

**Comparative Study**

## **A Comparative Study of Sex-Based Difference in Emotional Response of Suspects During Interrogation Using Layered Voice Analysis (LVA)**

Saptarni Majumdar<sup>1\*</sup>, Dr. A. Rupaali<sup>2</sup>

### **ABSTRACT**

The study of speech for reasons other than linguistic content, such as speech recognition, is known as voice analysis. Layered Voice Analysis (LVA) analyses frequency fluctuations in the subject's replies that signify vocal stress by measuring and quantifying them using a microphone connected to a computer. It is possible to identify the various stress levels, cognitive processes, and emotional reactions that are conveyed in the voice's distinct features using layered voice analysis. LVA uses a unique statistical formulation that is integrated into the system to recognise different patterns and abnormalities in the speech flow and classify them according to stress, excitement, uncertainty, and other relevant emotional states. This study compares the difference in emotional reactivity in males and females suspected of a crime on a sample of 60 suspects (30 males and 30 females) aged between 18 to 40 years and uses LVA offline mode which can analyse up to 16 emotions. The comparison is done on four different emotional reaction levels which are emotional level, cognitive level, stress level and thinking Level.

**Keywords:** *Forensic Psychology, Layered Voice Analysis (LVA), Crime and Justice, Detection of Deception, Emotional Reactivity*

### **Speech and stress**

One of the most difficult, but crucial, motor abilities in the human body is speech. In both a personal and professional setting, speech is used to provide information about our surroundings and to discuss our present emotional and physical well-being. Speech is supplemented by nonverbal communication in our everyday interactions. However, there are occasions when individuals must simply rely on speech, including in sometimes-critical and difficult situations (e.g., professional radio communication). In both personal and professional settings, and frequently under varying degrees of physical, cognitive, and/or emotional burden, people rely on speech as a medium of communication. There have been an increasing number of research looking at the connection between voice production and the effects of stress since vocalisation is completely integrated inside both our central nervous system (CNS) and autonomic nervous system (ANS) (Puyvelde, 1994). The cooperation of about 100 muscles, innervated by a complex network of cranial and spinal nerves, as well as subcortical and

<sup>1</sup>Forensic Professional, Forensic Psychology Division, CFSL, DFSS, New Delhi, India

<sup>2</sup>Assistant Director and Scientist 'C' Forensic Psychology Division, CFSL, DFSS, New Delhi, India

\*Corresponding Author

**Received: September 18, 2023; Revision Received: November 14, 2023; Accepted: November 18, 2023**

## **A Comparative Study of Sex-Based Difference in Emotional Response of Suspects During Interrogation Using Layered Voice Analysis (LVA)**

cortical regions of the brain (Jürgens, 2002; Carlson, 2016), and cardiorespiratory processes (Câmara and Griessenauer, 2015), is necessary for both voice production and processing. Therefore, it is not shocking that speaking frequently gets worse under circumstances when human performance is tested or when emotional control is compromised. As a result, speaking is a psychophysiological process that is impacted by both internal and external factors (Hansen and Patil, 2007). Due to this intricacy, the study of small occurrences in the voice may provide a window into the effects of stress in conditions when good functioning from humans is required but where it is challenging to adequately measure stress due to environmental and/or task-related factors.

### ***Studies on Sex difference***

Emotional reactivity has been defined as the intensity, frequency, and duration of emotional responses to various stimuli. Sex differences in emotional reactivity have been widely studied, and evidence suggests that women tend to exhibit stronger emotional responses than men. The purpose of this literature review is to explore the existing research on sex-based differences in emotional reactivity and provide an overview of the current state of knowledge.

Several studies have found evidence of sex-based differences in emotional reactivity. A meta-analysis conducted by Fischer and Manstead (2000) found that women were more likely than men to experience and express emotions, particularly negative emotions. They suggested that this may be due to socialization processes that encourage women to be more emotionally expressive than men.

Similarly, a study by Kring and Gordon (1998) found that women tend to show greater emotional responses than men when viewing emotionally evocative stimuli. This was particularly true for negative stimuli, such as images of mutilation or injury. The authors suggested that this may be due to differences in the way that men and women process emotional information, with women exhibiting greater sensitivity to emotional stimuli.

Deng (2016) in a study examined gender variances in emotional experience and expressivity. The findings revealed that emotions experience and emotional expressivity differed between genders. Men feel angry and positive stimuli more emotionally than women, who express their emotions more strongly overall.

