T A D S 2004

The Power of Evidence Informing the Future

Sound-field systems for education access

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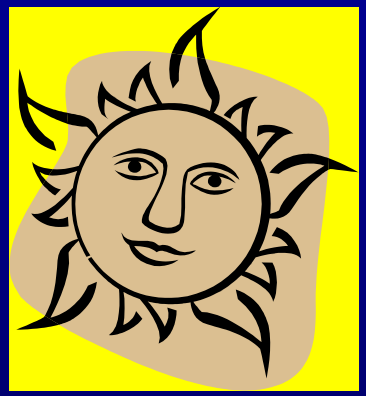
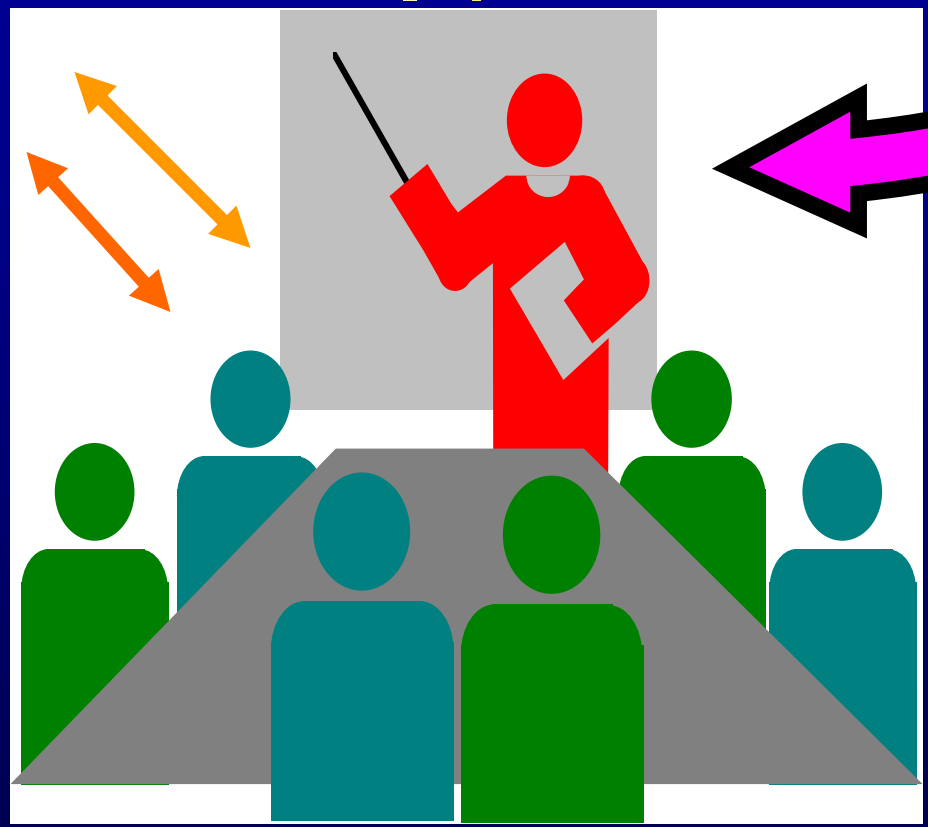
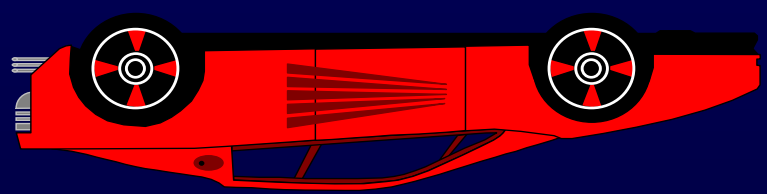
National Acoustic Laboratories
Brisbane 2004

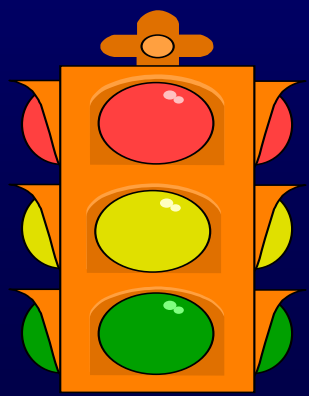
National Acoustic Laboratories

Typical classroom listening environment









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Barriers to speech perception in the classroom

Hearing status:

