

# Why acoustical environment matters?

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A target graphic with concentric circles in teal, red, and yellow, with a hand holding a pen at the center.

# Goal

Participants understand the significance of an acoustical environment on the development and wellbeing of children



We need sounds



Once upon time...

a ba-na-na



We need sounds



We need sounds



We need sounds

# Acoustical environment

- Reverberation time
- Speech Transmission Index (STI)
- All sounds in a certain space, including wanted and unwanted sounds (aka noise)

Jokitulppo, Pirilä, Niemitalo-Haapola & Rantala. Osallistava melunhallinta ja akustointi – miten opetustilan ääniympäristöä voidaan parantaa? Rakennusfysiikka 2017.

Klatte, Lachmann & Meiss. Effects of noise and reverberation on speech perception and listening comprehension of children and adults in a classroom-like setting. Noise Health 2010.

# Noise – unwanted sound (WHO)

## **Activity noise:**

**Speech and yells**

**Sounds from furnitures**

**Sounds from toys**

## **Background noise:**

**Ventilation**

**Traffic noise**

**Machinery (e.g. computers)**

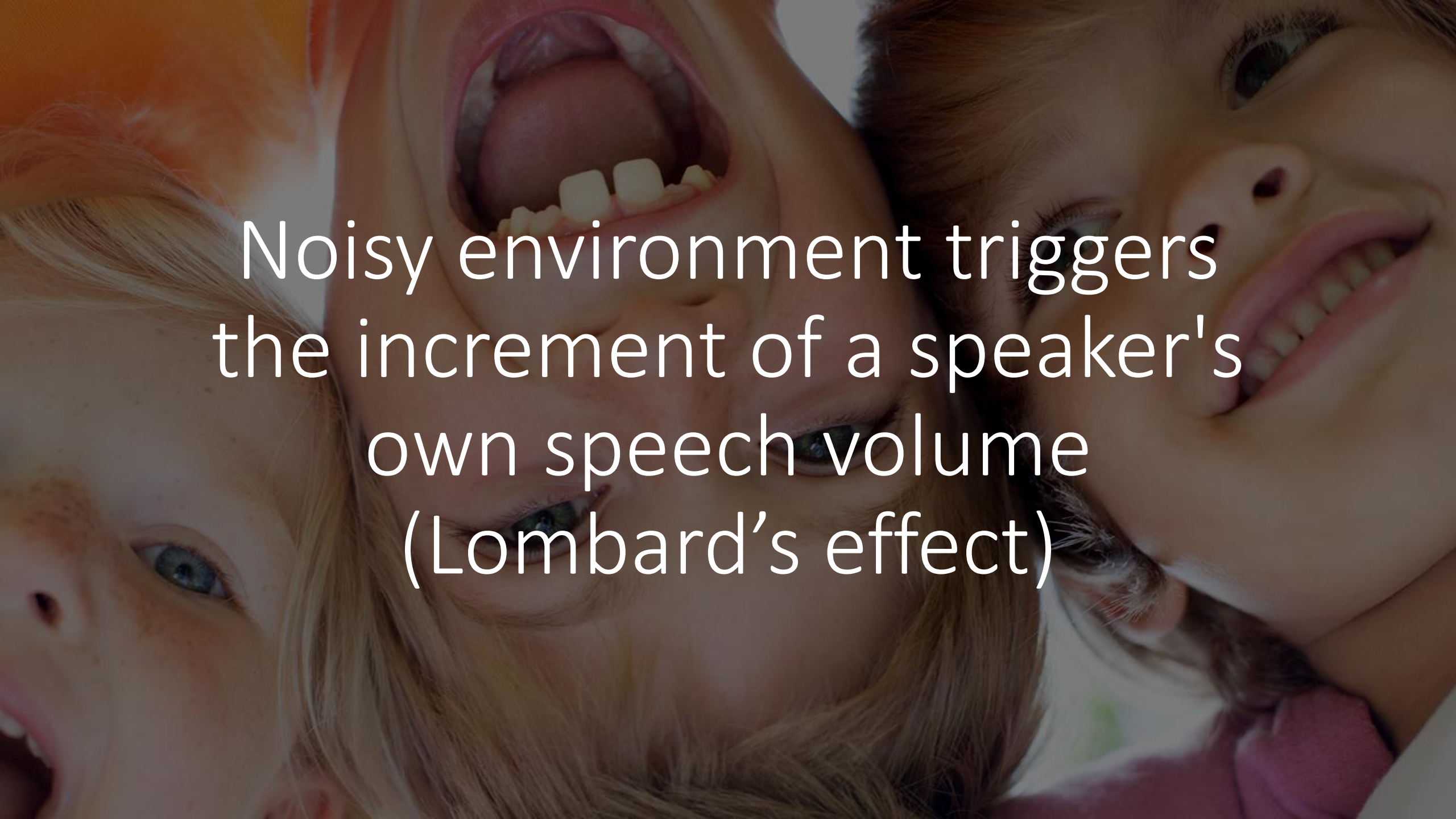


# Noise – unwanted sound (WHO)

A black and white photograph of three women in profile, looking towards the right. They are positioned in the lower half of the frame, with their heads and shoulders visible. The background is a dark, textured wall with some faint, curved lines.