A study by McRae et al. (2008) used functional magnetic resonance imaging (fMRI) to investigate sex-based differences in brain activity during emotional processing. They found that women showed greater activation in brain regions associated with emotional processing, such as the amygdala and insula, than men. They suggested that this may be due to differences in hormonal and neurobiological factors that affect emotional processing.

However, not all studies have found evidence of sex-based differences in emotional reactivity. A study by Montagne et al. (2005) found that men and women did not differ significantly in their emotional responses to a variety of emotional stimuli. They suggested that differences in emotional reactivity may be context-specific and depend on the specific emotional stimuli being presented.

A study by Matud (2004) found that cultural factors may also play a role in sex-based differences in emotional reactivity. She found that Spanish women were more likely than Spanish men to express negative emotions, such as sadness or anxiety, but that this difference

## A Comparative Study of Sex-Based Difference in Emotional Response of Suspects During Interrogation Using Layered Voice Analysis (LVA)

was not present in Mexican participants. This suggests that cultural norms and expectations may influence the expression and experience of emotions differently in different cultural contexts.

Overall, the existing research suggests that women tend to exhibit stronger emotional responses than men, particularly when presented with negative emotional stimuli. This may be due to a variety of factors, including socialization processes, differences in the way that men and women process emotional information, and hormonal and neurobiological factors. However, not all studies have found evidence of sex-based differences in emotional reactivity, and cultural factors may also play a role in shaping emotional expression and experience. Further research is needed to fully understand the complex interplay of factors that contribute to sex-based differences in emotional reactivity.

### *Layered Voice Analysis*

Nemesysco's key technology, Layered Voice Analysis (LVATM), was created by Amir Liberman. By identifying the emotional clues in a speaker's voice, LVA technology, in essence, offers greater comprehension of any suspect's mental state and emotional makeup at a particular time. The system can recognise different forms of stress levels, cognitive functions, and emotional responses that are expressed in distinct speech qualities. These details reveal the subject's mental processes, his concerns and passions, the parts of his speech he is unsure of, the queries that need more of his focus, and the topics that seem to be sensitive to him.

In order to identify various patterns and anomalies in the speech flow and to categorise them in terms of stress, excitement, perplexity, and other key emotional states that our study has proven to be closely connected with these emotions, LVA employs a special mathematical technique. By allowing the user to explore different emotional intensity levels, LVA technology also makes it possible to access previously hidden layers of data. Having this knowledge on hand may speed up any inquiry process significantly.

**Table: 1 Raw Values range**

Parameters	Range	Remarks
<b>SPT: Emotional Level</b>	<ul style="list-style-type: none"> <li>• Normal Males: ~100-300</li> <li>• Normal Females: ~200-400</li> </ul>	Above these indicated levels could indicate high emotion. Below these levels can indicate depression (temporary state of). Could be also a sign of low energy.
<b>SPJ: Cognitive Level</b>	<ul style="list-style-type: none"> <li>• Normal Males and Females: ~100-300</li> </ul>	The baseline of the condition that is occurring. Cognition is the mental process of knowing, thinking, learning and judging.
<b>JQ: Stress Level (not Physical)</b>	<ul style="list-style-type: none"> <li>• Less than 25 is normal – low</li> <li>• 26-35: Normal</li> <li>• 36-45: Normal – High</li> <li>• 46-60: Very High</li> <li>• 60+: Extreme (Potentially unhealthy)</li> </ul>	Negative arousal and fear. Indication of highly active “survival mode”. Stress is not necessarily a sign of deception but can be helpful in picking out potentially problematic topics for the subject.

**A Comparative Study of Sex-Based Difference in Emotional Response of Suspects During Interrogation Using Layered Voice Analysis (LVA)**

Parameters	Range	Remarks
<b>AVJ: Thinking Level</b>	<ul style="list-style-type: none"> <li>• 2-3.5 is a subnormal cognitive activity</li> <li>• 3.5-5 Normal</li> <li>• 5-10 High but normal</li> <li>• 10-13 Question Mental condition or drug use</li> <li>• 14+ Extreme</li> </ul>	Mental effort being put into what is being stated. Scores below 3 are very low and may also indicate alcohol use. Scores of 6 or above can indicate imagination, temporary mental condition, certain drug usage or things of this nature.

