Understanding the Removal of Classroom Auditory Distractors: An Interactive Design

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Abstract

Students with a specific learning disability (SLD) have unique learning needs that must be met. Thus, it is imperative for teachers to incorporate flexible instructional materials, techniques, and strategies for academic progress to take place. One way teachers can be flexible is by allowing students with disabilities to take standardized (i.e. high stakes tests) in removed, quieter settings rather than the typical classroom. Therefore, this naturalistic inquiry study sought to understand what happens when noise reducing headphones were introduced to students, specifically those with SLD, in an elementary classroom. Student descriptions and perceptions of wearing headphones during a reading comprehension assessment indicated student participants seemed to enjoy the experience. Student explanations for this response focused on three principles: (a) internal (i.e. to help the individual internally), (b) external (i.e. to reduce external distraction), and (c) internal and external (i.e. to help the individual internally by reducing external distraction).

Keywords: Learning disability, classroom distractions, noise, classroom environment, qualitative, teacher education, accommodations

Understanding Potential Classroom Auditory Distractors: An Interactive Approach

According to the National Center for Education Statistics (2015), students with disabilities accounted for nearly 13 percent of all students served in U.S. public schools during the 2010-2011 academic year. Specific learning disabilities (SLD; 36%) make up the largest of the 13 categories identified in the Individuals with Disabilities Education Improvement Act (2004) with the next largest category being speech or language impairments (21%) (U.S. Department of Education, 2013a). Additionally, it is estimated that 2% of students in the United Kingdom (UK) have some form of learning disability (British Institute of Learning Disabilities, 2017), while it is indicated that 10-16% of students in Australia have learning difficulties (Learning Difficulties Australia, 2017). Students with SLD have distinctive learning needs (Igo, Riccomini, Bruning, & Pope, 2006) that must be met in order to assure students successfully progress in the general education curriculum.

It is essential for all teachers to recognize the varied needs of students with and without disabilities. For academic progress to take place it is imperative for teachers to meet the diverse needs represented in each classroom by incorporating flexible instructional materials, techniques, and strategies (CAST, 2009).Effective teachers acknowledge diversity and adapt their teaching methods according to individual student needs (Erten & Savage, 2012, p. 228) by providing choices, flexibility in groupings, and various teaching strategies. One way teachers can be flexible is by allowing students with disabilities to take standardized (i.e. high stakes tests) in removed, quieter settings than the typical classroom. Testing accommodations are changes in the testing procedures enabling students to demonstrate their knowledge without restrictions (Kettler, 2012). This process is employed to ultimately reduce the negative effect auditory distracters have on academic performance. Auditory distraction impedes all students' (e.g., with and without disabilities) performance and functioning.

Literature Review

Researchers have been studying effects of noise on physiology, psychology, social interactions, and academics since the early part of the twentieth century (e.g., Laird, 1927; Laird, 1929; Morgan, 1916; Morgan, 1917; Harmon, 1933; Poyntz, 1933). Morgan's (1917) seminal work first established the adverse noise effects on academic performance. Participants attempted to learn novel information in both noisy and quiet surroundings. Results from this study demonstrated that participants in noisy environments had shorter attention spans and were less likely to retain information. Researchers have replicated similar results indicating the negative effect of auditory distraction on learning.

The Negative Effects of Noise

In 2003, Shield and Dockrell conducted a comprehensive literature review on the effects of noise on children while in the school setting. Thus, a new literature review on noise and academic performance beginning with the year 2002 permitted the researcher of this study to "catch" articles not included in the most recent literature review by Shield and Dockrell. The new search yielded 13 articles, three of which were printed in either 2002 or 2003 and not in the Shield and Dockrell review. Results from this literature review demonstrated noisy environments impacted participants' (a) performance on academic tasks; (b) attention or ability to concentrate; and (c) memory or ability to recall information. Articles are grouped by these categories below.