The study published in 2016 showed that only few classrooms from 40 classrooms evaluated fulfilled the acoustic criteria of the Finnish national standard (SFS 5907) and no classroom fulfilled the criterion for acoustics measured according to the STI.

Sala & Rantala. Acoustics and activity noise in school classrooms in Finland. Applied acoustics 2016.

A close-up photograph of three children's faces. The child in the center has their mouth wide open, showing their teeth and tongue. The child on the right is smiling, showing their teeth. The child on the left is looking towards the camera. The image is overlaid with a semi-transparent dark grey filter, and white text is centered over it.

Noisy environment triggers  
the increment of a speaker's  
own speech volume  
(Lombard's effect)



What kind of consequences there might be from poor acoustical environments?



potentially unpleasant

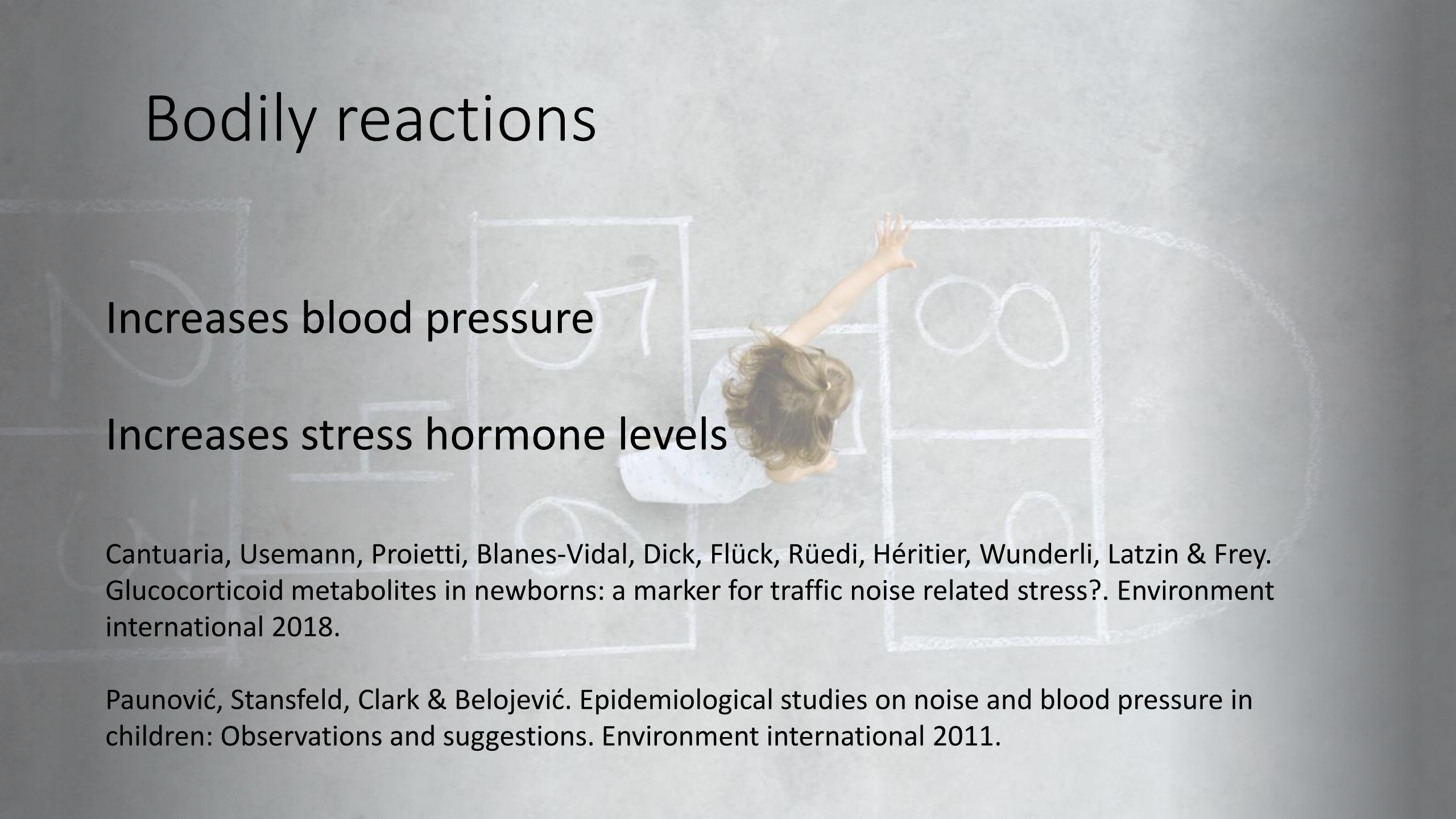
# Bodily reactions

Increases blood pressure

Increases stress hormone levels

Cantuaria, Usemann, Proietti, Blanes-Vidal, Dick, Flück, Rüedi, Héritier, Wunderli, Latzin & Frey. Glucocorticoid metabolites in newborns: a marker for traffic noise related stress?. Environment international 2018.

