Measuring Program Quality Using Sensors

Childcare Staff's Experiences, Perceptions, Needs

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Measuring Program Quality Using Sensors

Outline

1. Previous Research Using Sensors in Educational Settings
2. Exploring Early Childhood Educators' Perceptions of Sensor Use
3. Initial Findings from Deploying a Sensor in an Early Childhood Setting

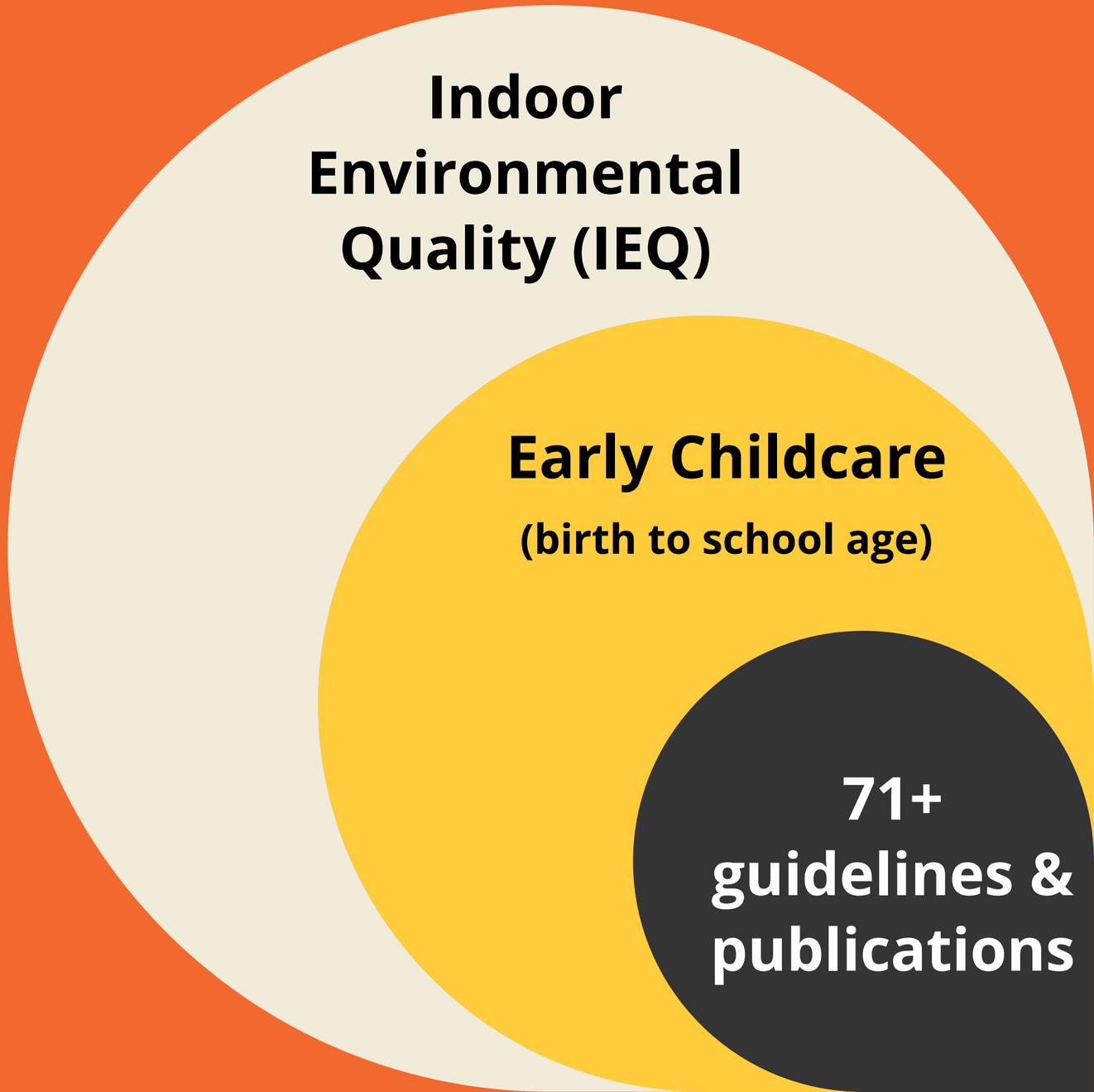
Previous Research Using Sensors in Educational Settings

Literature Review Components

Potential Impacts — How does IEQ impact occupants?

Guidelines — What IEQ recommendations exist?

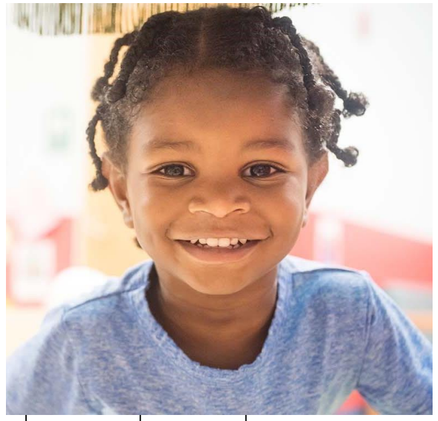
Sensors — How have sensors been used? What were the findings?



