Acoustic Source Perception of Human Under Noise: A Comparative Assesment

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ABSTRACT
Acoustic Source Perception is capability of human to classify incoming sensory information from the surroundings. Introduction of noise affects the Acoustic Source Perception (ASP) and also decrease the concentration of human subject for a particular task. Thus, an effort has been made to evaluate impact of introduction of noise on ASP by human subjects. A device has been developed using various electronic components to generate different frequencies of sound signal. Various sets of experiments were planned for exposure of sound levels with different frequencies range from 4 KHz to 10 KHz with fixed interval of 0.5 KHz. Total 20 human volunteers (10 Males and 10 Females) were asked to score or rate quality of sound perceived and provides their responses in a tabulated form. The 15 subjects have age range from 22 to 32 year and 5 subjects of 50 years plus and none of them have issue of abnormal or defective hearing. Duration of 2 minutes exposure is fixed during experiments on the subjects and performed under noise free environment and with white noise of 30dB. The comparative analysis was done for both the cases. The ASP of 15 subjects was assessed as 95 % while ASP of other 5 subjects as 88% under noise free environment. The presence of noise reduced ASP of 15 subjects to 85% and ASP of other 5 subjects to 77 %. Comparative analysis shows the ASP of human subjects is reduced to 10% with white noise of 30dB as compared to ASP of human subject under noise free environment. The obtained result show that older subjects provides low response to ASP while younger subjects give high ASP in both cases of noise free with frequency variation and induced noise environments with frequency variation.

General Terms
Acoustic Source Perception, Human performance, Noise

Keywords
Acoustic Source Perception (ASP), Noise

1. INTRODUCTION
Acoustic is key feature in terms of sound related experiments on human subject. Perception plays an significant role in performance of human under various environmental conditions. ASP has advantages for performance of work by human. In this work acoustic source perception by human is illustrated. Perception is a key part in performance of human under various environmental conditions. Acoustical environment modelling is an area of importance [1] and it has numerous applications. Acoustic environment require sound generation and variety of techniques are reported to generate acoustic effects. In all aspect of human activities, acoustic plays a significant role and sound perception is the most evident application [2-4]. Azimuthal angles were perceived due to binaural cues such as the interaural time difference and the interaural level difference [5].In [6], AVR microcontroller is used for sound generation and results can be stored in various file formats. Head Related Transfer Functions (HRTF) is used to demonstrate 3D sound and a functional explanation is provided of the software [7, 8]. Sound localization in near real time is outlined by a software based algorithm [9]. This work allows the user to perform the psychoacoustics experiments with subject in remote location via internet and helps the experimenter and subject to save time, money for travelling and also to create a database about the subject's perception about the sound level in a particular experiment [10].

Some author outlined a method called short-term light deprivation for increasing the accuracy in sound localization [11]. The study shows that in sighted subjects the accuracy of sound localization, measured by a task of head pointing to acoustic targets, is reversibly increased after short-term light deprivation of 90 min. Also author suggests that during light deprivation changes in accuracy was due to absence of visual calibration of the neural representation of auditory space. In [12], author presented novel software designed to facilitate the teaching of how 3D sound is synthesized using computerized techniques. This program simplifies the fundamentals with interactive examples. This work demonstrates HRTFs in both simulated and real-time environments. A detailed description is provided of the software and real-time based systems proposed to demonstrate 3D sound using Head Related Transfer Functions (HRTF). In this work acoustic source perception by human in horizontal plane is illustrated. For experiments to be performed in horizontal plane eleven Bluetooth enabled speaker (BES) tagged 1 to 11 numbers were placed evenly at 30 degree in a circular outline and input to BES was controlled with the help of computer [13]. From [14-18], it is obvious that this area requires advancement in technologies and this may be helpful for further study in acoustics. Sound perception and localization in human subject can also be analyzed with different set of acoustic experiments. Literature also demonstrates that higher amount of efficient and modern technologies are required in this area. The development of newer technologies may efficiently increase the study and research in this area. The methodologies implemented in this field are highly complex and thus require a simplified solution to the problem of sound localization. In the current work ASP by human is illustrated and whether the addition of noise signal will have an instantaneous impact on ASP.

2. MATERIAL AND EXPERIMENTAL SETUP
The loudspeaker arrangement is required for performing experiments. The setup consisted of variable frequency acoustic generator and addition of noise was controlled with

help of computer. The angular distance was kept 90 degree order to achieve better perception results. Speaker was checked for accuracy with the available sound level meter. The subject was allowed to sit on the stool provided and with speakers at ear level.The instructions sheet was provided before performing the experiment which consists of how to provide response in response measurement sheet (RMS) in the stipulated time duration and what the subject expected to do.

