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How Children with and without Hearing Loss Describe Audiovisual Content

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ABSTRACT

The main objective of this study was to explore the benefits of the use of educational audio-visual materials in facilitating learning for students with hearing loss. The study analysed whether students with hearing loss had a visual learning preference when they watched an audio-visual and if the images present contributed to the retention of more information by this group. The study sample was made up of 28 participants, from 7 to 9 years old, of whom 14 had prelingual hearing loss and 14 were age- and sex-matched students without hearing loss. They were all schooled together in general education classrooms in an oral modality. They were asked to watch an educational video and then to describe its contents orally. The results obtained from analysing the references to the video content indicate that, despite the fact that the hard of hearing group made greater reference to video content transmitted from the images than the group without hearing loss, the effect does not achieve statistical significance. The study reinforces the idea that deafness does not determine a specific learning preference.

KEYWORDS

Audiovisual material; documentary; education; hearing loss; images; language; learning; subtitles; video

Introduction

We are now in the so-called digital era, with communication technologies taking on ever-greater importance by facilitating new ways of transmitting information. In the field of education, the incorporation of new technologies into the classroom has brought about new resources for teaching. This is the case with the use of audiovisuals, which, when properly used by teachers, can effectively complement other means of acquiring academic content (Baadte, 2019) and can even become essential in certain contexts, such as in the case of lockdowns imposed during the Covid-19 pandemic, during which knowledge could only be transmitted online.

The incorporation of these new audio-visual resources has generated investigation into the benefits of their use both for acquiring academic content in distinct disciplines and for understanding the information transmitted by mass media (Chan, 2000; Lawlor & Prothero, 2003; Nikken & Peeters, 2009; Quain, Bokunewicz, & Criscione-Naylor, 2018). Paul and Wang (2012) highlighted the importance of the role of adults as learning facilitators, since they can control viewing by pausing the image, and by discussing and

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reviewing content to facilitate students' understanding of the information. Likewise, studies such as those by Jones and Cuthrell (2011) and Beltrán-Pellicer, Giacomone, and Burgos (2018) highlighted the role of the teacher in the critical selection of videos with educational value.

Audio-visuals, specifically those of an educational nature, do not merely motivate and facilitate learning (Hidayat, Gunarhadi, & Hidayatulloh, 2017; Shepherd & Madelon, 2015); they also improve students' linguistic competence (Bickham, Wright, & Huston, 2001). In the case of students with hearing loss, it has been proposed that congenital hearing loss can favour certain modes of receiving information (Marschark, Morrison, Lukomski, Borgna, & Convertino, 2013). However, these students have different experiences depending on their technological and educational conditions, and their mode of communication (Marschark et al., 2015). Studies on how children with hearing loss benefit from audio-visual aids can guide us towards more individualised assistance of subgroups within the population.

Knowledge of the use of audio-visuals in the education of students with hearing loss is of special interest both from the point of view of facilitating access to information (Cambra, Silvestre, & Leal, 2008), and from the point of view of supporting language acquisition (Golos & Moses, 2013; Mueller & Hurtig, 2010), as well as facilitating the exploration of distinct learning modes within this group (Knoors & Marschark, 2014). A certain controversy has been created with respect to students with hearing loss that revolves around the question of preference for visual learning. It could be conjectured that this group, due to neuroplasticity, compensates for lower auditory acuity by relying on vision, as they are better visual learners than students without hearing loss. However, as Knoors and Marschark (2014) pointed out, this is not always the case. One of the reasons given by Bavelier, Dye, and Hauser (2006) to explain why this is not a generalised fact in the population with hearing loss is the heterogeneity present within this group. Nikolaraizi, Vekiri, and Easterbrooks (2013) pointed out that it is precisely this diversity that should lead to the development of different instructional programs for students with hearing loss, according to their specific characteristics within the learning process. The authors conducted a study of 8 students with severe to profound prelingual hearing loss, aged 7–12 years, using an educational platform of videos and audio-visual material for improving reading comprehension. It was found that these students lacked strategies to exploit visual resources efficiently. These results are consistent with those of who, with a larger sample of 30 children with severe or profound hearing loss and a median age of 11 years, also found no evidence that people with hearing loss have better visual memory than people without hearing loss.