Performance on Academic Tasks. Nine studies controlling the environments' noise level in various ways found significant changes in participants' ability to perform specific tasks such as reading comprehension, (Boman, 2004; Smith & Roccomini, 2013; Stansfield et al., 2005); arithmetic tasks (Dockrell & Shield, 2006), standard academic practice tests (Furnham & Strbac, 2002); computer generated cognitive tasks (Gumenyuk, Korzyukov, Alho, Escera, & Naatanen, 2004; Jamieson, Kranic, Yu, & Hodgetts, 2004; Soderlund, Sikstrom, & Smart 2007); picture word identification (Nelson, Kohnert, Sabur, & Shaw, 2005). Greater detail for each of these studies are presented below by specific cognitive tasks measured.

Reading comprehension was negatively impacted, in the study conducted by Boman (2004), when three auditory conditions (i.e., road traffic noise, meaningful irrelevant speech, silence) were present during reading assessments conducted with 96 children (age range=13-14). Findings from this study indicate that students processed material semantically when in the presence of traffic noise or irrelevant speech, reducing their ability to comprehend text. Similarly, reading assessments were given while 254 participants (i.e., participants with disabilities, n=52; participants without disabilities, n=202) were wearing and not wearing noise reducing headphones. Results indicated a positive correlation between test scores and noise reducing test accommodations for students with disabilities (Smith & Roccomini, 2013). Finally, Stansfield and colleagues (2005) found aircraft and road traffic noise had a significant negative effect on reading comprehension measured by standardized tests for 2844 children (i.e., ages 9-10, attending 89 schools).

Arithmetic performance of students with special needs was negatively affected, in Dockrell and Shield's (2006) study exploring the effect of noise on performance in the classroom. Three separate classrooms were randomly assigned to be used for one of three distinct noise conditions (a) *base*: no talking, no additional noise, (b) *babble*: noise consisting of children's babble, and (c) *babble and environmental noise*: children's babble plus intermittent environmental noise. Assessment measures were done on student completion of non-verbal tasks, verbal tasks, and arithmetic tasks. Results varied for both verbal task and arithmetic task completion. However, poor overall performance on non-verbal tasks was shown to be affected by noise conditions.

Standard academic tests (i.e., reading comprehension, prose recall, mental math) were were given while 66 participants (age, M=17) were exposed to typical city noises on CD, contemporary garage-style music on CD, and silence (Furnham & Strbac, 2002). Results demonstrated performance declined for introverts and extroverts on all tasks when in the presence of noise and music. Furthermore, there was no difference in performance tasks between typical city noises and music.

Three studies used a computer screen that presented pictures and/or directions to the participants (Gumenyuk, Korzyukov, Alho, Escera, & Naatanen, 2004; Jamieson, Kranic, Yu, & Hodgetts, 2004) while being exposed to typical sounds found in the environment (Gumenyuk, Korzyukov, Alho, Escera, & Naatanen, 2004; Soderlund, Sikstrom, & Smart 2007) or real-life classroom noise (Jamieson, Kranic, Yu, & Hodgetts, 2004). The 26 participants (age range, 8-13) were asked to ignore the sounds and respond to the tasks presented on the computer screen (Gumenyuk, Korzyukov, Alho, Escera, & Naatanen, 2004). Data was collected on performance tasks when noises were present as well as during silent phases. Results showed that auditory distractions, in the form of environmental sounds, increased reaction time and decreased performance accuracy (Gumenyuk, Korzyukov, Alho, Escera, & Naatanen, 2004). Similarly, 40 participants (age range, 5-8) sat in front of computers wearing headphones playing real-life classroom noise at typical auditory levels were simultaneously given directions to follow on the computer (Jamieson, Kranic, Yu, & Hodgetts, 2004). This study showed that children performed better while no noise was being played through the headphones. Results indicated the youngest participants, ages five and six, were more effected by the noise than older participants. Finally, 42 participants with ages ranging between nine to thirteen (Control group those without ADHD, *n*=21; participants with ADHD, *n*=21) were asked to perform cognitive independent verbal tasks while different levels of white noise found in the environment were presented via headphones (Soderlund, Sikstrom, & Smart 2007). Results from this study demonstrated white noise had a negative effect on cognitive performance on the control group with a positive effect on the ADHD group

Picture word identification was significantly decreased for both English speaking and English language learners (ELL) participants (*N*=22; ELL students, *n*=15; three classrooms) when exposed to classroom noise (Nelson, Kohnert, Sabur, & Shaw, 2005). Participants were given a list of spoken words in English during both noise and quiet conditions. The participants were then asked to match the word with the corresponding picture. Results of this study show auditory stimuli had no effect on student's on-task behavior.