SENSORY environment

Literature Review Findings

Wide range of potential impacts, such as:

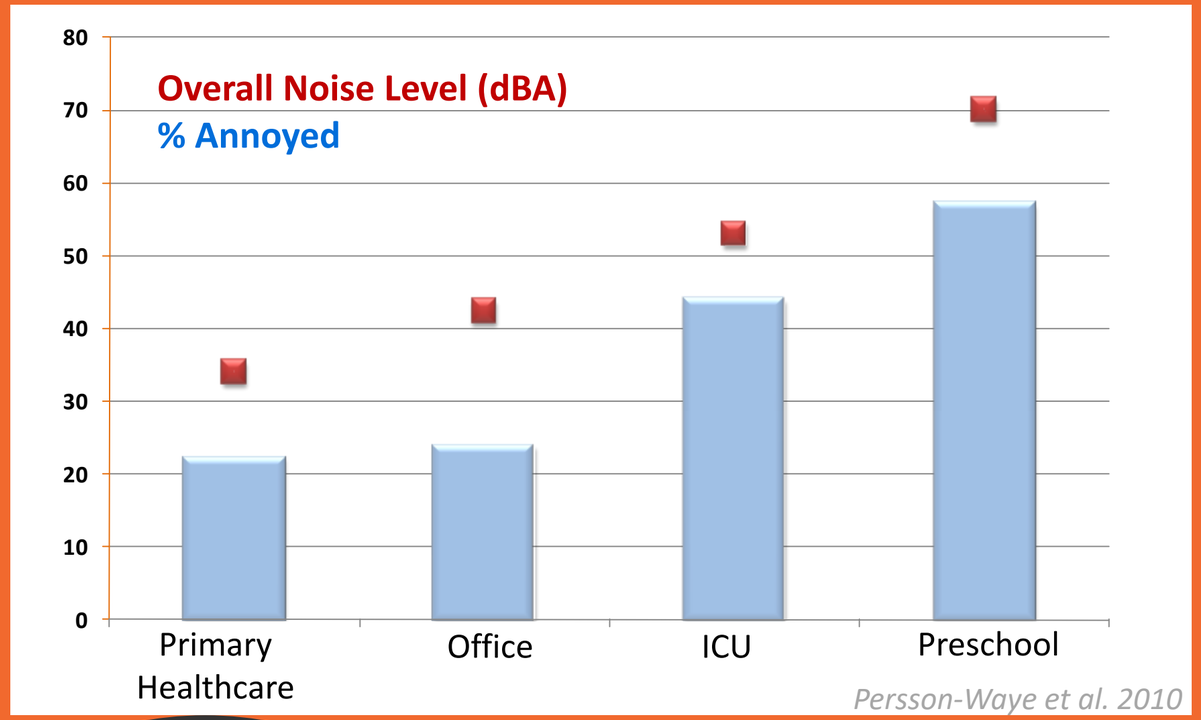


- *mood*
- *comfort*
- *health*
- *learning*
- *physical activity*
- *language development*

Some of these impacts we understand from other domains

- *performance*
- *concentration*
- *mood*
- *comfort*
- *health*

SOUND environment



Persson-Waye et al. 2010

Example Childcare Findings

26%

Children with noise doses higher than 85 dB

McLaren & Dickenson 2005

Childcare teachers had more voice disorders

(e.g., nodules, laryngitis)

Compared to hospital nurses

Södersten et al. 2002

THERMAL environment & INDOOR AIR QUALITY

Example Childcare Findings

CO_2 concentrations in childcare centers related to asthma & wheezing in children

Carreiro-Martins et al. 2014

Air conditioning design linked to:

rhinitis, phlegm, cough, respiratory health

Zuraimi et al. 2006

Lower air exchange rates linked to

more sick days

Kolarik et al. 2016

LIGHTING environment

Example K-12 Findings

Higher color temperature lighting positively impacts teacher perceptions of:

- alertness
- attitude
- energy level

Morrow 2018

Dynamic lighting helps support different activities throughout the day

Mogas-Recalde & Palau 2020

Daylight design impacts

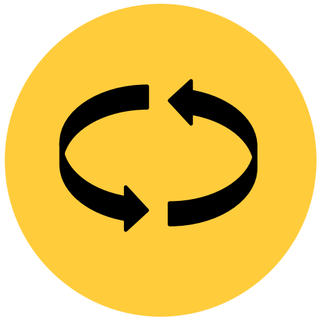
student performance

Baloch et al. 2021

Take Home Points

Literature Review

IEQ impacts children & providers



Few studies utilize holistic approach

More studies needed

Exploring Early Childhood Educators' Perceptions of Sensor Use

Purpose

Assess early childhood education and care (ECEC) professionals' willingness to accept and utilize sensor-based technology to measure different aspects of early childhood education and care quality

Explored use of the following sensors:

1) Indoor built environment (noise, thermal, light)
2) Children's behavior (language, physical activity
3) Multi-use (video cameras)

Mixed Methods Study

Total — ECEC Professionals Received Survey Link

Survey — 40 questions via Qualtrics

Interview — Semi-structured interviews

What are ECEC professionals' current experiences with sensors?