Although some studies have assessed the effect of the use of still images on the reading comprehension of students with hearing loss (Al-Hilawani, 2008; Reynolds & Rosen, 1973; Robbins, 1983; Walker, Munro, & Richards, 1998; Wilson & Hyde, 1997), there are very few studies that have analysed the utility of educational audio-visual materials as a complementary resource in the education of students with hearing loss who receive instruction in an oral modality. Kelly's study of adult learning (1998) investigated whether a sequence of actions presented on video could facilitate the understanding of written sentences. The sample comprised 11 adults with severe-to-profound prelingual hearing loss (8 adults were female and 3 were male), parents without hearing loss and no additional disabilities. Their ages ranged from 18 to 37 years. In the study, they

had to choose between two sentences that best represented the sequence of actions seen in the video. The results indicated that the context of the video facilitated comprehension in participants with a good reading level, while those who were not good readers did not do as well.

Previous studies coincide in deeming the use of visual educational material relevant to the facilitation of learning for students with hearing loss; however, more recent studies question the assertion that these resources are useful for all such students. In a 2017 study, Marschark et al. stated that it cannot be assumed that students with hearing loss are stronger visual learners than students without hearing loss. 102 students with hearing loss (50 of them used CIs) and 21 students without hearing loss participated in the study. Over 65% of the CI users and over 90% of the non-users indicated that they were skilled enough to have a natural, signed conversation about social and school topics. Ten of the 21 students without hearing loss indicated that they had varying levels of sign-language skill. Results indicated that relying more on visual information than on auditory input does not automatically *transform* people with hearing loss into visual learners, nor does it do so for those who use oral language to communicate or for those who use sign language. In fact, the students with hearing loss that were interviewed stated that they did not consider themselves to be more visually skilled than students without hearing loss.

In a previous study of 175 first-year university students, of whom 106 were students with hearing loss (51 were CI users and 55 were students with hearing loss who did not use CIs) and 69 were students without hearing loss, Marschark et al. (2015) have already shown, on the basis of three visual-spatial cognitive tasks, that students with cochlear implants did not differ significantly from students without cochlear implants. The authors found that not only were there no differences between the two groups of students in solving these visual-spatial tasks, but also that the participating students without hearing loss performed as well as – and even better than – the students with hearing loss. The results did not support the assumption that individuals with hearing loss are visual learners or are superior to individuals without hearing loss across a broad range of visual-spatial tasks.

In short, taking into account that individuals with hearing loss are potential beneficiaries of audio-visual media, it is surprising that – in the current era of the predominance of images and audio-visual media – there are so few studies that have explored how this group interprets these in everyday situations.

The present study aimed to deepen the understanding of the learning processes of the students with hearing loss that use spoken language by studying the references that they make to educational audio-visual content depending on whether it is transmitted visually, through images, or verbally, through language. The objectives of the study were as follows:

(1) To analyse the quantity and diversity of content retained from the educational audio-visuals by students with hearing loss and students without hearing loss.
(2) To explore differences between the two groups in information selection in the oral description of the educational audio-visual, depending on whether presentation of content in the audio-visual is predominantly visual or verbal.

(3) To verify the reading speed of the students with and without hearing loss and to ascertain its relationship with the description of the educational audio-visual.
(4) To analyse differences in the description of the audio-visual according to age, sex and hearing status, and in the case of students with hearing loss, in relation to the effective hearing threshold achieved with their prostheses (hearing aids or cochlear implants).

Methodology

Participants

The study was carried out with participants from the province of Barcelona, a region within the Autonomous Community of Catalonia. Catalonia has its own language, which is Catalan; throughout Catalonia, this is co-official with Spanish (the official language of Spain). For the past three decades, the Catalan education system has applied linguistic immersion in Catalan-language education to all schools. This means that the language of instruction is Catalan and all children, both those with hearing loss and those without, learn to read and write in this language, regardless of the language they speak at home.