Attention: The Ability to Concentrate. Two studies found attentiveness and concentration levels to be effected when noise level in the environment was manipulated (Fosnaric & Planinsec 2008; Norlander, Moas, & Archer, 2005). Twenty male participants (age, M=13) were exposed to an artificially created learning environment, called a "climate chamber", where sights, sounds, and climates were manipulated by researchers (Fosnaric & Planinsec 2008). Participants were presented with 360 measures during 18 different working combinations. Results indicated noise decreases work efficiency and increases stress levels. It was also shown that alterations to the physical environment affects attentiveness on cognitive exercises. Similarly, Norlander, Moas, and Archer (2005) examined noise, stress, and concentration levels in primary and secondary school children. Measures of noise levels in five primary and secondary classrooms were given before and after the implementation of a short, consistent exercise and relaxation program. Overall results indicate reduced noise levels in classrooms where students took part in the exercise and relaxation program (Norlander, Moas, & Archer, 2005). Results from a teacher questionnaire showed students in the experimental group had an increase in concentration level.

Memory: The Ability to Recall Information. Three studies explored the effects of different noise sources and sound levels on long-term recall (Elliot, Bhagat, & Lynn, 2007; Hygge, 2003; Hygge, Evans, and Bullinger, 2002). In the first study, a computer, computer software (i.e., Cool Edit and E-Prime), and Radio Shack headphones were used to assess performance on immediate span task and serial recall (Elliot, Bhagat, & Lynn, 2007). This study was conducted with 1358 children (age range, 12-14). The computer program Cool Edit handled the onset and offset of irrelevant sounds. The computer program E-Prime selected digits one through nine for the immediate span task and serial recall procedures (Elliot, Bhagat, & Lynn, 2007). Results demonstrated that irrelevant sound disrupts memory performance significantly for all children. Similarly, Hygge (2003) conducted ten noise experiments (single and combined), presented for 15 minutes per experiment, in the children's ordinary classrooms, during silent reading, and followed up one week later with an assessment. Results from this study indicate significant negative effects of noise on recognition and long-term recall (Hygge, 2003). The third study, tested 326 students between the ages of eight to 12 (participants living near the old airport, *n*=108; participants living near the new airport, *n*=218) while living away from and in the region of an airport due to the study taking place before and after construction of the new airport (Hygge, Evans, & Bullinger, 2002). Attention and speech perception was tested using evidence-based assessments; memory was tested using a national standardized reading test. Results demonstrated (a) reading and long-term memory were lessened for the group at the new airport, (b) reading, long-term memory, and short-term memory increased for the group at the old airport, and (c) speech perception was lessened at the new airport (Hygge, Evans, & Bullinger, 2002). Results from this study emphasize the damaging impact living in an area with large amounts of aircraft traffic has on learning.

Summary of Literature Review

Researchers in the field of cognitive psychology and education have demonstrated the negative effects of noise on academic performance for almost a decade. The information gained from previous research is significant and critical to this research because it shows how reducing auditory distractions in the educational setting could increase academic performance. Furthermore, a beneficial insight to both student and teacher would be qualitative research focused on how people behave when they are captivated by life experiences occurring in natural settings (Lincoln & Guba, 1985), of students' experience using noise reducing headphones as a test accommodation in the real classroom.

Typically, qualitative research is motivated by the researcher's curiosity and excitement about a specific topic (Moustakas, 1994). The current research study stems from the author's previous positive experience using noise reducing headphones as a student. Therefore, this study sought to understand what happens when headphones were introduced to students with and without disabilities, in an elementary classroom. Thus, exploring student descriptions and perceptions of wearing headphones during a reading comprehension assessment.