Survey Findings

Video cameras most often used

19%

Least used

Physical activity and noise sensors (2%)

Most interested in using noise sensors

58%

Interested in language, physical activity, noise, and adult-child interactions

Interview Findings

Use and perceptions of video camera use

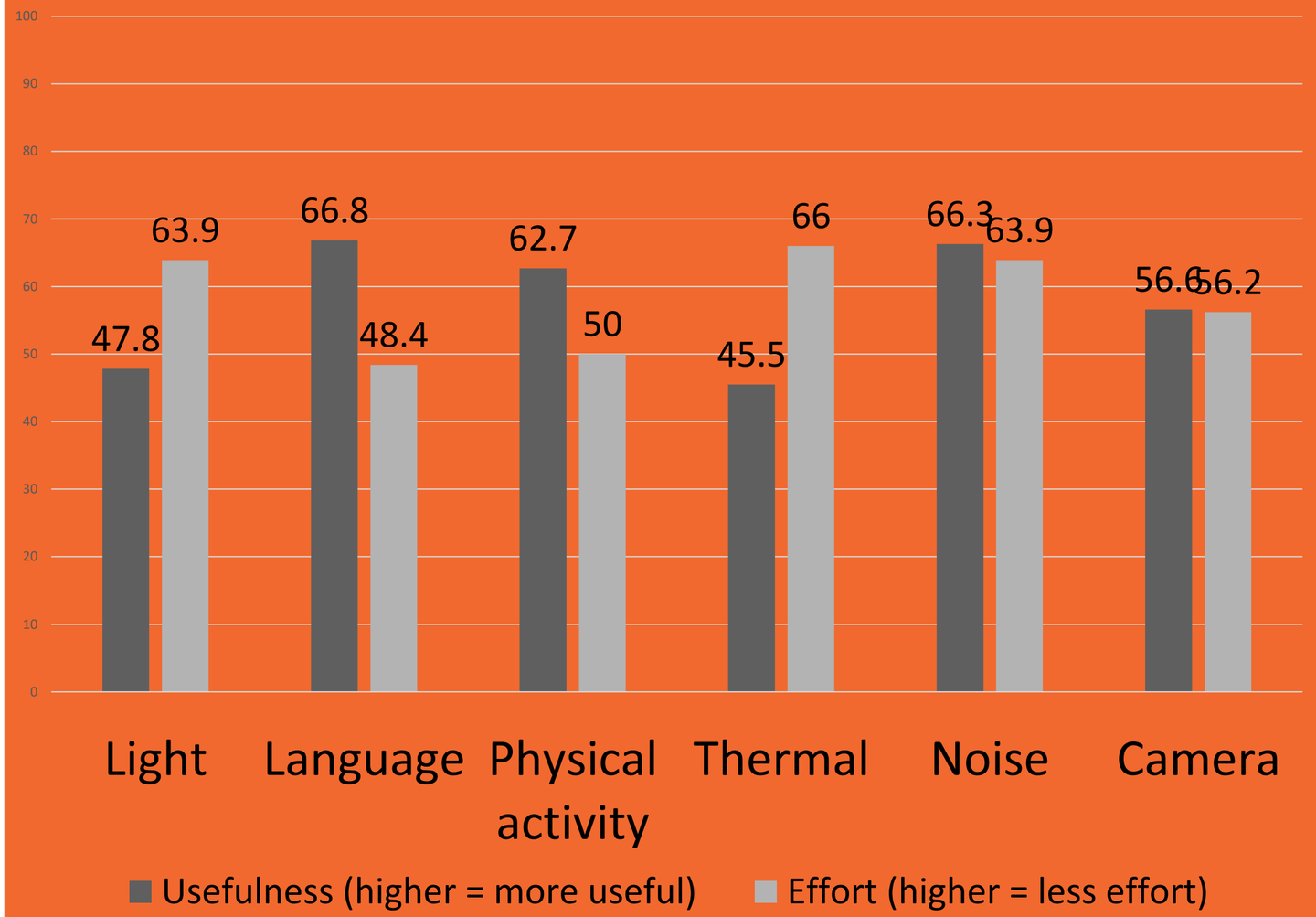
- 2 participants used continuous video monitoring, 1 as teaching tool
- Concerns of privacy and security

Desire for new assessments

- Wide range from child outcomes to interactions and social-emotional learning

What are ECEC professionals' perceptions of the use of sensors to measure aspects of quality within programs?