As for the modality of schooling for students with special educational needs, school inclusiveness has been implemented since the 1980s, with specific extracurricular support resources. In Catalonia, students who are deaf or hard of hearing have the support of Educational Resource Centres for the Hearing Impaired (CREDA). These centres are responsible for providing speech-therapy attention to students with hearing loss in their own schools. The study was carried out with the collaboration of three CREDAs in the province of Barcelona.

The sample consisted of 28 participants. The group of students with hearing loss comprised 9 girls and 5 boys, aged 7–9 years, with prelingual hearing loss (deafness prior to language acquisition) and no other associated deficits. The group without hearing loss was made up of 14 students of the same age and sex as the group of students with hearing loss. This group was chosen by the teacher in order to represent typical development and an oral linguistic competence equivalent to the average level of the whole class. Of the group of participants with hearing loss, 10 children wore hearing aids and 4 used cochlear implants. Their effective hearing threshold (EHT) with prostheses ranges between 15 dB and 35 dB. All of these students had hearing parents, used oral language to communicate and were enrolled in regular schools with students without hearing loss; they followed the school curriculum without adaptation.

Material

The study used an audiovisual documentary on dolphins obtained from Channel 33 on the Catalan TV network (https://www.ccma.cat/tv3). 110 seconds long, the video was broadcast in Catalan, the language used in the participants' schools, and was subtitled word for word in synchrony with the voiceover (see appendix).

Additionally, because the video was presented with subtitles, the reading speed subscale of the standardised and scaled test used in Catalonia was selected to determine participants' reading ability. This test is the *Proves Psicopedagògiques d'Aprenentatges*

Table 1. Results of the reading speed test (Canals, 1991) for both groups.

Participant	Participants WITH hearing loss	Participants WITHOUT hearing loss
1	4	6
2	6	3
3	5	3
4	3	2
5	2	6
6	3	4
7	3	4
8	7	3
9	5	3
10	4	7
11	10	3
12	3	3
13	2	3
14	5	5

Instrumentals (Canals, 1991).[1] The reading speed test consists of reading a text for one minute and counting the number of words read. For each academic level, the test contains a distinct text appropriate to the school year and age of the readers. The instructions are that the child should read as accurately as possible and should not stop. Based on the total number of words read, typical scores are obtained for each academic level, with 5 as the average score (see Table 1).

Data-Collection Procedures

The video was shown in each child's school, in individual sessions in a quiet room. Participants were told that they would watch a video and, at the end of the screening, that they would then have to describe it. The instructions given to them were: 'Now you'll be shown a video; watch it carefully because you will have to describe it to me afterwards'. After each participant described what they had seen in the video, they were thanked for their participation in the study, but were not asked any questions.

The activity was filmed from the moment the video was shown until after the child had described it. Descriptions were transcribed and classified into distinct categories, as detailed in the Results section.

Data Analysis

Non-parametric statistics were performed due to the low number of cases. The Mann-Whitney U test was used for comparing scores between groups of participants with and without hearing loss, comparisons between sexes, or between types of prostheses. The Friedman test was used for comparison between blocks within the same group, and the Wilcoxon test was used for related samples when comparing the differences between verbally and visually transmitted content.

The Fisher exact test for 2×2 tables was used to compare references made by individuals with and without hearing loss in each one of the items. To analyse the relationship between reading speed and EHT with the number of references performed, a scatter plot was applied and the Spearman correlation ρ was calculated.

Results

Analysis of oral explanations given by the participants after viewing the audiovisual was carried out by counting the number of references to its content in accordance with the following thematic blocks: a first block containing the definition of dolphins as mammals; a second block containing the physical characteristics of dolphins; and a third block indicating various details about dolphin behaviour.

Additionally, the way in which content was transmitted was also taken into account in each block. This could be either by exclusively linguistic means, through voiceover and subtitles, (termed 'verbal transmission of content'); or through video images in addition to linguistic means (termed 'visual transmission of content').

