NORDIC ACOUSTICAL MEETING
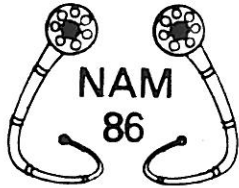
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PREFERRED DISTANCE TO A WALL BEHIND TALKERS

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Introduction

The investigation presented here is an extension of a
previous paper concerning the acoustical conditions
preferred for talkers presented at the 12th Inter-
national Congress on Acoustics ICA-86 [1]. In the pre-
vious experiment the talking comfort of six different
synthetic sound fields was judged by 10 talkers. The
sound fields were simulated for rooms of different cross
sections with no reflections in front of or behind the
talkers. The results showed that the lateral-vertical
ratio does not have the same important influence on
talking comfort as on listening quality in auditoria. In
this new experiment a wall behind the talker has been
added and the distance to the back wall has been varied.

In all previous experiments with musicians and singers
[2, 3, 4] only a very limited number of early reflections
were simulated. This limitation will probably cause the
test to be "oversensitive", i.e. the subjects will
perhaps detect differences between simulations that will
never occur in reality. In real sound fields the great
number of reflections will in some cases mask differen-
ces that would be detected if for instance, only rever-
beration and the first order reflections were present.
Therefore all early reflections with a delay time of up
to approx. 125 ms were simulated in our tests.

Stimuli

One of the cross sections from the previous study
(w x h = 10 x 10 m²) was chosen. In this section the
source-receiver position was asymmetrical as indicated
in fig. 1. The cross section was left invariant and only
the distance to the wall behind the talker was varied
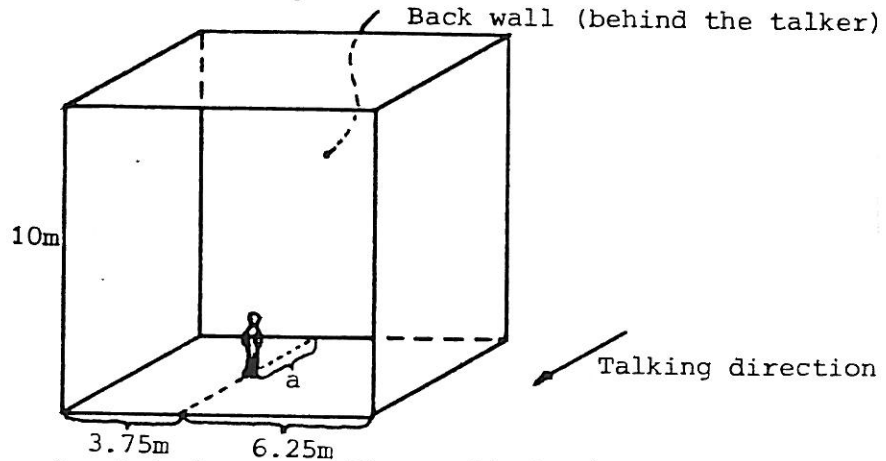according to table 1 and fig. 1.

Figure 1. The simulated room. The wall facing the talker
was totally absorptive ($r = 0$).

	1	1.5 m
	2	3 m
Stimuli	3	6 m
	4	12 m
	5	∞ (no wall)

Table 1. Distance a in fig. 1.

Since we were only interested in the early reflections
the front wall was eliminated from this study. In prac-
tice the front wall (facing the talker) is often so far
removed that its reflections are part of the general
reverberation. Although no reverberation was added the
stimuli are relevant as a rough approximation of the
"theatre situation" with reflecting scene surfaces and
an auditorium with a very short reverberation time. The
remaining five surfaces were totally reflecting ($r = 1$).

Stimuli, containing reflections with a delay time of up
to 125 ms, corresponding to approx. 100 image sources,
were calculated. In order to avoid rebuilding the simu-
lator, the lower half plane image sources were created
by reflection in a reflecting floor plane. This introdu-
ces some errors in the lower half plane reflections. The
actual propagation path lengths become slightly longer
than the theoretical, however these errors are probably
negligable compared with the differences between sti-
muli.

Simulation of stimuli

The speech signal from the talker was picked up using a
directional microphone (AKG 451 & CK1) 50 cm away from
the mouth at an angle of approx. 90° laterally and 45°
vertically. The signal from the microphone entered a
1/3-octave equilizer, to compensate the loudspeaker fre-
quency response, and was then fed to the delay unit.
From the delay unit the 13 delayed signals entered the
mixer. In the simulations 29 output signals from the
mixer were amplified and fed to 29 loudspeakers. The
overall frequency response of the system was within
± 2 dB from 100 Hz to 5 kHz.

Experiments

Because of the rather small perceptible differences the
method of paired comparisons was chosen. Fifteen
trained talkers were used, 9 male and 6 female, varying
from 20 to 50 years of age. The subjects were told that
they were standing in a lecture hall with appr. 200 - 300
listeners and were asked to judge the "talking comfort".
They were allowed to talk for unlimited time and were
forced to choose one of the alternatives of the pair
(A, B). The pairs were presented in random order and
four replications (including AB and BA) were used. This
gave totally 40 comparisons per subject equivalent to
approx. 45 minutes test time. The test was therefore
subdivided in 3 blocks.

Statistical analysis

When trying to scale the judgements according to the
assumptions of Thurstones case V [6, 7, 1] two groups
with different mean values of the discriminal differen-
ces were detected. Therefore these groups were also ana-
lysed separately giving two different preference scales
as shown below. Nevertheless the χ^2-test showed that the
response variable was one-dimensional as is assumed in
the Thurstone case V model.

Results

The significant differences obtained are indicated in
table 2, 3 and 4. A X in the matrixes indicates a

	1	2	3	4	5
1					
2	X		X		
3	X				
4	X				
5	X	X	X	X	

	1	2	3	4	5
1					
2	X		X		
3	X				
4	X				
5	X	X	X	X	

	1	2	3	4	5
1		X	X		
2					
3					
4		X			
5				X	

Tab.2. All 15 subjects   Tab.3. Group 1 (10)   Tab.4. Group 2 (5)

significant (5 %) preference for the column stimulus compared with the row stimulus. From the preference scales in figs 2-4 we can observe that subject group 1 judged stimulus 1 to have the best "talking comfort" while subject group 2 thought this stimulus was the worst case.
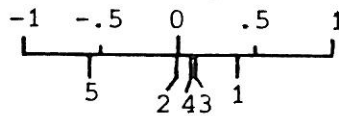

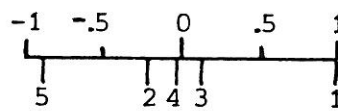Fig. 2. Pref. scale for all (15) subjects
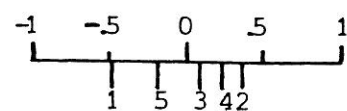
Fig. 3. Pref. scale for group 1 (10 subj.)

Fig. 4. Pref. scale for group 2 (5 subj.)

Discussion

The opposite opinions concerning stimulus 1 shows that the optimal distance to the wall is different for different groups. Probably this is mainly caused by different speech levels. However, the "average subject" seems to prefer the shortest distance to the back wall which gives high level and more correlated reflections (the two image source planes are close together).

Acknowledgement

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