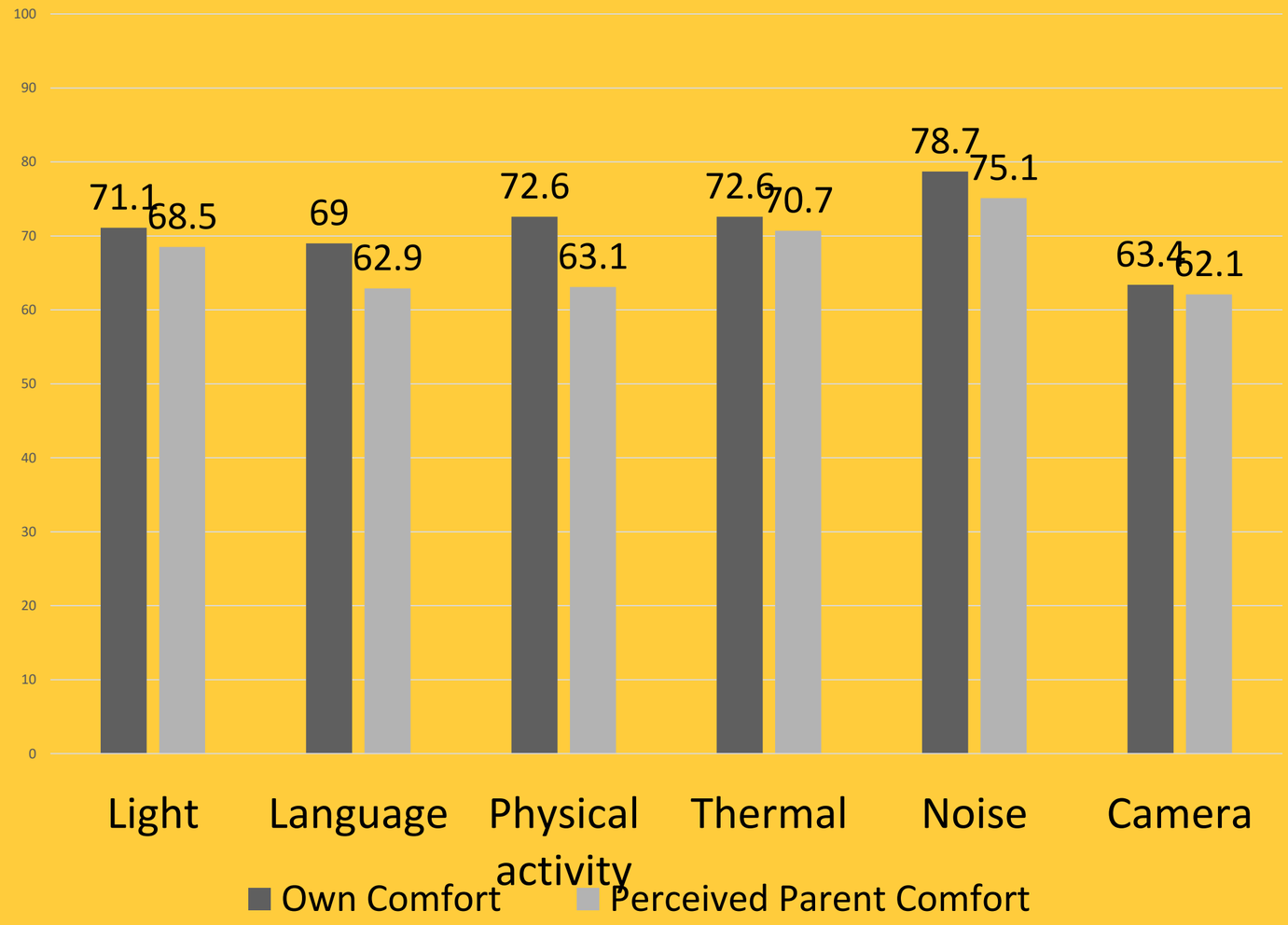
Survey Findings



Participants' mean ratings of the usefulness and effort needed for each sensor type.

What are ECEC professionals' perceptions of the use of sensors to measure aspects of quality within programs?

Survey Findings



Participants' mean ratings of their own comfort and perceived comfort of parents for each sensor type

Interview Findings

Perceptions of specific sensors

Light sensors

- Could be beneficial, some unsure of utility
- Parents would be supportive or indifferent

Noise sensors

- Would be beneficial
- Some concerns related to privacy and poor reflection of teaching practices
- Parents supportive w/ feedback

Thermal sensors

- Could provide important feedback, understand children’s behavior
- Some have lack of control
- Parents supportive

Interview Findings

Perceptions of specific sensors

Language sensors

- Could have positive impact
- Would require effort
- Concerns of privacy and data storage
- Parents perceptions varied

Physical activity sensors

- Would be beneficial
- Concerns related to distraction, privacy of data, additional effort (a little to a lot)
- Parents supportive w/ feedback

What do ECEC professionals feel is needed to support the use of sensors within programs?

Interview Findings

General privacy/security concerns

- Overall perceived minimal concern but communication key

General support needed

- Education of parents and ECEC professionals
- Differences between settings

Take Home Points

Educator Perception

There is interest

Communication is key

More studies needed

Initial Findings from Deploying a Sensor in an Early Childhood Setting

Purpose

Use what we learned from lit review + ECEC professionals to conduct a trial sensor deployment

Explore the sound environment via:

1) Noise sensor measurements
2) Provider perception surveys
3) Child behavior sensors (language)

Soundscape Study Components

Noise

Precision measurement of existing, ambient noise

Survey

7 questions via Survey Monkey

(11 respondents)