The first block consisted of two items (D1 and D2). These two contents were transmitted verbally and provide information about the dolphins' condition as mammals, explaining how they breathe. The second block consisted of six items (F1-F6) describing the physical characteristics of dolphins: skin type, hearing, eyes, teeth, nose and distinct fins. These were all visually transmitted content, with the exception of item F2, which referred to the dolphins' hearing. The third block consisted of three items (T1-T3) referring to how the dolphins move, what they eat and what they like to do. All three of these items were transmitted visually. Each of these items was scored with a value of 0 or 1, depending on whether or not it was correctly mentioned by the participants.

In accordance with the objectives proposed in the study, the results obtained are described below:

(1) Scores obtained in the group of students with and without hearing loss, both for the amount and diversity of content retained from the audio-visual.

The total scores obtained by each group were compared using the Mann-Whitney U test; results indicated that the group of children with hearing loss obtained an average number of references to the video content that is lower than the group without hearing loss (xx = 3.71 and xx = 4.07), although these differences are not significant (U = 85; $P > .05$). When we compared the references that the participants with and without hearing loss made to the content of the video using Fisher's exact test, we obtained the results shown in Table 1.

Insert (Table 2. Percentage of references for each item by hearing status).

Table 2. Percentage of references to each item by hearing status.

VARIABLE	% references Participants without hearing loss	% references Participants with hearing loss	Sig, bilateral	Sig, unilateral
D1	50,0%	21,4%	,236	,118
D2	57,1%	57,1%	-	-
F1	21,4%	7,1%	,596	,298
F2	0%	0%	-	-
F3	14,3%	7,1%	>,500	,500
F4	28,6%	35,7%	>,500	,500
F5	14,3%	21,4%	>,500	,500
F6	35,7%	50,0%	,704	,352
T1	**57,1%**	21,4%	,120	,060
T2	42,9%	57,1%	,706	,353
T3	85,7%	92,9%	>,500	,500

The results showed no significant differences in the number of references produced by the two groups. However, it can be observed that participants with hearing loss made more references to items F4, F5, F6, which describe certain physical characteristics of the dolphins (teeth, nose and fins), and to items T2 and T3, which describe what dolphins eat and their other behaviours. In contrast, 50% of participants without hearing loss classified dolphins as mammals (D1), more often than was the case for the participants with hearing loss (21%). Of the items referring to physical characteristics, students without hearing loss more frequently mentioned the skin and eyes of the dolphins (F1 and F3, respectively). Finally, statistical analysis performed with Fisher's exact test showed no significant difference in the description of the dolphins' group movement (T1), although a trend towards significance was observed ($P = .060$).

Two aspects to highlight in these results are the coincidence in percentage (57%) of references to item D2, which described how dolphins breathe, and the lack of reference by either group to item F2, which refers to the dolphins' hearing. Both audio-visual items were transmitted verbally.

As shown in Figure 1, the intra-group comparison indicated that, in terms of the number of references in each block, participants with and without hearing loss behaved in the same way and followed the same pattern: the information in the third block of behavioural traits (T1-T3) was the most retained, followed by the information contained in items D1-D2 – first block – on the definition of dolphins as mammals, and finally the information on physical characteristics (F1-F6) was the least mentioned – second block.

Insert (Figure 1. Percentage of references from participants with and without hearing loss by content block).

According to Friedman's test, differences between references in one or another block were significant in each of the groups ($P = .001$ in the group of participants with hearing loss and $P = .019$ in the group of participants without hearing loss).