Paunović, Stansfeld, Clark & Belojević. Epidemiological studies on noise and blood pressure in children: Observations and suggestions. Environment international 2011.



# Attention

A young child with curly hair is playing with colorful blocks. The child is wearing a striped shirt and is looking towards the right. The background is a bright, slightly blurred indoor setting.

Partially conflicting results – depends on the quality of the sound (continuous or alternating or even surprising)

Hygge, Boman & Enmarker. The effects of road traffic noise and meaningful irrelevant speech on different memory systems. *Scandinavian Journal of Psychology*. 2003.

Lercher, Evans & Meis. Ambient noise and cognitive processes among primary schoolchildren. *Environment and Behavior*. 2003.

Massonnié, Rogers, Mareschal & Kirkham. Is classroom noise always bad for children? The contribution of age and selective attention to creative performance in noise. *Frontiers in psychology*. 2019

# Quality of sleep

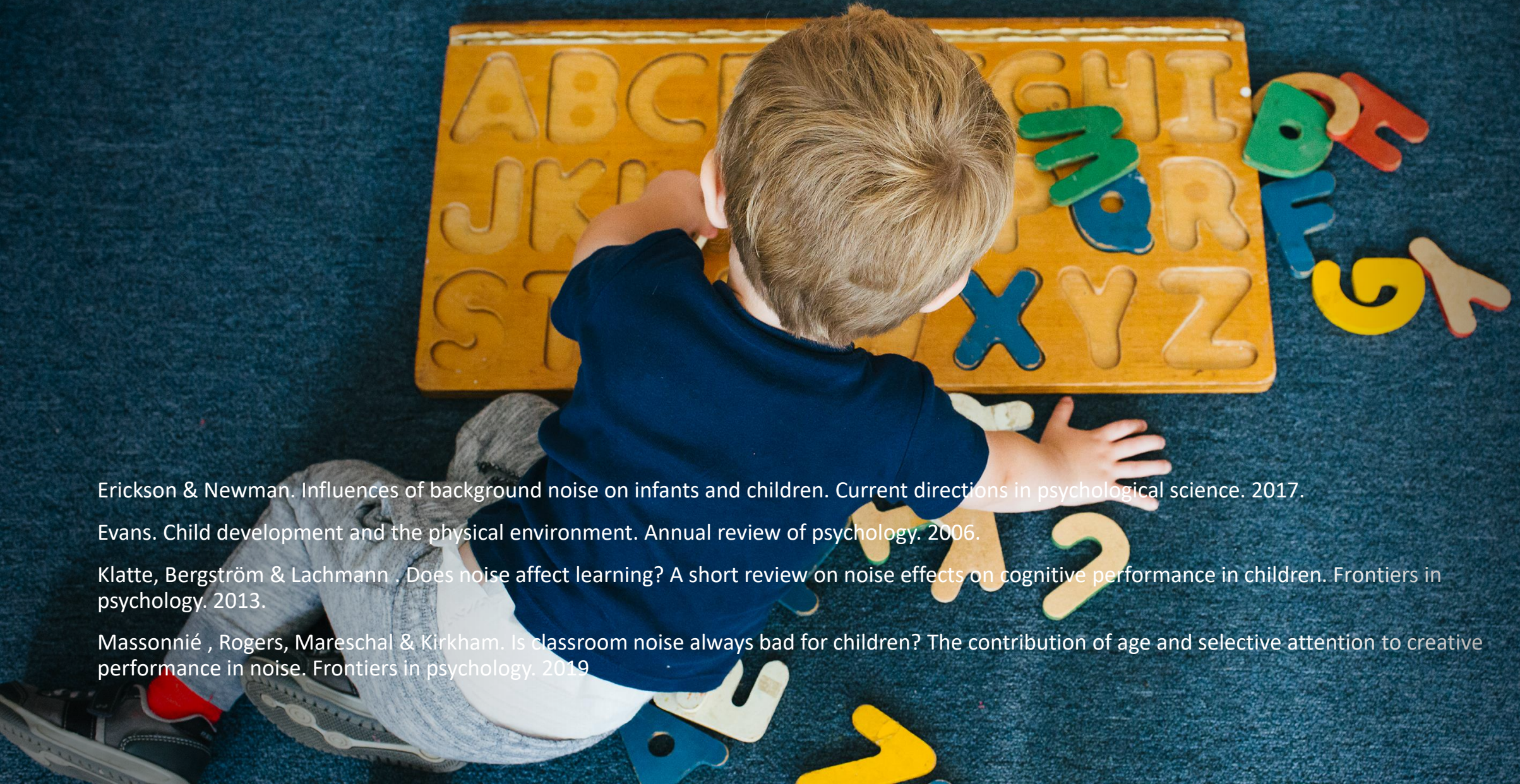
A young child with curly hair is sleeping peacefully on a colorful striped blanket. The child is holding a blue knitted stuffed animal. The background is a soft, out-of-focus pattern of colors including blue, green, yellow, and red.