Normal	**<15dB**
Minimal	**16dB - 25dB**
Mild	**26dB - 40dB**
Moderate	**41dB - 55dB**
Severe	**56dB - 70dB**
Sev/profound	**70dB - 90dB**
Profound	**>90dB**

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Barriers to speech perception in the classroom

Australian Hearing statistics May 2004:
15,222 aided children under 21 years

< 30 dB HL	**37 %)**	**= 74%**
31 - 60 dB HL	**37 %)**	
61 - 90 dB HL	**12 %**	
> 90 dB HL	**11 %**	
unspecified	**3 %**	

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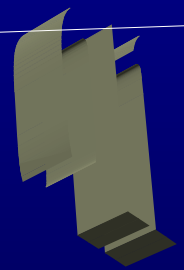
Barriers to speech perception in the classroom



Children listen differently from adults

Auditory neurological network not developed until 15 years of age (Chermak & Musiek, 2000)

Children do not have data banks of information (Flexer, 2002)

Young listeners perform poorly in noise compared with adults (Nelson & Soli, 2000)

Ability to listen in noise not developed until adolescence (Stelmachowicz et al. 2000)

What does this mean?

Children need a quieter environment and a louder signal than adults in order to learn

(Anderson, 2001)

Is this what sound-field amplification sets out to achieve?

What is sound-field amplification?

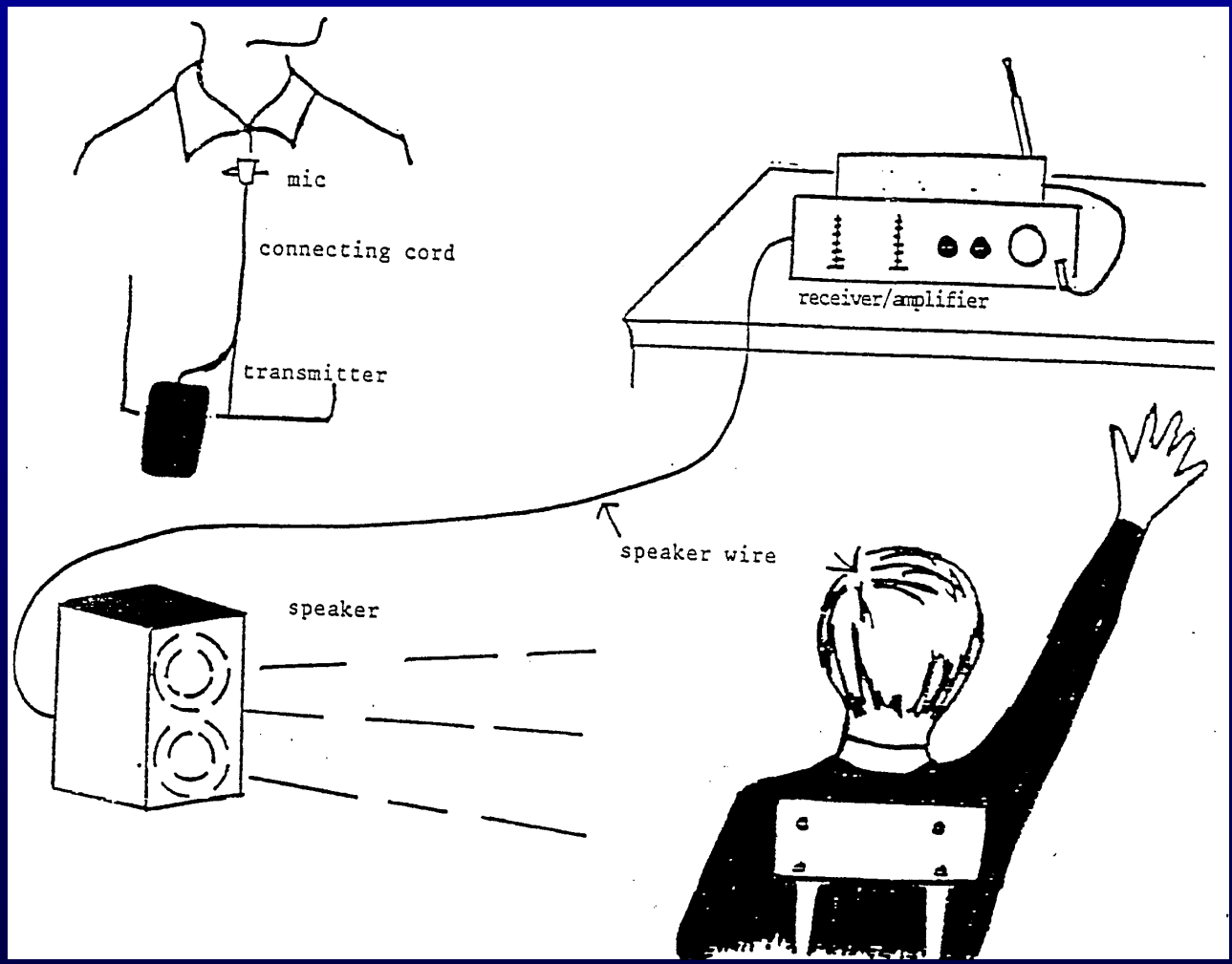
Educational tool controls classroom acoustic environment