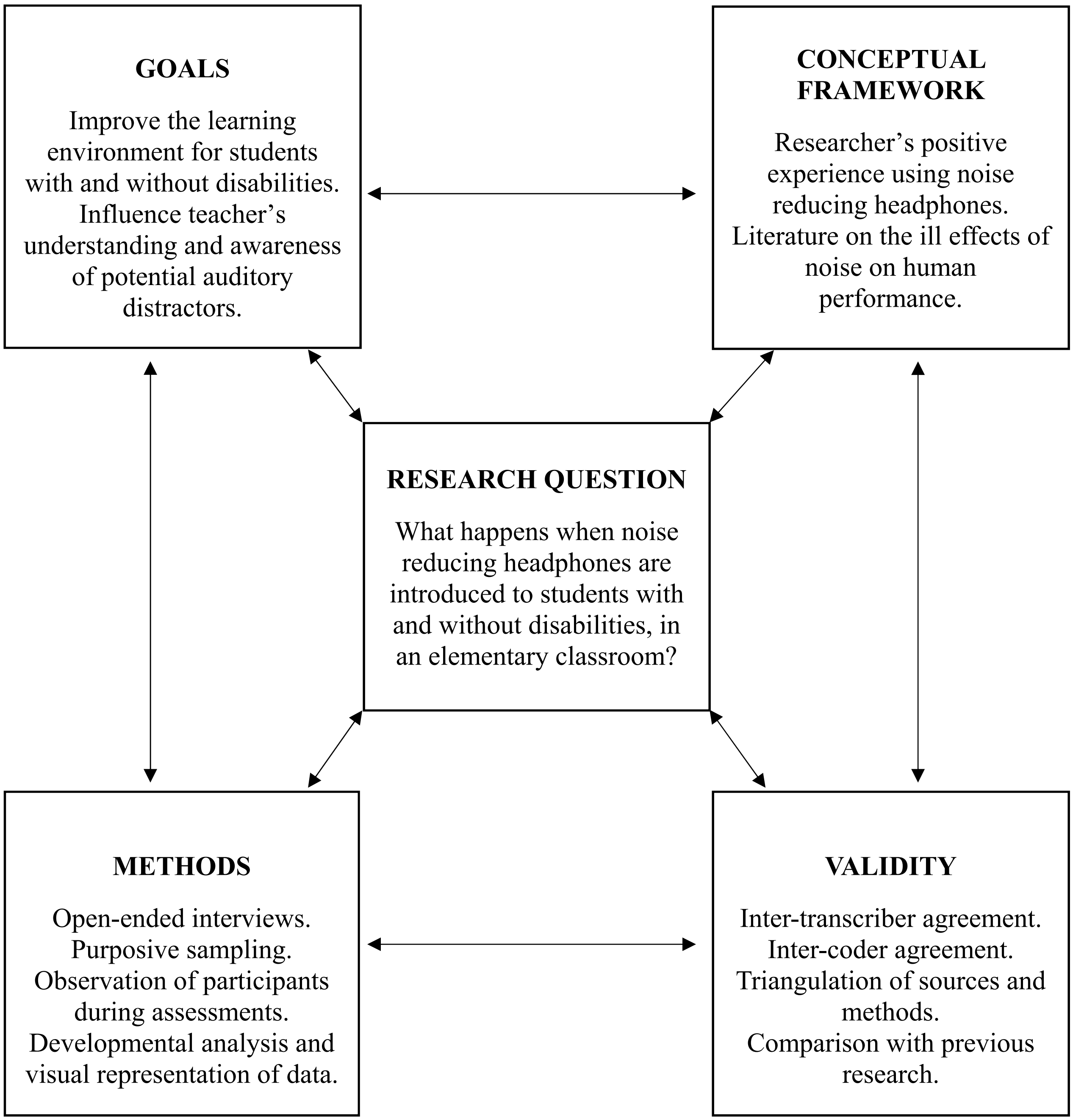

Figure 1. An Interactive Research Design Model.