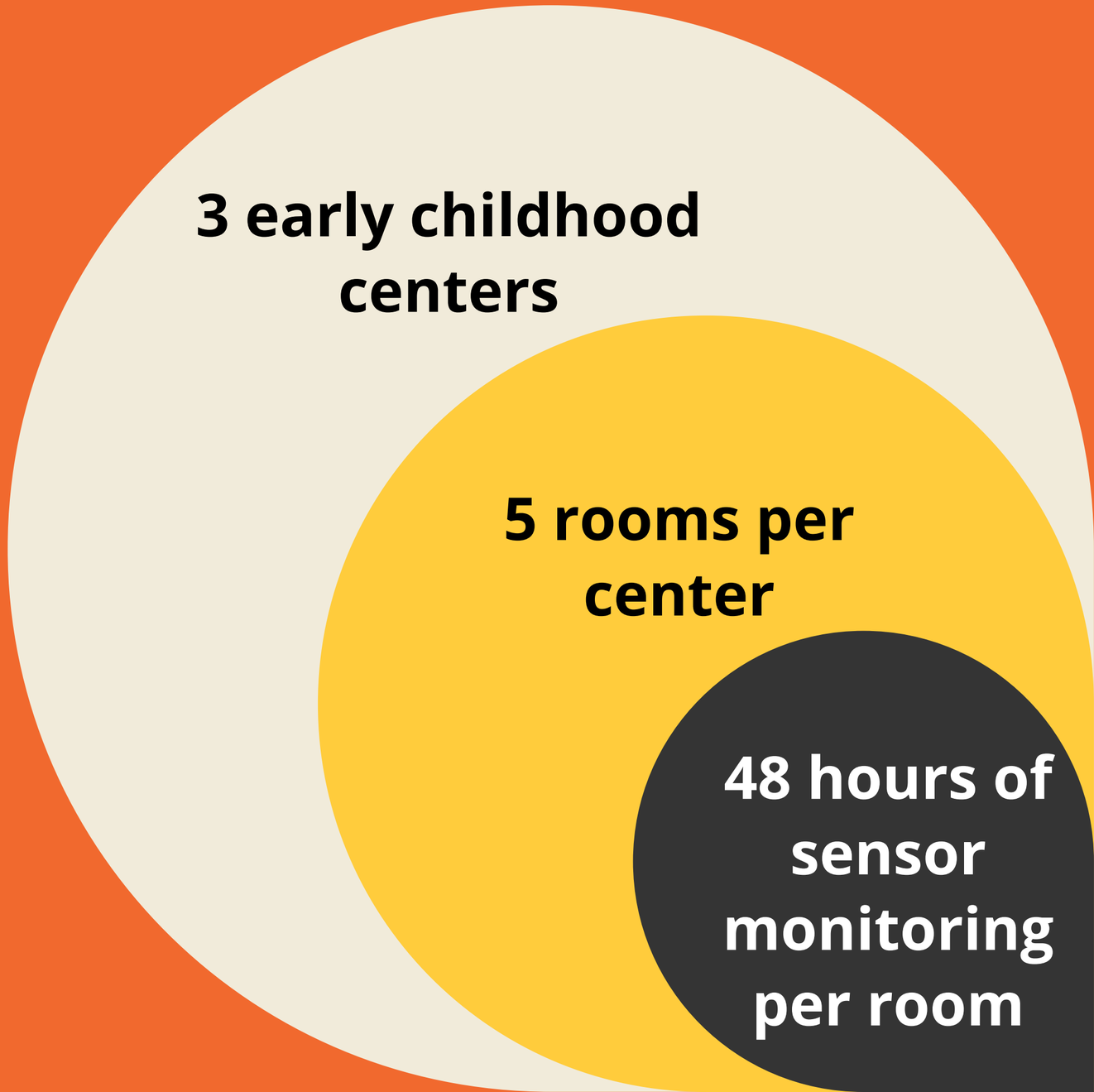
Language

Language data

(1 center)