Public address system

Consists of

- **transmitter microphone/s**
- **receiver/amplifier**
- **speakers**

What is sound-field amplification?



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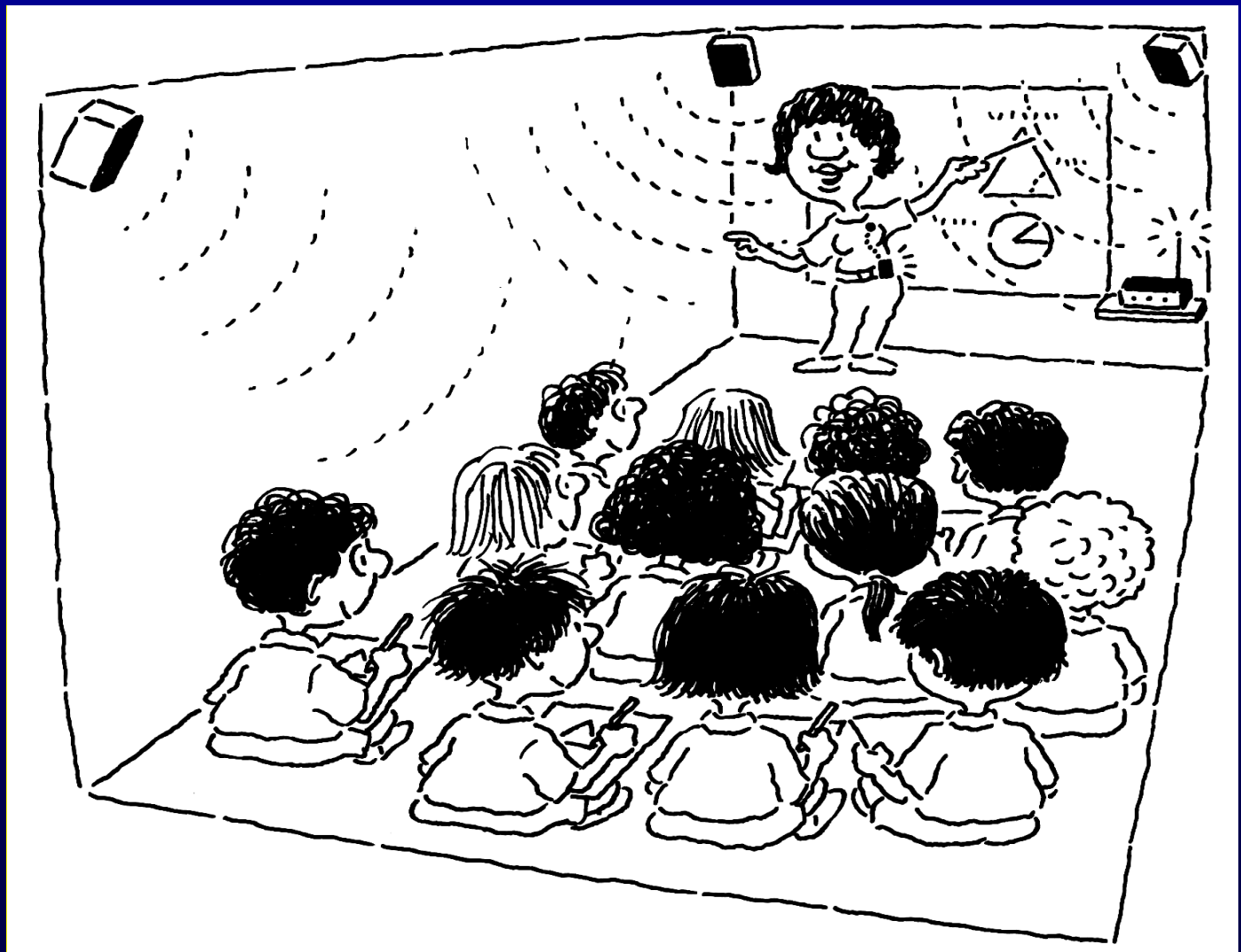
What is sound-field amplification?