**Adapted from Maxwell (2005).*

Method

This qualitative inquiry was a part of a large mixed-methods study exploring how noise reducing headphones used as a testing accommodation effected a reading comprehension assessment for elementary students with and without disabilities. Quantitative results were analyzed and disseminated separately. Qualitative research is distinguished by three assumptions. One is a holistic view of "situations in their uniqueness as part of a particular context and interactions" occurring there (Merriam, 2002, p. 5). Two, the researcher must be involved in order to understand a phenomenon (Merriam, 2002). Finally, the researcher seeks a thorough description of the phenomena so hypotheses can be generalized.

An Interactive Approach

Researchers followed Maxwell's (2005) *Qualitative Research Design: An Interactive Approach* that utilizes an interconnected and flexible structure to conduct qualitative research. The five components of this "Interactive Approach" include (a) developing goals for the study, (b) using a conceptual framework, (c) developing research questions, (d) designing the methods of the study, and (e) assuring processes are in place to ensure validity (Maxwell, 2005). However, the relationship between each of the components mentioned above are critical because they are closely linked to each other. See figure one for an example of the five components specific to this study. All five components of the Interactive Approach are embedded throughout the Method and Results sections.

Participant Demographics

To achieve maximum variation, twenty-four students were purposively selected to participate in interviews for this qualitative inquiry, mirroring the participants sampled in the quantitative component (i.e. students represented two schools, all three grades, and all four groups). Table 1 presents demographic variables for all participants. As was the case in the quantitative study, over half of all students selected to take part in the interviews were eligible for free or reduced lunch status (n=15). Also similar to the quantitative study, general education students (n=13) represented the largest group interviewed, and students with other disabilities (n=2) embodied the smallest number of participants.

Table 1
Qualitative Participant Demographics

	General Education	At-Risk	Learning Disabilities	Other Disabilities	All Groups
N	13	4	5	2	24
Gender					
n Female	6	2	3	1	12
Grade Level					
n 3rd	3	1	1	0	5
n 4th	4	1	2	1	8
n 5th	6	2	2	1	11
Reading Level					
Mean	5.00	4.37	3.06	3.09	4.36
SD	1.67	.618	.687	.664	1.50
Range	1.4-8.7	3.7-4.9	2.1-4.0	3.4-3.5	1.4-8.7
Lunch Status					
n Free	6	2	3	1	12
n Reduced	3	0	0	0	3
n Pay	4	2	2	1	9

Data Collection Procedures
Twenty-four elementary students were given two reading comprehension assessments each lasting five to twenty minutes. Each student was afforded the opportunity to wear the headphones during one of the two assessments. The primary researcher observed participants while taking the assessment and collected interview data after the assessments were administered. As Bogden and Biklen (2007) recommend, qualitative researchers should conduct all investigations in the natural setting. Therefore, the interviews took place in the hallway directly outside the classroom where the researcher presented this question "Would you choose to wear the noise reducing headphones during class if you were allowed to do so?" and a follow up question of "Why?" or "Why not?"

Observations of participants. The primary researcher observed participants during the assessment phase of this study. As previously stated, all participants took a reading comprehension assessment in their natural classroom environment. The primary researcher entered the classroom and (after a brief introduction) randomly selected students to wear noise reducing headphones during the first assessment. After the first assessment, students that were not chosen to wear the headphones during the first assessment were afforded an opportunity to do so during the second assessment. As recommended by Maxwell (2005), the primary researcher kept a written log (e.g. notes) of the observations (what was seen and heard). Observational data is presented in the results section below (see: participant specifics).

Interview transcriptions. Following the conclusion of the larger mixed-methods, the researcher transcribed all of the interviews utilizing the Olympus VN-6000 Digital Recorder and Microsoft Word via a laptop. Each of the 24 interviews were listened to, and transcribed in their entirety. Playback of interviews occurred until the researcher was confident all data was transcribed accurately. A trained doctoral student listened to 12 interviews (50%) to ensure accuracy; inter-transcriber agreement on transcription accuracy was achieved (100%), as both the researcher and doctoral student transcribed identical data. Inter-coder agreement was also achieved (100%); both the researcher and trained doctoral student developed similar topics and supporting statements.