Reports

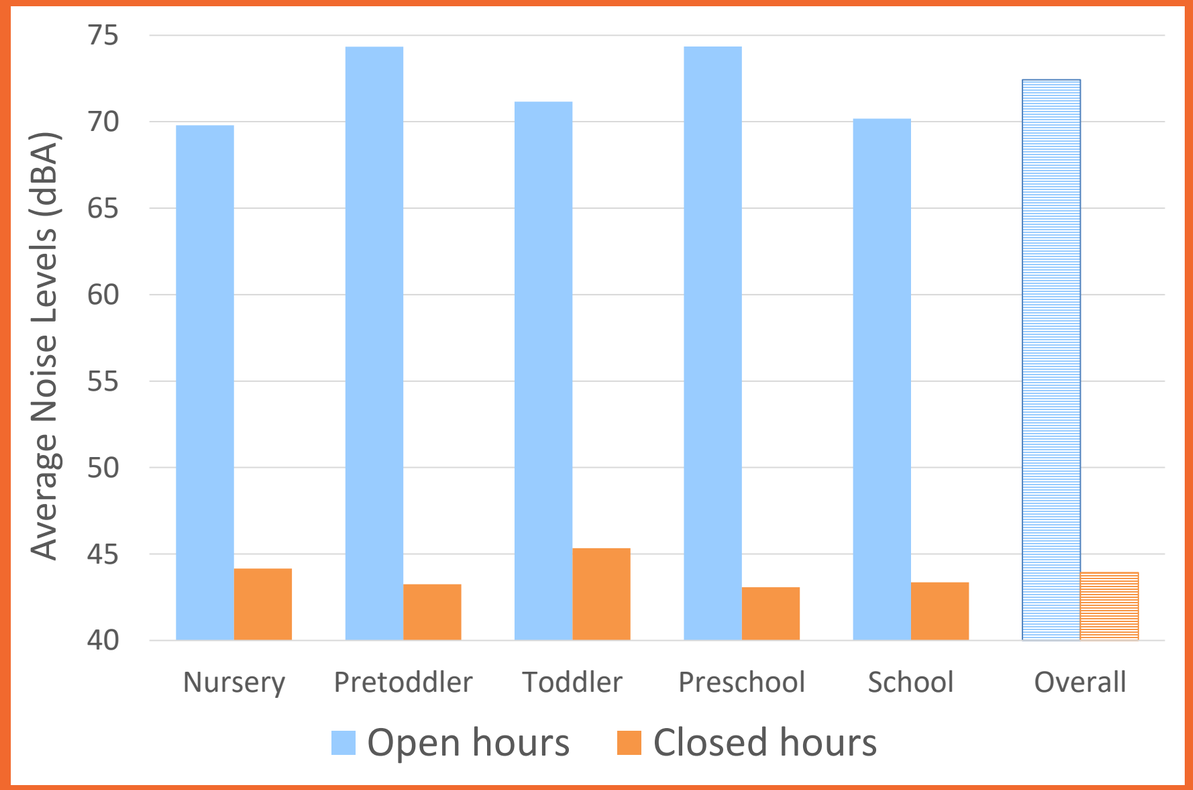
Feedback to care providers



Example Noise Findings

High average sound levels during open hours

- Range of 62 to 74 dBA across 3 centers

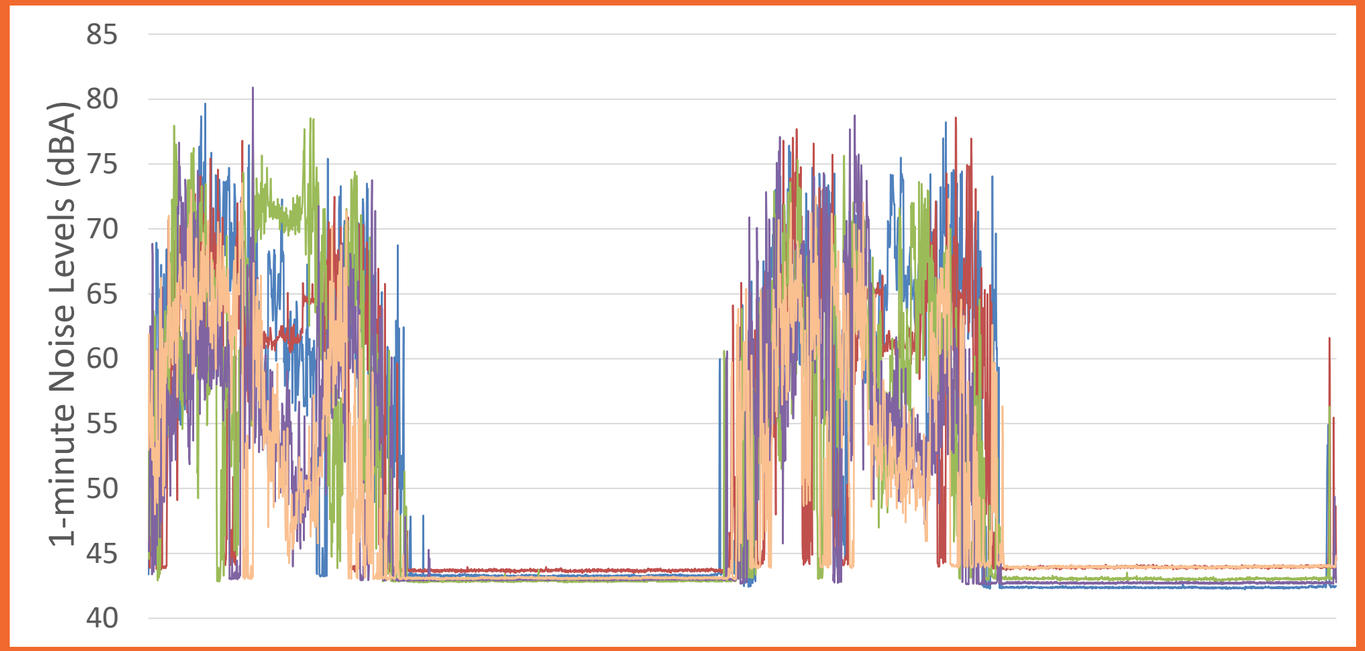


Example average noise data collected at a single center

Example Noise Findings

Large fluctuations over time

- Some patterns emerge, such as noticeable reductions during rest time in some rooms