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What is sound-field amplification?

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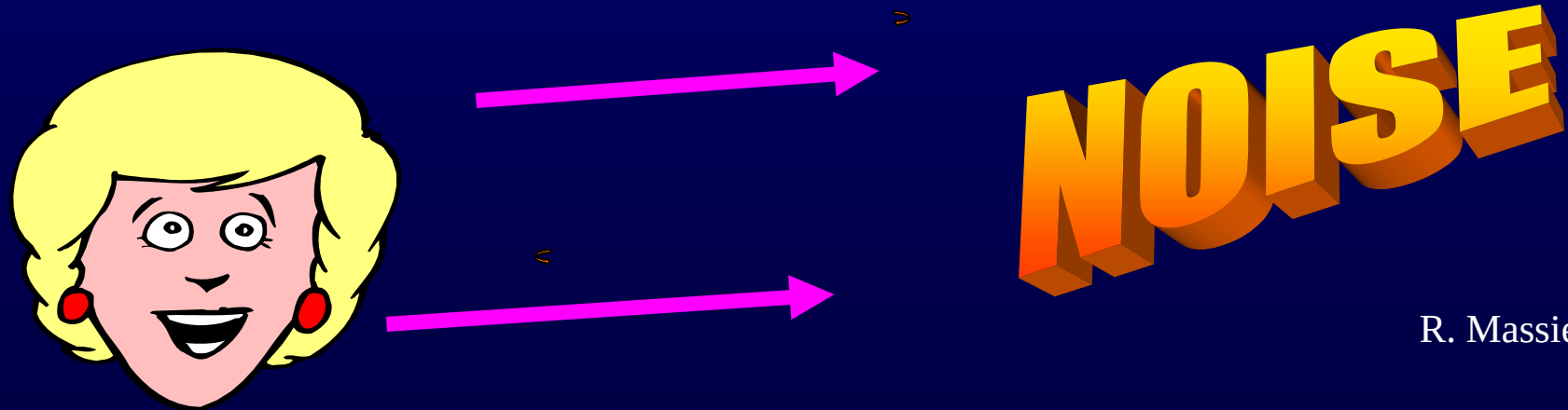
Signal - to - noise ratio (S/N)

Speech level 6dB louder than noise **+6 dB**

Noise level 6dB louder than speech **- 6 dB**

Recommended (ASHA, 1995) **+15 dB**

Children with sensorineural loss require greater S/N ratio



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What does sound-field amplification do?

Increases overall level of the teacher's speech

Improves S/N ratio by 8dB to 10 dB

Delivers a constant level of voice no matter where teacher is in room and when teacher's back is turned

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Another question

Can sound - field systems and personal amplification systems be used in the same classroom?

YES!

Answer

Using sound-field systems and individual amplification systems at the same time creates the best listening and learning environment possible

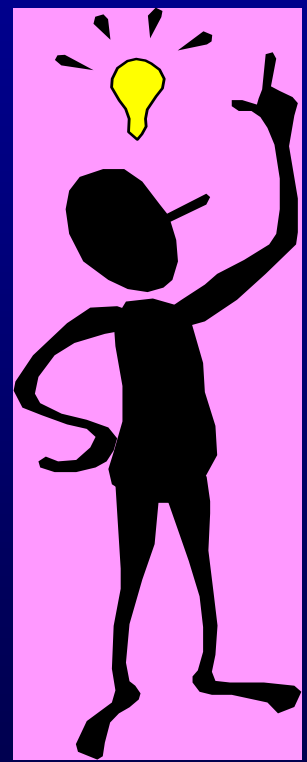
(Flexer 2002)

Why?

- **Sound-field amplification improves acoustic access for all children**

- **Individual FM systems provides individual child wearing hearing aids with most favourable S/N ratio**

(Flexer 2002)



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Who Benefits?