Comparison of the number of references made by each group with respect to the three thematic blocks showed that the average number of references by the group without hearing loss in the first verbal block (D1 and D2) was xx = 1.07 and in the group with hearing loss was xx = 0.78. In the second and third blocks, with a considerable amount of information transmitted through images, differences between the two groups were minimal. In the second block, the average for references in the listener group was

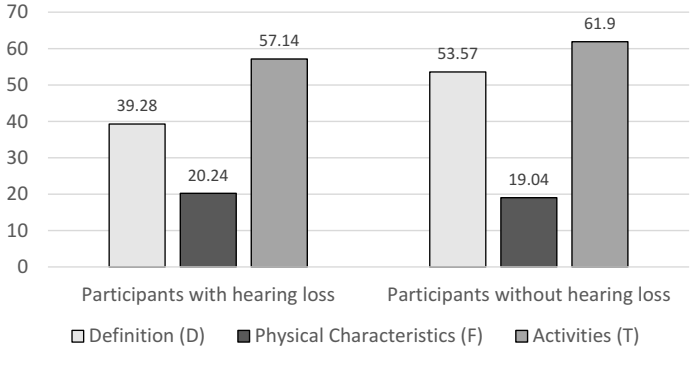


Figure 1. Percentage of references from participants with and without hearing loss by content blocks.

xx = 1.14, and xx = 1.21 in the group with hearing loss. In the third block, the participants without hearing loss obtained an average of xx = 1.85, while that of the participants with hearing loss was xx = 1.71 Use of the Mann-Whitney U test indicated that there are no significant differences in any of the cases between the means obtained.

(2) Selection of information when giving an oral description depending on whether visual or verbal transmission is predominant in the audio-visual.

In the group of participants with hearing loss, the percentage of references to visually transmitted content (xx = 32.53) was higher than the percentage of references to verbally transmitted content (xx = 26.19). In the group of participants without hearing loss, the opposite behaviour was observed: the percentage of references to verbally transmitted content (xx = 35.71) was higher than the percentage of references to visually transmitted content (xx = 33.33). In no case was comparison of means with the Wilcoxon test significant.

(3) Relationship between reading speed of students with and without hearing loss and description of the audio-visual.

As the video was presented with subtitles, the influence of participants' reading speed on the description of the video was evaluated. In the group of participants with hearing loss, the higher the reading speed, the lower the number of content items explained, although this relationship is not significant (Spearman's Rho = −.421; P = .134); on the other hand, in the group of students without hearing loss, no correlation between these two variables was observed.

(4) Differences in the description of the audio-visual by participants' age and sex and, in the case of students with hearing loss, correlation between EHT and access to the information in the audio-visual.

In order to ascertain whether participants' age influenced the oral explanations of the video, the Mann-Whitney U test was applied to compare the average number of references among the 7-, 8- and 9-year-old age groups, obtaining non-significant results. If we take the mode of transmission of the information into account, we can see in (Table 2) that the older the participants with hearing loss, the more references they made to verbally transmitted content (33.33%), and the fewer references they made to visually transmitted content (16.67%). The opposite process occurred with participants without hearing loss.

Insert (Table 3. Relationship between participants' age and references to content transmitted verbally or visually in the video).

However, the gender variable established differences in the group of participants without hearing loss, with girls making fewer references to visually transmitted content (29.63%) than boys did (40%) and more references to verbally transmitted content (44.4% average percentage of references for girls and 20% for boys). On the other hand, in the case of participants with hearing loss, girls made more references to visually transmitted content (34.57%) than boys did (28.89%). In both cases, application of the Mann-Whitney U test revealed that the differences are not significant.

Table 3. Relationship between participants' age and references to the verbal and visual contents of the video.

	Deafness	Age	VERBAL REFERENCES	VISUAL REFERENCES
Average	No	7	41,6667	33,3333
		8	37,5000	33,3333
		9	16,6667	33,3333
		Total	35,7143	33,3333
	Yes	7	25,0000	33,3333
		8	25,0000	36,1111
		9	33,3333	16,6667
		Total	26,1905	32,5397
	Total	7	33,3333	33,3333
		8	31,2500	34,7222
		9	25,0000	25,0000
		Total	30,9524	32,9365