LVA can be used in two modes- Online and Offline Modes (Chowdhary, 2021). In the present study, the offline mode was utilized to run the recordings of males and female suspects while they were being interviewed in the Forensic Psychology labs. The online mode analyses 6 emotions whereas the offline mode analyses 16 emotions (Ltd.).

**METHODOLOGY**

*Objectives*

To observe and compare the difference among the four dimensions of emotional reactions i.e., emotional level, cognitive level, stress level and thinking level between male and female using Layered Voice Analysis (LVA) technology.

*Hypothesis*

H01: There is no significant difference in Emotional reactivity on the four different emotional reaction levels i.e., emotional level, cognitive level, stress level and thinking Level between male and female suspects of a crime during interrogation.

*Sample*

The samples have been taken from cases received at CFSL, DFSS, New Delhi. A total of 60 samples have been taken (30 males and 30 females) of suspects aged between 18 to 40 years. LVA offline mode has been used which can analyse up to 16 emotions. The comparison is done on four different emotions which are emotional level, cognitive level, stress level and thinking Level.

**RESULTS AND DISCUSSION**

*Table 2: Mean, SD and 't' Values on the Variables of Emotional Reactivity between Male and Female*

Variable	Group	N	Mean	SD	df	t-value	Significance level
<b>Emotional level</b>	Male	30	342.4	48.04	58	6.42*	Significant
	Female	30	431.4	58.80			
<b>Cognitive level</b>	Male	30	315.87	11.95	58	5.67*	Significant
	Female	30	286.13	26.13			
<b>Stress level</b>	Male	30	30.8	2.60	58	2.45*	Significant
	Female	30	29.2	2.44			
<b>Thinking level</b>	Male	30	5.27	.58	58	5.2*	Significant
	Female	30	4.53	.50			

*\*\*p<0.05, t- test is significant at the 0.05 level(2-tailed).*

*\*p<0.01 t- test is significant at the 0.01 level(2-tailed).*

Table 2 shows the mean scores, Standard deviation and t values of men and women on emotional level, cognitive level, stress level and thinking level. In case of emotional level

## **A Comparative Study of Sex-Based Difference in Emotional Response of Suspects During Interrogation Using Layered Voice Analysis (LVA)**

(M=342.4, SD=2308.4), (M= 431.4, SD=3457.5). The t value obtained was ( $t= 6.42$ ), indicating a highly significant difference between the 2 groups at a significance level of 0.01. Similarly, in case of cognitive level (M= 315.87, SD=4147.4), (M= 286.13, SD= 19807.4). The t value obtained was ( $t= 5.67$ ), indicating a highly significant difference between the 2 groups at a significance level of 0.01. In case of stress level (M= 30.8, SD= 196.8), (M=29.2, SD=172.8). The t value obtained was ( $t= 2.45$ ), indicating a highly significant difference between the 2 groups at a significance level of 0.01. In case of thinking level (M=5.27, SD=9.87), (M=4.53, SD=7.47). The t value obtained was ( $t=5.2$ ), indicating a highly significant difference between the 2 groups at a significance level of 0.01.

The aforementioned findings indicate that Emotional level in females is higher as compared to males. The finding also suggests that cognitive level in males is higher as compared to females. Similarly, the above study findings indicate that stress level in males are higher as compared to females. And finally, the findings indicate that thinking level in males are higher as compared to females. This finding aligns with the scholarly investigations carried out by Fischer and Manstead (2000), Kring and Gordon (1998), Deng (2016), McRae et al. (2008), Montagne et al. (2005), and Matud (2004) that suggest that there exists a difference in emotional reactivity in the emotions expressed by men and women.

### ***Limitations***

The study's sample size, which is restricted to 60 samples, may lessen the likelihood that the findings will be broadly generalizable. Another factor that may have an effect on emotional response was the fact that the majority of the study's participants (or suspects) were from lower socioeconomic backgrounds.

### ***Suggestions***

The findings of the study support the notion that males and females may differ in their emotional processing and regulation, which may have implications for mental health and well-being. Further research is needed to explore the underlying mechanisms of these differences, as well as their potential consequences for interpersonal relationships and other social outcomes.