Acoustic Source Perception			
Response/Score Sheet (Range: 0-100)			
Subject_Id:	**Age:**	**Sex:**	**Date &Time**
Frequency 4KHz ……	**Frequency 6KHz** ……	**Frequency 8KHz** ……	**Frequency 10KHz** ……
Frequency 4KHz (with noise) ……	**Frequency 6KHz (with noise)** ……	**Frequency 8KHz (with noise)** ……	**Frequency 10KHz (with noise)** ……
Signature			

Fig.1 RMS for Acoustic Source Perception

Every subject was given a brief explanation about the task. The subject's response, and the response time was stored for every experiment and each response was saved as times stamped excel data for later analysis by the experimenter. Various sets of experiments were planned for exposure of sound levels with different frequencies range from 4 KHz to 10 KHz with fixed interval of 0.5 KHz. Total 20 human volunteers (10 Males and 10 Females) were asked to score or rate quality of sound perceived and provides their responses in RMS. The 15 subjects have age range from 22 to 32 year and 5 subjects of 50 years plus and none of them have issue of abnormal or defective hearing. Duration of 2 minutes exposure is fixed during experiments on the subjects and performed under noise free environment and with white noise of 30dB. The comparative analysis was done for both the cases. The sample responses are kept as record for further studies. The sound perception experiment is done in a lab, each subject is advised to not to discuss the experimental procedure with other subject. Subjects are asked to sit and feel relaxed while the experiment is performed. The response is written or filled by the subject under the supervision of the task operator in RMS as shown in figure 1.

3. RESULT

The Results are shown for 4 KHz, 6 KHz, 8 KHz and 10 KHz frequency. The perception is determined by the response given by the subject on the response sheet. 20 (10 Male, 10 Female) subjects are provided subject_id and a separate sheet to give any comment while performing acoustic experiment. Each subject is exposed to the acoustic source for a fixed duration and is asked to provide their response after each acoustic exposure. The range of response score/ rate is 0-100. The sound perception experiment is performed on 20 subjects (10 Male, 10 Female, 15subjects aged 22-32, 5 Subjects aged above 50), all reported normal hearing. The result shows that all subjects are able to listen at this frequency and given high response.

3.1 Perception at 4 KHz

The perception rate of various subjects at 4 KHz Frequency is shown in figure 2. The result shows that all subjects are able to listen at this frequency with addition of noise and given high response.

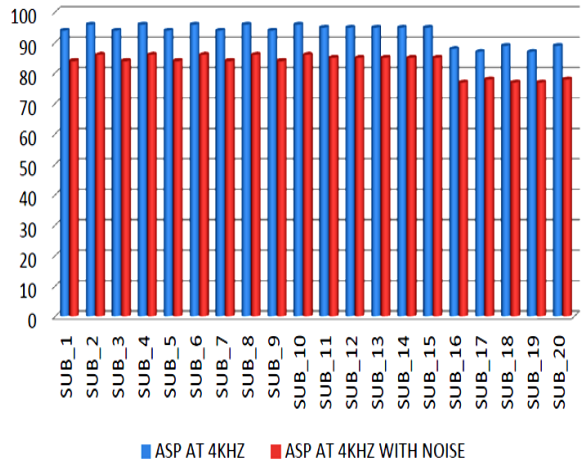

Fig. 2. ASP at 4KHZ with and without Noise

3.2 Perception at 6 KHz

The perception rate of various subjects at 6 KHz Frequency is shown in figure 3. The result shows that all subjects are able to listen at this frequency with addition of noise and given high response.

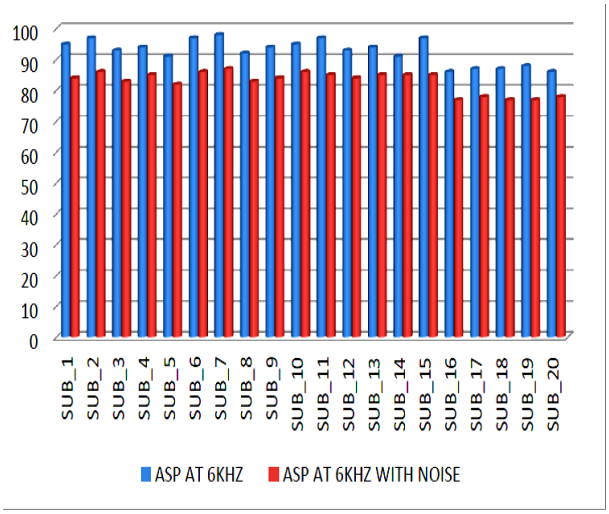

Fig. 3. ASP at 6 KHz with and without Noise

3.3 Perception at 8 KHz

The result shows that all subjects are able to listen at this frequency and given high response. The perception rate of various subjects at 8 KHz Frequency is shown in figure 4. The result shows that all subjects are able to listen at this frequency with addition of noise and given high response.