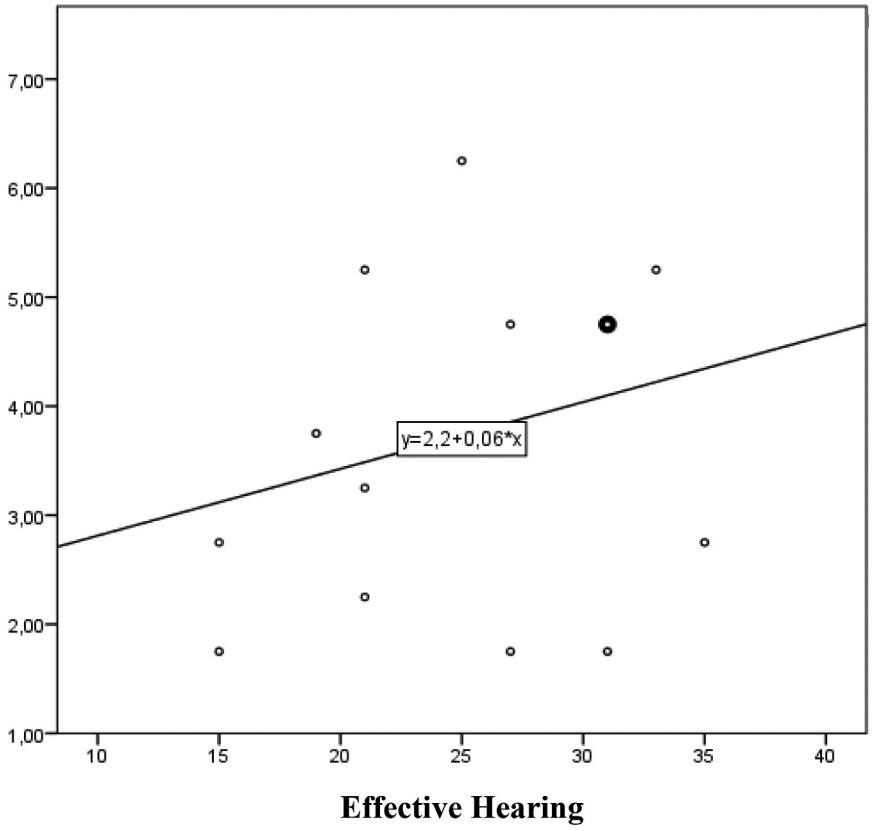


Figure 2. Scatter plot with regression line between EHT and total number of references to the video.

To determine the influence of EHT on oral explanations of the video, a Spearman correlation was applied (Rho = .299; *P* = .298). As can be seen in Figure 2, there is a weak direct relationship between the two variables: the higher the EHT, the more the content was retained.

Insert (Figure 2. Scatter plot with regression line between EHT and total number of references to the video).

The type of prosthesis (cochlear implants or hearing aids) did not show significant differences when comparing the number of total references, according to the Mann-Whitney U parametric test (U = 14,500, P = .255).

Discussion

This study is a contribution to a little-explored line of research on how students with hearing loss who are taught in regular schools in an oral modality deal with an educational audiovisual. The main objective was to explore the benefits of the use of audiovisuals in facilitating learning, and to ascertain whether there was a visual learning preference in the group of students with hearing loss.

In broad terms, after watching the documentary, participants with hearing loss incorporated 33.75% of the content transmitted in the video into their explanation, whilst the percentage for participants without hearing loss was 37.01%. The first conclusion of this study is that, although audio-visual documents should be promoted as a learning tool, the low percentage of content explained by the participants after watching the video shows the need for additional resources to optimise retention of the transmitted content. For certain authors, there is a need to make an adequate selection of audio-visual material according to specific given content such as mathematics (Beltrán-Pellicer et al., 2018). Other authors have pointed out that it is important to have the intervention of an adult facilitator to improve retention of the subject matter, as indicated by Paul and Wang (2012).

