0.17	0.13	-0.08
Excited	-0.01	0.03	0.11	0.05	0.04	0.11	-0.03	0.14	0.05	-0.20	-0.16	0.14
Energy	0.25	0.15	0.33	0.23	0.10	-0.06	0.20	0.32	0.18	-0.09	-0.05	0.12
BrainPower	0.12	0.12	0.14	0.08	-0.03	-0.11	0.06	-0.02	-0.02	0.22	0.16	0.04
EmoCogRatio	0.26	0.20	0.32	0.25	0.11	-0.01	0.16	0.26	0.16	-0.05	-0.02	0.11
IJQ	-0.19	-0.10	-0.29	-0.20	-0.12	-0.08	-0.14	-0.27	-0.17	0.22	0.18	-0.05
mJQ	-0.24	-0.21	-0.32	-0.17	-0.17	-0.10	-0.19	-0.33	-0.12	0.15	0.12	-0.11
JQcl	-0.13	-0.07	-0.28	-0.17	-0.11	-0.17	-0.07	-0.25	-0.14	0.25	0.24	-0.01
AVJcl	-0.15	-0.12	-0.28	-0.17	-0.15	-0.19	-0.11	-0.27	-0.11	0.29	0.22	-0.04
saliva amylase	-0.05	0.04	0.02	0.01	-0.07	0.00	-0.11	-0.04	0.02	0.31	0.27	0.26



●Result

Most parameters showed $\alpha > 0.6$ but SOS, SAF, hJQ, and Mecl. As a result, we can say that the reliability is high. Many significant correlations with both gender difference and age were observed in scores of each parameter. As compared with saliva amylase, many LVA parameters showed significant correlations with psychological index STAI and POMS as well as physiological index.

- Conclusion

Correlations were observed among each parameter, psychological and physiological indexes.

If we implement a standards-work for both age and sex and a study of both mood and anxiety disorders, the LVA will be reliable technology that can assess the depression and anxiety symptom.