Data Analysis Procedures
After all of the data was transcribed verbatim, the researcher began analyzing the data to (a) develop emergent themes, (b) refined codes, (c) developed code definitions with examples, and (d) compare relationships between codes. The next step was to code the data so the evidence reflected increasingly broader perspectives. Thus, the researcher began to highlight significant statements (quotes) that provided an understanding of how the students experienced the phenomenon of wearing the headphones. From the 24 interview transcripts, significant statements were extracted and topics were developed. This coding process is the main categorizing strategy in qualitative research (Maxwell, 2005).

Results

Three topics were developed from 24 significant statements extracted from the transcriptions. The three topics identified were internal, external, and both internal and external. Statements describing students' ability or inability to focus, concentrate, or think were coded as internal. For example, an internal code was assigned to the quote "I could focus more. I think it helped me." Statements describing how the noise reducing headphones reduced noise and sound both positively and negatively were coded as external. An external coded statement was, "People are always talking and making noise." Finally, statements describing the students' level of concentration, distraction along with mention of noise and sound being reduced were coded as both internal and external. An internal and external code example was, "It would keep the noise out, and I would have no interruptions. I can hardly concentrate when the class is noisy." The topics along with the best supporting statements representing the essence of the topics can be found in the Comparison Matrix (Table 2). The organizing framework for this qualitative component culminates in a comparison matrix; the qualitative data are displayed and visually represented in a manner allowing others to easily compare statements coded for each topic. The use of a matrix helps to display the logical connections between the research questions and the analysis of the data (Maxwell, 2005).

Table 2
Comparison Matrix

Topic	Answer	Significant Statements
Internal	Yes	"It keeps me focused on my work, not anyone else."
	Yes	"I could do better on my test than I do now."
	Yes	"I could focus more. I think it helped me."
	Yes	"I could concentrate more, get better grades."
	Yes	"It makes me focus better, it makes me want to stay on-track whenever I'm reading and writing."
	Yes	"I could concentrate better, and listen better, and get my work done faster."
	No	"It was hard to think about"
External	Yes	"People are always talking and making noise."
	Yes	"It blocks out all of the sound."
	Yes	"Sometimes other people are so loud."
	Yes	"If someone else is talking when you are going your work, you won't be able to hear them."
	Yes	"I liked not hearing people read out loud. They bother me."
	Yes	"Other kids make noise."
	Yes	"The other people in the class, they be loud."
	No	"I like talking to Jessie, and if I wore the headphones I would not be able to hear what she says."
Internal and External	Yes	"So I can't get distracted by other things. I sit next to the window and the heater, and I always get distracted by them."
	Yes	"It would keep the noise out, and I would have no interruptions. I can hardly concentrate when the class is noisy."
	Yes	"I usually get distracted and in trouble because of the people around me."
	Yes	"It's like if you're taking a test, and somebody right beside you is making noise, and you wanna get them out of your head, you could just put on the headphones."
	Yes	"It helped me do better because a lot of people talk in class. It would drown out distractions and I kind of get distracted real easy."
	Yes	"I usually get distracted by other things, and the headphones would make me focused."
	Yes	"People make a lot of noise, and I can't concentrate."
	Yes	"I hate sitting next to people. They are always noisy, and I can't get anything done."
	No	"Sometimes the people around me help with my work."

Participant Specifics

Observations of participants included: (a) students visually pleased (e.g. facial expressions) when selected to wear the headphones, (b) students visually displeased when not selected to wear the headphones, and (c) clear physical signs of amusement and wonder (e.g. facial expressions) when placing the headphones on for the first time. Additional information regarding: (a) group category, (b) reply, (c) grade level, (d) reading level, and (d) assessment score is provided in Table 3. Interestingly, two of the three students that answered, “No” to the question, “Would you choose to wear the headphones during class if you were allowed to do so?” scored better when wearing the headphones. Conversely, six of the 21 students that replied, “Yes”, scored worse when wearing the headphones. These findings are imperative, especially when taking into consideration whether or not to allow students to make their own decision when choosing a specific learning or test-taking accommodation.