In relation to the second objective concerning whether learners with hearing loss have a primarily visual learning preference, the results of this study – both in the sample and through the material studied – did not support the conclusion that children with hearing loss exhibit a stronger visual learning preference than other children (Marschark et al., 2017). Although it is true that participants with hearing loss included a lower number of references than the participants without hearing loss did in their oral explanations, it is interesting to note that selection of content by topic block followed the same pattern in both groups. Indeed, for some content, the scores between both groups were the same. In this sense, the score for the item related to hearing is particularly striking; this is verbally transmitted content that was not complemented by any image, and which was not retained by either group. The interpretation of this result is not easy. It might be expected, due to the condition of people with hearing loss, that this item would have a more *special* meaning for the participants with hearing loss than for the group without hearing loss. Or also that by being transmitted verbally it would not be perceived by this first group. However, a possible reason common to both groups could be that, since the documentary did not explain the function of hearing in dolphins nor was this information visible, they simply did not consider it important.

However, there were also differences in the content retained by each group. It was observed that the children without hearing loss in the sample retained verbally transmitted video content in a way that was equal or superior to their peers with hearing loss; in turn, the participants with hearing loss retained more visually transmitted video content.

Despite the fact that the participants without hearing loss referred more to verbally transmitted content than the group with hearing loss, and that this latter group referred more to visually transmitted content (which would indicate that they need more

reinforcement through images than the group without hearing loss), the results did not show any statistically significant difference. Therefore, the fact that the group with hearing loss did not differ significantly in their preferences from the group without hearing loss further reinforces the idea that deafness does not determine a specific, preferably visual, learning mode (Marschark et al., 2017).

Consequently, these results coincide with those found by Marschark et al. (2015), which showed that the visual-spatial skills required in a type of geometric learning are not influenced by deafness. The results of the present study allow us to complement the conclusions of these authors by studying another type of knowledge, expressed more figuratively, which does not so directly involve visual-spatial skills. The non-significant differences obtained in the present study can also be attributed, among other reasons that are commented on below, to the nature of the content presented in each study and also to sample size.

However, in agreement with Bevelier, Dye & Hauser (2006), it is possible that in the population of students with hearing loss, distinct learning preferences may be found due to the heterogeneity of their development, deriving from a combination of multiple influential factors. This obliges us to be particularly cautious when assigning a certain visual or non-visual learning preference to the group of students with hearing loss as a whole.

A clear difference not taken into account in this study (as it includes oral-language participants), and which can certainly be influential on learning processes, is the use of sign language. Our results are therefore not greatly comparable with studies found in our review of the literature that included participants who use sign language, or even with those studies that used still images rather than audio-visual material, as is the case with studies by Reynolds and Rosen (1973), Robbins (1983), Al-Hilawani (2008) or Mohd Hashim and Tasir (2020).

This study has been limited to considering the following factors: type of prosthesis (hearing aids or cochlear implants), reading speed, age and sex. The results show that type of prosthesis (cochlear implant or hearing aid), did not influence the references to visual- or verbal-content. In fact, there was little variability in the EHT depending on the type of prosthesis, which indicates that participants were fitted with the appropriate prostheses for their degree of loss. These results concur with a recent and important contribution made by Marschark et al. (2017) showing that there was no difference between students fitted with implants or hearing aids with respect to preference for visual over verbal information.

As regards the relationship among factors common to the entire sample, that is, both the group without hearing loss and the group with hearing loss (reading speed, age and sex), the same correlations have not been found. Thus, while there was no relationship between reading speed and number of references for participants without hearing loss, it was observed for the participants with hearing loss that those with a higher reading speed tended to recall fewer details from the audio-visual. These results are consistent in the population without hearing loss since the information given in the documentary was transmitted simultaneously through voice-over and subtitles and, therefore, it is assumed that such a population would not have to resort to reading the subtitles. However, observations from the results in the students with hearing loss raise questions about the importance of the reception of non-verbal information from an audio-visual presentation which is hard to represent in a figurative way, but is essential for understanding the message better (Cambra, Penacchio, Silvestre, & Leal, 2014).

In relation to the variables of age and sex, contrasting behaviours have been observed in the groups with different hearing statuses. As for age, in the participants with hearing loss, as age increased, more references were made to verbally transmitted content than to visually transmitted content; the opposite occurred in the participants without hearing loss. It could also be expected that for the group with hearing loss, as oral and written language acquisition progresses with age, the amount of verbally expressed content would increase. In the case of the group without hearing loss, however, progress in reading did not have an impact, since they perceived this content orally and the process of oral-language acquisition occurs very early. With respect to sex, whilst girls with hearing loss made more references to visually transmitted content than was the case for boys with hearing loss, the opposite held for girls without hearing loss. This fact, which does not show significant differences, is another element that prevents interpretative assumptions.