The authors suggest further study, which may be conducted in this area, particularly with regards to the potential impact of cultural factors on emotional reactivity. It also underscores the importance of considering sex-based differences in emotional reactivity in clinical and therapeutic settings, as well as in everyday social interactions, in order to promote more effective communication and emotional regulation.

## **CONCLUSION**

In conclusion, Layered Voice Analysis (LVA) is a technique used to analyze speech patterns and detect emotions, stress levels, and potential deception. LVA analyzes the various layers of sound that make up a person's voice, including the fundamental frequency, harmonics, formants, and noise, to identify patterns that may indicate the speaker's emotional state, stress levels, or deception. LVA has potential applications in fields such as law enforcement, mental health, and business, but it is important to use this technology responsibly and with a clear understanding of its limitations and potential biases. The results of the study indicates that there is evidence of sex-based differences in emotional reactivity, with men exhibiting stronger emotional responses than women. However, the specific factors that contribute to these differences are complex and multifaceted, including socialization processes, differences

## A Comparative Study of Sex-Based Difference in Emotional Response of Suspects During Interrogation Using Layered Voice Analysis (LVA)

in processing emotional information, and hormonal and neurobiological factors. Additionally, cultural factors may play a role in shaping emotional expression and experience.

### REFERENCES

- Câmara, R., & Griessenauer, C. J. (2015). Anatomy of the vagus nerve. In *Nerves and nerve injuries* (pp. 385-397). Academic Press.
- Carlson, N. R., & Carlson, N. R. (2007). *Physiology of behavior*.
- Chowdhary, S. (2021, December 01). Financial Express. Retrieved 01 01, 2022, from Layered voice analysis: Using voice analysis to detect emotions: <https://www.financialexpress.com/industry/technology/layered-voice-analysis-using-voice-analysis-to-detect-emotions/2379382/>
- Deng, Y., Chang, L., Yang, M., Huo, M., & Zhou, R. (2016). Gender differences in emotional response: Inconsistency between experience and expressivity. *PloS one*, *11*(6), e0158666.
- Duffy, J. R. (2000). Motor speech disorders: Clues to neurologic diagnosis. In *Parkinson's disease and movement disorders* (pp. 35-53). Humana Press, Totowa, NJ.
- Fischer, A. H., & Manstead, A. S. R. (2000). The relation between gender and emotions in different cultures. In W. J. Lonner, D. L. Dinnel, S. A. Hayes, & D. N. Sattler (Eds.), *Online Readings in Psychology and Culture* (Unit 3, Chapter 3).
- Hansen, J. H. L., Patil, S., & Müller, C. (2007). Speaker Classification I. *Lecture Notes in Computer Science*.
- Jürgens, U. (2002). Neural pathways underlying vocal control. *Neuroscience & Biobehavioral Reviews*, *26*(2), 235-258.
- Kring, A. M., & Gordon, A. H. (1998). Sex differences in emotion: Expression, experience, and physiology. *Journal of Personality and Social Psychology*, *74*(3), 686-703.
- Ltd., S. E. (n.d.). LVA Training PPT, Version- 6.50. Nemesysco Voice Analysis Technologies.
- Manchireddy, B., Sadaf, S., & Kamalesh, J. (2010). Layered Voice Analysis Based Determination of Personality Traits. *Australasian Medical Journal*, *3*(8).
- Matud, M. P. (2004). Gender differences in stress and coping styles. *Personality and Individual Differences*, *37*(7), 1401-1415.
- McRae, K., Ochsner, K. N., Mauss, I. B., Gabrieli, J. J. D., & Gross, J. J. (2008). Gender differences in emotion regulation: An fMRI study of cognitive reappraisal. *Group Processes & Intergroup Relations*, *11*(2), 143-162.
- Montagne, B., Schutter, D. J. L. G., & Verbaten, M. N. (2005). Electrophysiological correlates of emotional information processing: Evidence from event-related potentials and alpha band oscillations. *Biological Psychology*, *68*(2), 157-182.

### Acknowledgment

The author appreciates all those who participated in the study and helped to facilitate the research process.

### Conflict of Interest

The author declared no conflict of interests.

**How to cite this article:** Majumdar, S. & Rupaali, A. (2023). A Comparative Study of Sex-Based Difference in Emotional Response of Suspects During Interrogation Using Layered Voice Analysis (LVA). *International Journal of Indian Psychology*, *11*(4), 1381-1386. DIP:18.01.123.20231104, DOI:10.25215/1104.123