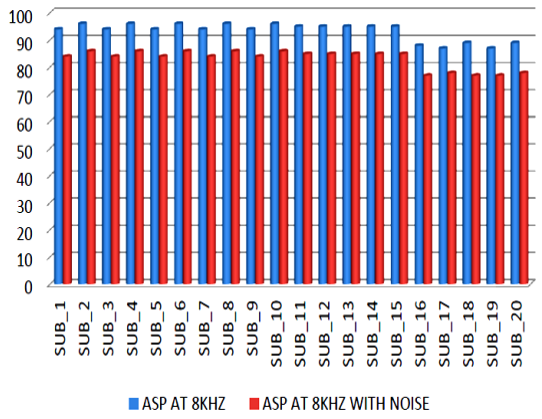

Fig. 4. ASP at 8 KHz with and without Noise

3.4 Perception at 10 KHz

The perception rate of various subjects at 10 KHz Frequency is shown in figure 5. The result shows that all subjects are able to listen at this frequency with addition of noise and given high response. The result shows that all subjects are able to listen at this frequency and given high response. The perception rate of various subjects at various Frequencies is shown in figure 6. The result shows that all subjects are able to listen at this frequency with addition of noise and given high response. The acoustic experiment done on various subjects provide a data to analyze the perception of sound at different frequencies.

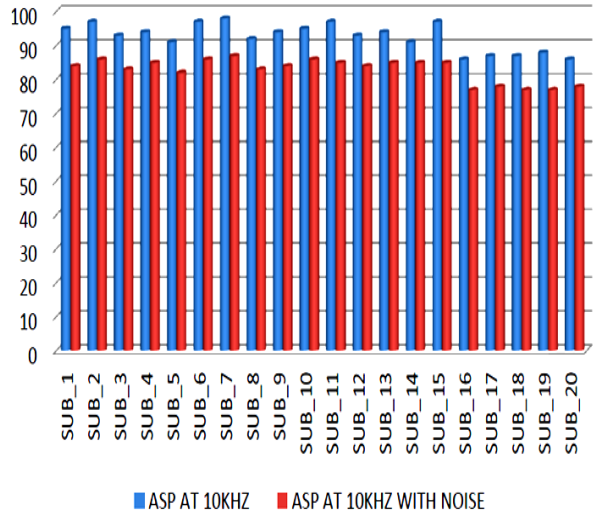

Fig. 5. ASP at 10 KHz with and without Noise

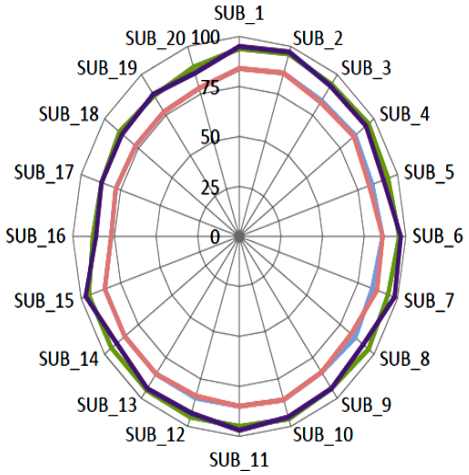

Fig. 6. Comparative Analysis of ASP at various frequencies with and without Noise

4. CONCLUSION

The ASP of 15 subjects was assessed as 95 % while ASP of other 5 subjects as 88% under noise free environment. The presence of noise reduced ASP of 15 subjects to 85% and ASP of other 5 subjects to 77 %. Comparative analysis shows the ASP of human subjects is reduced to 10% with white noise of 30dB as compared to ASP of human subject under noise free environment. The obtained result show that older subjects provides low response to ASP while younger subjects give high ASP in both cases of noise free with frequency variation and induced noise environments with frequency variation.From the above result it is clear that noise play important factors which affects the perception of sound. In future the work can be done on higher frequencies which can be helpful in analysis of sound perception by human.

Table 1: Tabulated Response of Various Subject at Various Frequencies

Subject_ID	ASP AT 4 KHz	ASP AT 6 KHz	ASP AT 8 KHz	ASP AT 10 KHz	ASP AT 4 KHz WITH NOISE	ASP AT 6 KHz WITH NOISE	ASP AT 8 KHz WITH NOISE	ASP AT 10 KHz WITH NOISE
SUB_1	94	94	93	93	84	84	83	82
SUB_2	96	96	95	94	86	85	84	84
SUB_3	94	93	93	93	84	83	83	83
SUB_4	96	96	95	94	86	85	85	84
SUB_5	94	92	92	92	84	82	81	80
SUB_6	97	96	96	95	86	85	85	84

SUB_7	94	94	93	92	84	83	83	82
SUB_8	96	95	95	93	86	83	82	81
SUB_9	94	94	94	94	84	83	83	83
SUB_10	96	95	95	95	86	84	84	83
SUB_11	95	97	96	95	86	84	85	84
SUB_12	95	93	93	93	85	84	84	83
SUB_13	94	94	93	93	84	84	83	82
SUB_14	96	96	95	94	86	85	84	84
SUB_15	94	93	93	93	84	83	83	83
SUB_16	88	86	86	85	76	75	74	74
SUB_17	87	87	86	86	78	78	78	78
SUB_18	89	87	86	86	76	75	74	74
SUB_19	88	88	88	87	76	76	75	74
SUB_20	89	87	85	84	76	75	74	74

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