Children with:

fluctuating middle ear hearing impairment

unilateral hearing impairment

“minimal” permanent hearing impairment where hearing aids not recommended

Who Benefits?

Children with:

permanent hearing impairment who wear hearing aids and FM systems

“at risk” populations

e.g. non-native English
auditory processing
attention deficits
learning problems

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What are the benefits?

Contributes to academic achievement

Improves:

- **speech perception**
- **comprehension**
- **reading/spelling ability**
- **attention**
- **on-task behaviours**
- **psychosocial function e.g. confidence**

(Crandell & Smaldino, 2000)

Other benefits.....

cost effective procedure for improving classroom acoustics

can enhance other equipment

does not stigmatise individual children

does not require co-operation from child

equipment malfunction obvious

Benefits to teachers

reduced vocal strain and fatigue

increased ease of teaching

increased versatility of instructional techniques

increased teacher mobility

(Rosenberg et al, 1999)

Potential limitations

- appropriate teacher training and follow-up support vital
- loudspeaker arrangement important
- not a substitute for personal amplification
- most cannot be transported from room to room

Study with Aboriginal children

Subjects: 64 children **Mean HL = 20dB**

increased verbal communication

increased response to teacher instruction to class

children more proactive in discussion

decrease in disruptive behaviours

teachers reported less voice fatigue

Study in mainstream cross-cultural classrooms

AIM

Investigate the effects of sound-field amplification on educational outcomes

Mainstream cross-cultural study

Subjects: **43% Vietnamese,Samoan,**
(n=242) **Spanish, Aboriginal**
18% other ethnic backgrounds
39% English backgrounds

No prior experience with technology

Dual-channel systems installed

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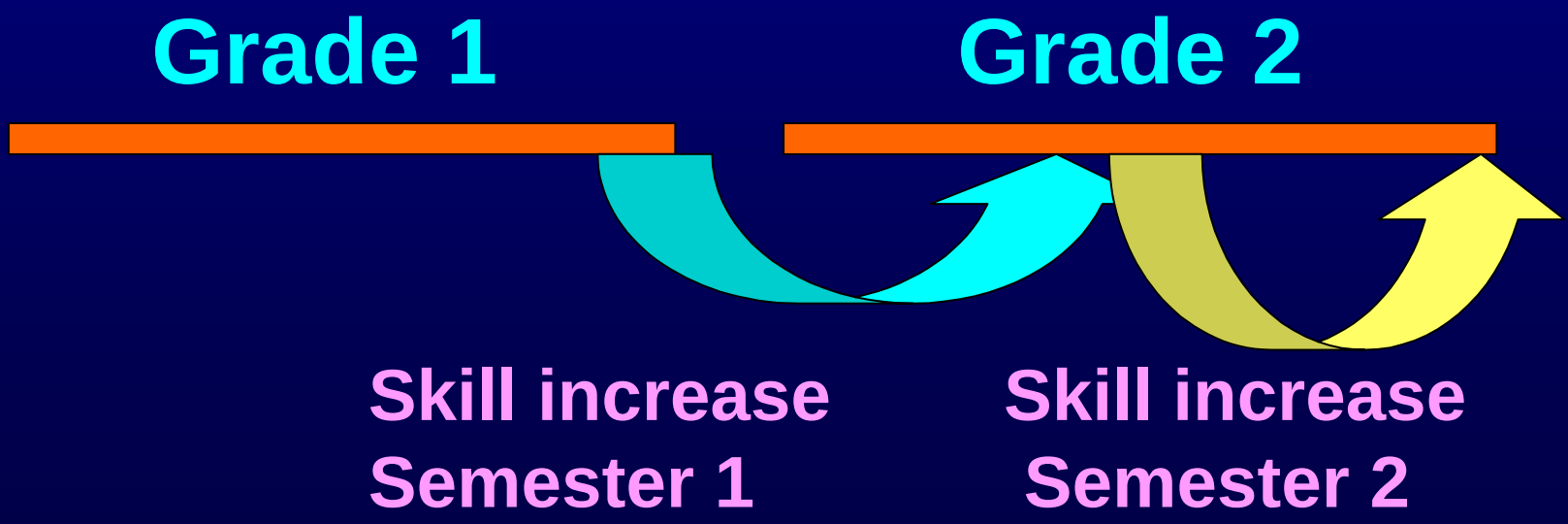
Study Design