In summary, the results of the study provide important insight into the creation of audio-visual material designed to improve education for students with hearing loss.

First, the documentary presented was equally effective for all participants' learning, irrespective of hearing status, showing no differences with regard to the acquisition of knowledge. Despite this, some results should be highlighted, such as the fact that the participants with hearing loss retained the verbal information about the classification of dolphins as mammals at a lower rate than the participants without hearing loss. This suggests that some of the children with hearing loss might require a visual complement to the linguistic terms, because of their level of abstraction, which can make them more difficult to understand. It will be necessary, however, to consider the diversity that the group of children with hearing loss presents in the development of language when creating documents adapted to such diversity (Duchesne, Sutton, & Bergeron, 2009).

Second, although the study showed that participants with hearing loss, and especially younger girls, continued to show greater dependence on visual information than on that provided verbally, they cannot be considered visual learners on this basis, since the differences between this group and the group without hearing loss were not significant. In terms of total items of information retained, both groups followed the same pattern of preferences. This indicates that, in the case of the students with hearing loss studied – i.e. a group that communicates orally – we are currently witnessing a significant process of decreasing differences with respect to students without hearing loss.

Despite its limitations, the most important of which undoubtedly is the size of our sample, this is a study that, for its ecological value – since the data are obtained from an audio-visual fragment extracted from a television program without having been manipulated – provides complementary results to those obtained in other studies through indirect observations such as questionnaires, scales or tests in experimental situations.

In light of this, and in accordance with the results of this study, it is clearly interesting to promote the use of audio-visuals for all students. Furthermore, the use of an instructional programme adapted to a specific learning mode for students with hearing loss is not necessary (Nikolaraizi et al., 2013), since it has not been demonstrated that this group exhibits different preferences for visual or verbal learning than the group without hearing loss.

However, analysis of students' behaviour when faced with the same documentary may allow the discovery of distinct learning tendencies within the same group of students with hearing loss. Moreover, this is an aspect that has been observed according to age and probably depending on their level of development of spoken language. Indeed, it should be taken into consideration that the younger the students, the more dependent they will be on visual information, especially students with hearing loss.

In conclusion, this study provides data supporting the lack of evidence for a learning preference characteristic of students with hearing loss and distinct from their hearing peers. The study opens new lines of research into how the group of individuals with hearing loss, particularly in the context of an oral educational modality presents heterogeneous learning. Our aim is to advance knowledge of new teaching strategies adapted to those differences presented by individuals.

Note

1. Educational Psychology Instrumental-Learning Tests

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Ethical Procedures

All families, both of the children with and without hearing loss, were informed in writing of the objective of the research and gave their signed consent for their children to participate in the study, following regulations established by the Ethics Committee for Human and Animal Experimentation at the Universitat Autònoma de Barcelona (UAB, 2020). In this informed assessment, families were assured that their childrens' answers and our video recordings would remain anonymous.

Disclosure Statement

No potential conflict of interest was reported by the author(s).

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Appendix A. The dolphin documentary

Dolphins live under water, but they are not fish, they are mammals. Under water they hold their breath. They need to poke their head out of the water in order to breathe, or otherwise they would die. Dolphins have soft, velvet-like skin. They also have very acute hearing which helps them find their way around. Their eyes are small and they only use their teeth to fish or to get food. They breathe by pushing the air out of their lungs and through a hole called the spiracle. These are their pectoral fins which help them stay balanced in the water. This is their dorsal fin. And this is their caudal fin, which they move up and down to swim and jump. Dolphins like living in groups. Mothers don't separate from their babies until they are 4 or 6 years old. They eat fish. They love sardines. But what they like most is singing, playing with the hoop, doing flips, jumping and saying hi.