Table 3
Participant Specifics

Category	Reply	Grade Level	Reading Level	Assessment Score W/O Headphones	Assessment Score W/ Headphones	Score Difference
Gen. Ed.	Yes	3	4.9	8	6	-2
Gen. Ed.	Yes	3	1.4	3	3	0
Gen. Ed.	Yes	3	1.4	3	3	0
SLD	Yes	3	3.3	4	6	2
At-Risk	Yes	3	3.7	4	4	0
Gen. Ed.	Yes	4	5.2	6	7	1
Gen. Ed.	Yes	4	3.9	6	6	0
Gen. Ed.	Yes	4	3.3	2	3	1
Gen. Ed.	Yes	4	6	6	7	1
Gen. Ed.	Yes	4	5.5	6	6	0
SLD	Yes	4	2.9	2	3	1
SLD	Yes	4	2	0	0	0
At-Risk	Yes	4	2.6	4	5	1
Other	Yes	4	3.1	6	1	5
Gen. Ed.	Yes	5	8.7	7	7	0
Gen. Ed.	Yes	5	5.9	4	3	-1
Gen. Ed.	Yes	5	5.6	7	6	-1
Gen. Ed.	No	5	3.4	2	7	5
Gen. Ed.	No	5	4.7	6	6	0
Gen. Ed.	No	5	4.9	4	6	2
SLD	Yes	5	2.1	4	1	3
SLD	Yes	5	5	4	5	1
At-Risk	Yes	5	5	8	4	-4
At-Risk	Yes	5	4.9	0	1	1
Other	Yes	5	3.4	0	0	0

Note. Gen. Ed.=General Education; SLD=Specific Learning Disability; Other=Other Disability
W/=With; W/O=Without

Summary
From the interview data, overall findings indicate student participants seemed to enjoy the experience of wearing the headphones, and taking part in the study. The replies to the proposed question, "Would you choose to wear the noise reducing headphones during class if you were allowed to do so?" followed by "Why?" or "Why not?" were answered by a total of 24 elementary students. Twenty-one of the 24 students that participated in the interviews responded with a, "Yes." Student explanations for this response focused on three principles: (a) internal (i.e. to help the individual internally), (b) external (i.e. to reduce external distraction), and (c) internal and external (i.e. to help the individual internally by reducing external distraction).

Discussion

Findings from the current study indicate that many more students preferred to use (n=21) the noise reducing headphones during a reading comprehension task than students who did not (n=3). Additionally, students' preference to use the headphones revolved mostly around the idea that they believed the reduction in noise helped them better preform the task (e.g., keeps me focused, could concentrate, and reduces distraction). The headphones were used in a whole class setting during a routine reading comprehension task and were overwhelmingly positively received by the students. Interestingly, some students that scored better while not wearing the headphones would still choose to wear them if given the opportunity to do so.

Another important finding of this current study is what students did not say; no students reported that while wearing the headphones, it was too quiet and attributed the lack of noise for performing poorly on the task. This is interesting for at least two reasons: (1) not all students performed better using the headphones (n=8 scored the same), and (2) some students actually performed worse using the head phones (n=5 scored worse). Since, students were not provided feedback on the completion of their tasks (i.e., scores with and without headphones), students perceived experiences of using the headphones do not necessarily match their performance (n=13). This finding could be explained because the sample in this study purposefully targeted students with learning disabilities and those students at-risk; student with learning difficulties as a group are often are not effective at self-regulating their own learning. This ability to demonstrate self-regulation awareness is connected to improved performance; in other words, students who are more strategic learners will perform better than non-strategic learners (see Berkeley & Riccomini 2013; Garner & Alexander, 1989; Pressley & Ghatala, 1990).

From a teaching and learning perspective, this finding has important implications for teachers. A major responsibility of educators is to improve student performance, it is central to their effectiveness as a teacher that they properly match students learning needs to activities or accommodations in this case. This idea of an appropriate match was also evident in the quantitative aspect of this project (see Smith & Riccomini, 2013) where the overall findings demonstrated a positive impact on student performance, but it also demonstrated that not all students benefited from the use of the headphones. A main recommendation from the larger empirical study was to determine who might benefit from the use of the headphones. The findings from this qualitative inquiry further extends the importance of this determination [of who might benefit] being made in a systematic way by the teacher and not necessarily by allowing the student to make the determination (i.e., choice).

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