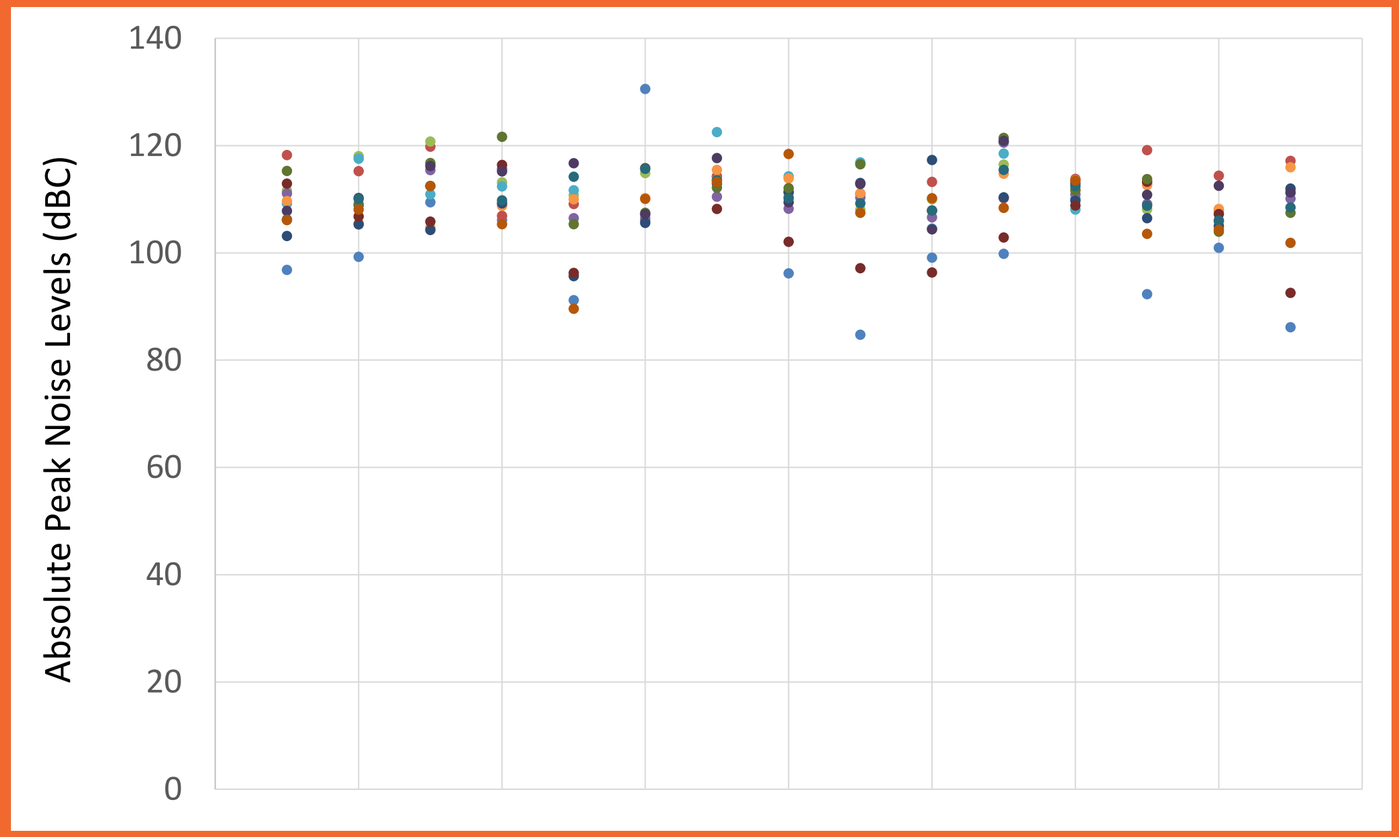


Example 1-minute average noise data collected over 48 hours
at a single center

Example Noise Findings

Some very loud peak events observed

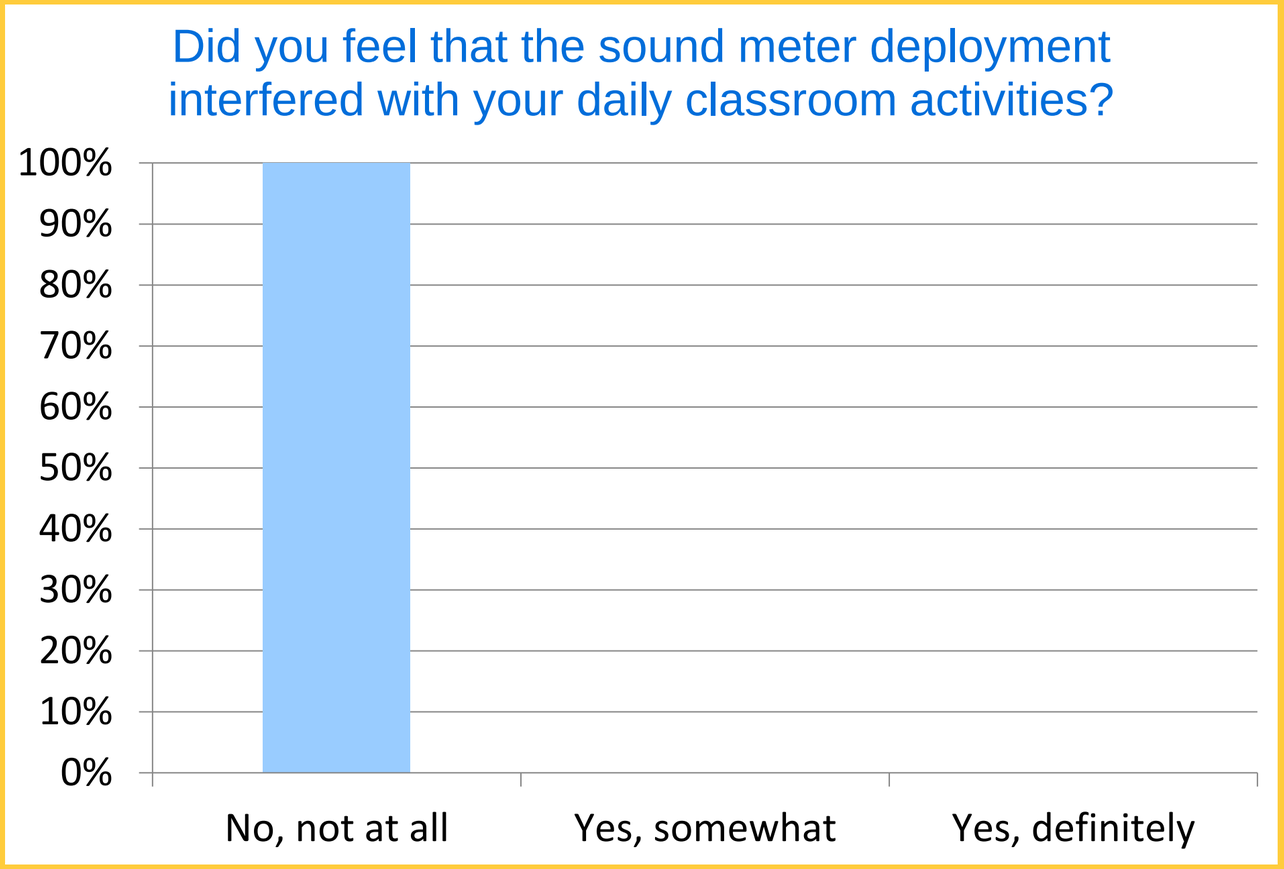
- up to 131 dBC



Example hourly peak noise data collected at all 3 centers

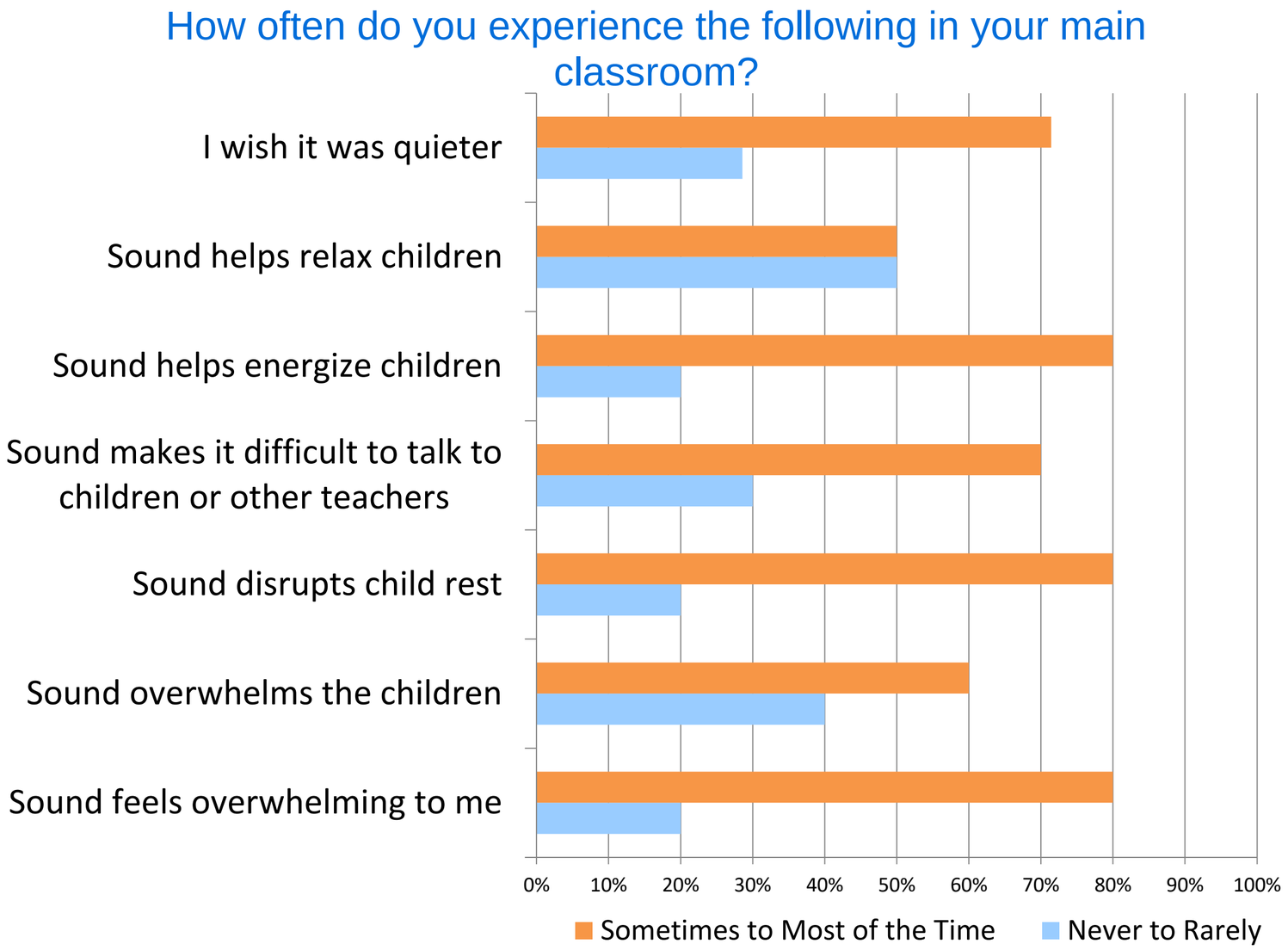
What are teacher's perceptions of the noise sensors?

Survey Findings



What are teacher's perceptions of the sound environment?

Survey Findings



Perceptions of sound environment

Survey Findings

Negative Aspects

- “the sound can get overwhelming at times”
- “When it gets loud, my kids talk louder to hear each other”
- “music used to distract or drown out noise at loud volumes often”

Positive Aspects

- “music helps them refocus & come together”
- suggest “using a sound machine or more natural sounds to help soothe, que or support transitions and emotions”

Survey Findings

Perceptions of sound environment

“I'm excited to look more into ways to help support teachers, students and kids to use sound the most effectively!”

Take Home Points

Sensor Deployment

Providers were excited about sensors

Sensors provide useful insights

Additional work ongoing

Conclusions

Sensors may provide new insights on childcare quality

Sensors can be easily deployed and can generate relevant data

Parents and teachers both open to exploring more fully

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