## Children need sleep in support of language development

Schreiner & Rasch. The beneficial role of memory reactivation for language learning during sleep: A review. *Brain and language*, 2017.

Öhrström, Hadzibajramovic, Holmes, & Svensson. Effects of road traffic noise on sleep: Studies on children and adults. *Journal of environmental psychology*, 2006.

# Learning and cognitive skills



Erickson & Newman. Influences of background noise on infants and children. *Current directions in psychological science*. 2017.

Evans. Child development and the physical environment. *Annual review of psychology*. 2006.

Klatte, Bergström & Lachmann . Does noise affect learning? A short review on noise effects on cognitive performance in children. *Frontiers in psychology*. 2013.

Massonnié , Rogers, Mareschal & Kirkham. Is classroom noise always bad for children? The contribution of age and selective attention to creative performance in noise. *Frontiers in psychology*. 2019



# (Central) auditory processing



Noise hinders the formulation of sensory representation and auditory discrimination; both are needed for language development

Niemitalo-Haapola, Haapala, Kujala, Raappana, Kujala & Jansson-Verkasalo. Noise equally degrades central auditory processing in 2- and 4-year-old children. *Journal of Speech, Language, and Hearing Research*. 2017.

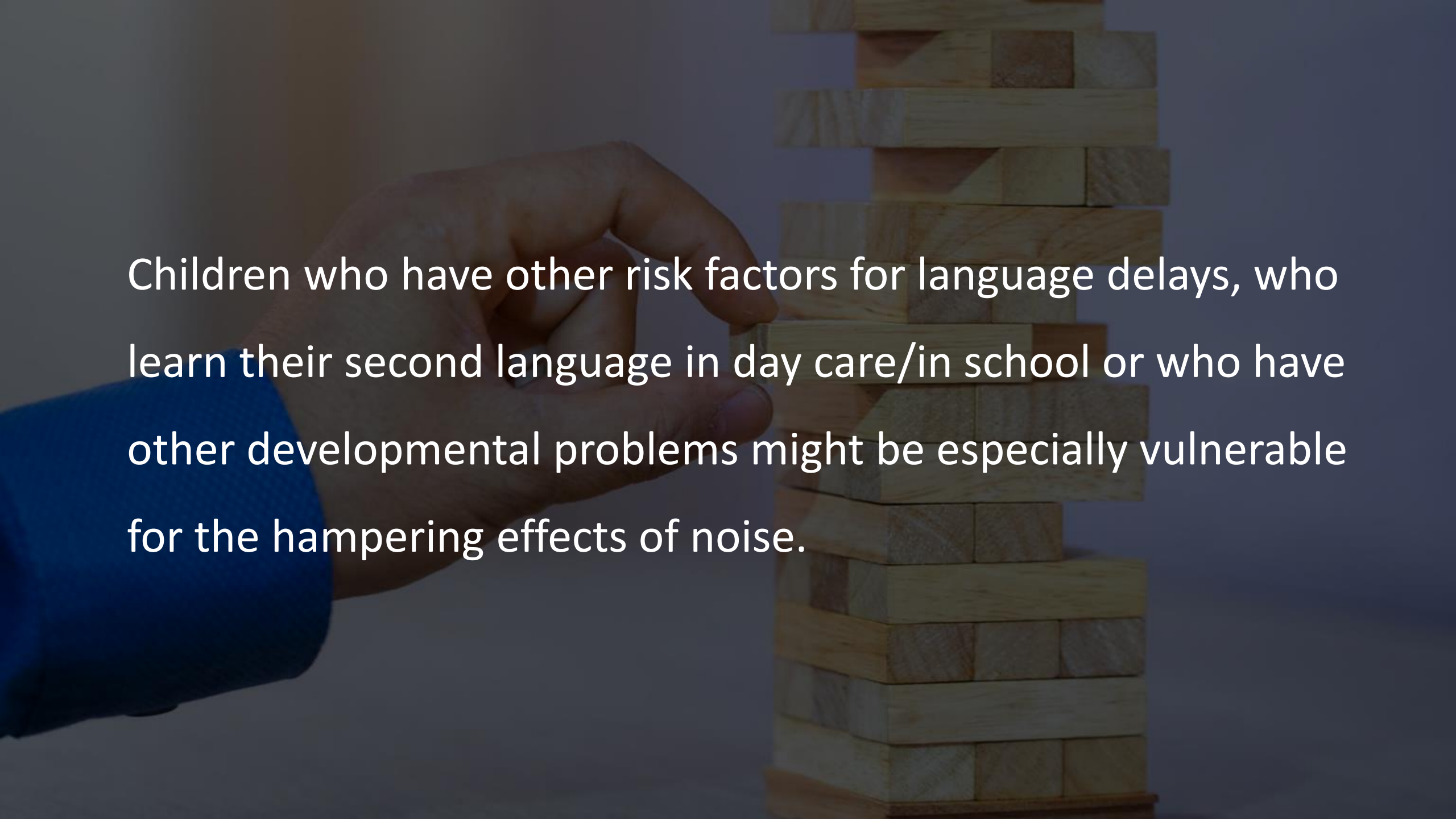
# Language skills

A photograph of two children lying on a light-colored sofa, reading books. The child on the left is wearing a blue and white striped shirt and is holding a book up high. The child on the right is wearing a blue and white striped shirt and is holding a book open. The background is a plain wall.

E.g. vocabulary, speech comprehension, the learning of new words

McMillan & Saffran. Learning in complex environments: The effects of background speech on early word learning. *Child Development*. 2016.

Prodi, Visentin & Feletti. On the perception of speech in primary school classrooms: Ranking of noise interference and of age influence. *The Journal of the Acoustical Society of America*. 2013.