	Semester 1	Semester 2
Classes 1- 4	On	Off
Classes 5- 8	Off	On
Classes 9-10	On (one mic)	On (two mics)
Classes 11-12	On (two mics)	On (one mic)

Year 2 Diagnostic Net

- **Identifies children needing support**
- **Teachers monitor progress using indicators of literacy and numeracy**



Audiological and acoustic findings

Mean hearing level		15dB HL
Mean	**Actual**	**Recommended**
Noise__	**68dB**	**35dB**
Reverberation	**1.5sec.**	**0.6sec.**
S/N ratio "off"	**- 3 dB**	**+ 15dB**
S/N ratio "on"	**+4 dB**	**+15 dB**

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Questions

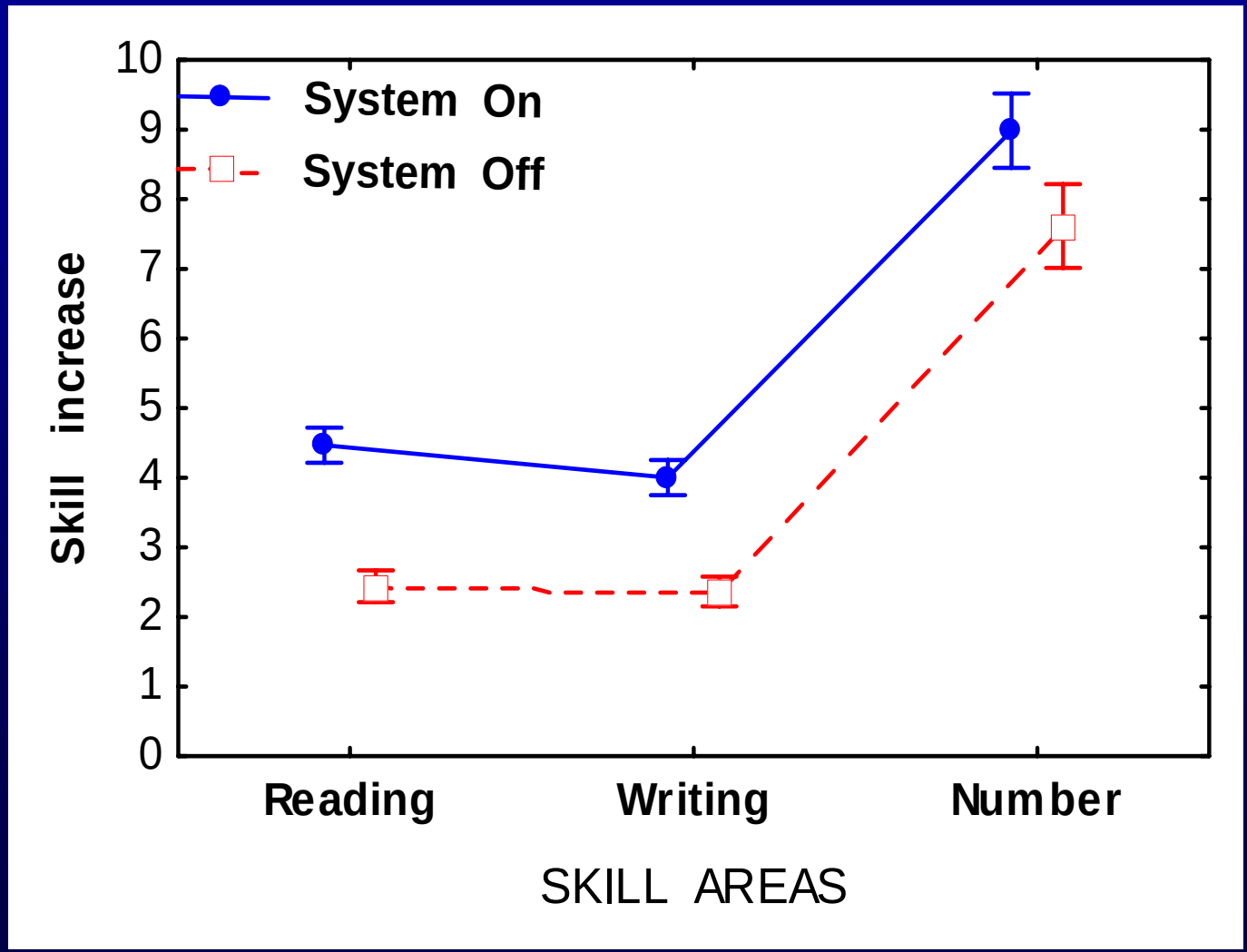
Did intervention affect outcomes?