A hand in a blue sleeve is shown balancing a single wooden block on top of a tall, narrow tower of stacked wooden blocks, resembling a Jenga game. The background is a plain, light-colored wall. The text is overlaid on the image in white, centered horizontally and vertically.

Children who have other risk factors for language delays, who learn their second language in day care/in school or who have other developmental problems might be especially vulnerable for the hampering effects of noise.

# Noise in day care settings

SPL exceeding 70 dB affects personnel's vocal health negatively

However, no connection between acoustics and children's or personnel's self evaluated wellbeing

The negative experiences of noisiness was increased by sound spreading, poor insulation, and solid surfaces

It was concluded that there is a need for solutions that enable acoustically separated spaces

Martikainen, S., Prawda, K., Ståhlberg-Aalto, F., Lautanala, I., Kostilainen, K., Välimäki, V., & Tervaniemi, M. (2023). Acoustics and the well-being of children and personnel in early childhood education and care. *Frontiers in education*, 8, Article 1244428. <https://doi.org/10.3389/feduc.2023.1244428>

# Noise in a classroom

Internal and external noise level affects cognitive skills evaluated with tests

- Internal noise levels more closely related to test results than external levels
- Children with specific needs more severely affected than children without
- The strongest correlation were with noise levels measured in occupied classrooms.

Shield, B., & Dockrell, J. (2008). The Effects of classroom and environmental noise on children's academic performance. In 9th International Congress on Noise as a Public Health Problem (ICBEN), Foxwoods, CT.



Acoustical environment  
matters

# What can you do?

- Promote awareness
- Influence on planning of new buildings (location of buildings, location and number of rooms, materials used, professional acoustical planning)
- Influence on renovations and updates of existing spaces
- Influence on daily acoustical culture (e.g. number of children in one space, carpets, toys)
- Conversations with the children regarding acoustical environment and the role of each speaker



Thank you

Any question or comments?

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