Were some skills affected more than others?

Did family language affect outcomes?

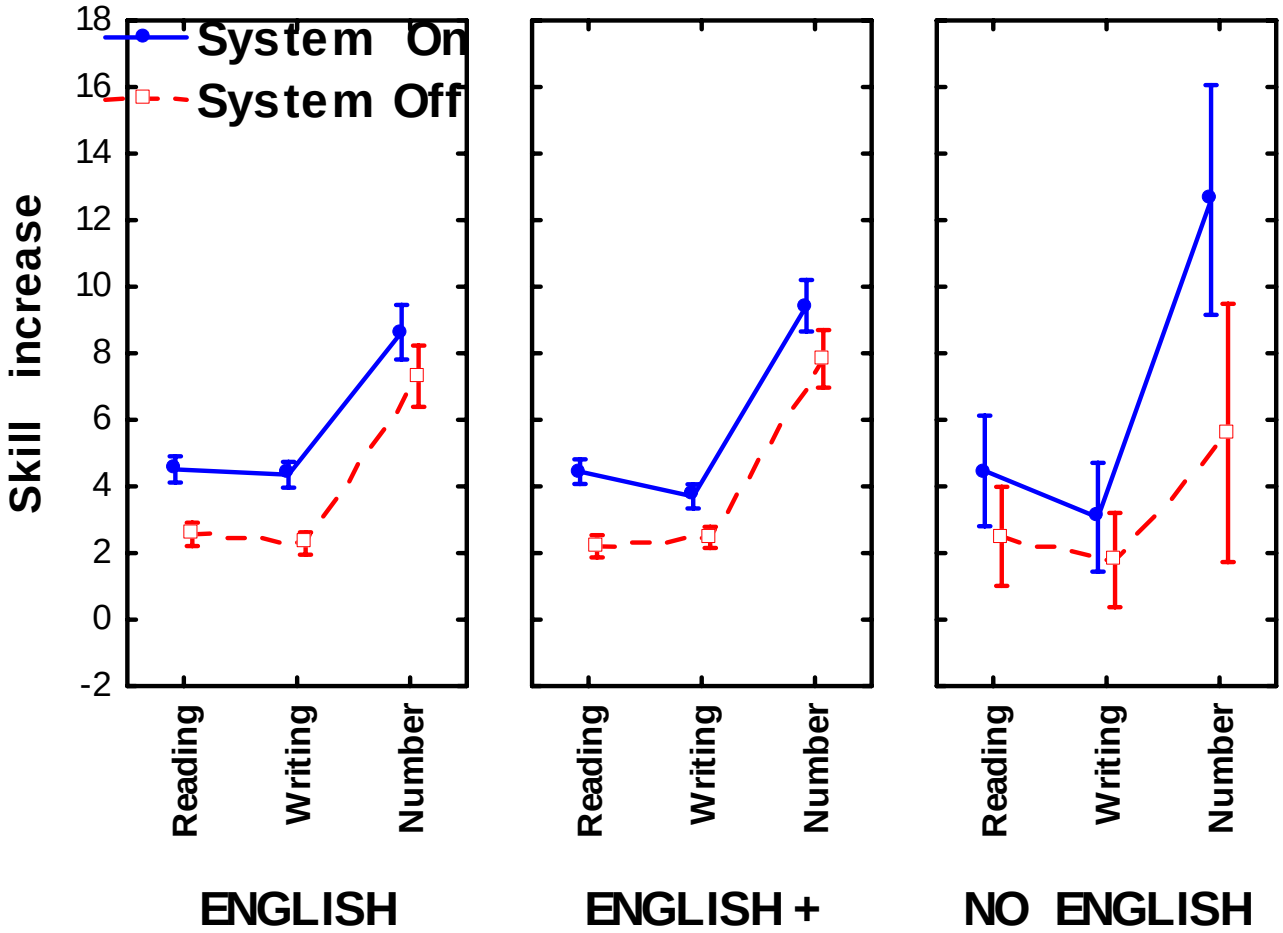
Effects of single vs dual channel options?

Classes 1-8: Systems “on”/“off”



Beneficial effects in each skill area

Classes 1-8: Family Language



Beneficial effects for each subgroup

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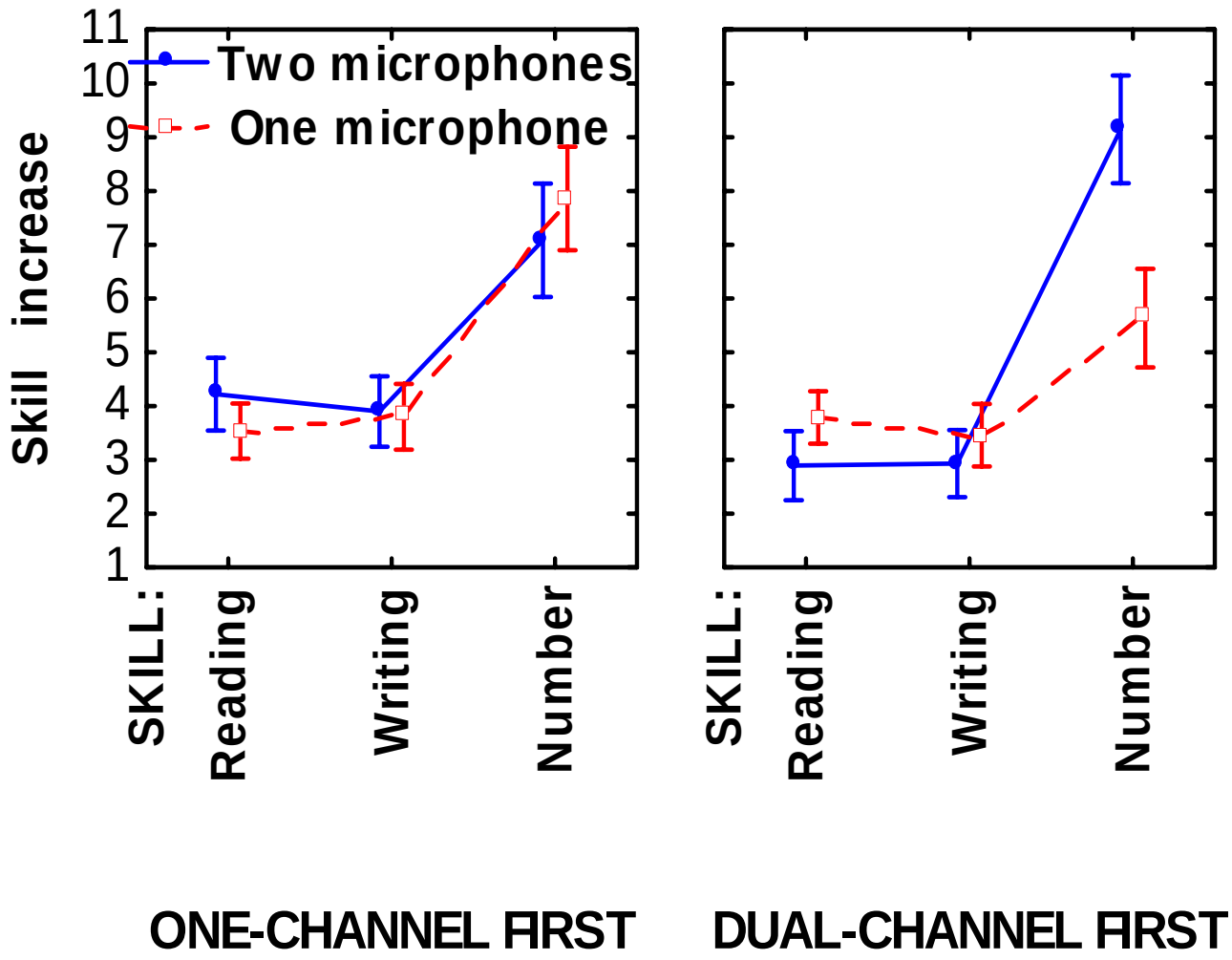
Classes 9-12 Single vs dual-channel transmission



No effect

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Implication of findings

Importance of early foundation in literacy and numeracy skills

Intervention had similar effect to increasing each semester by one third

Number of microphones did not affect outcomes

Implication of findings

Vital role of teachers: training and ongoing support

Limitation: individual not group training

Greater emphasis on microphone strategies

The future

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Thankyou

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