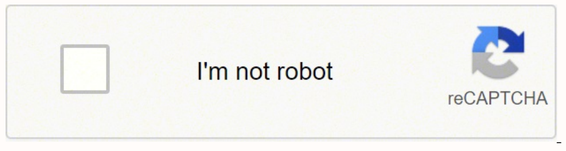

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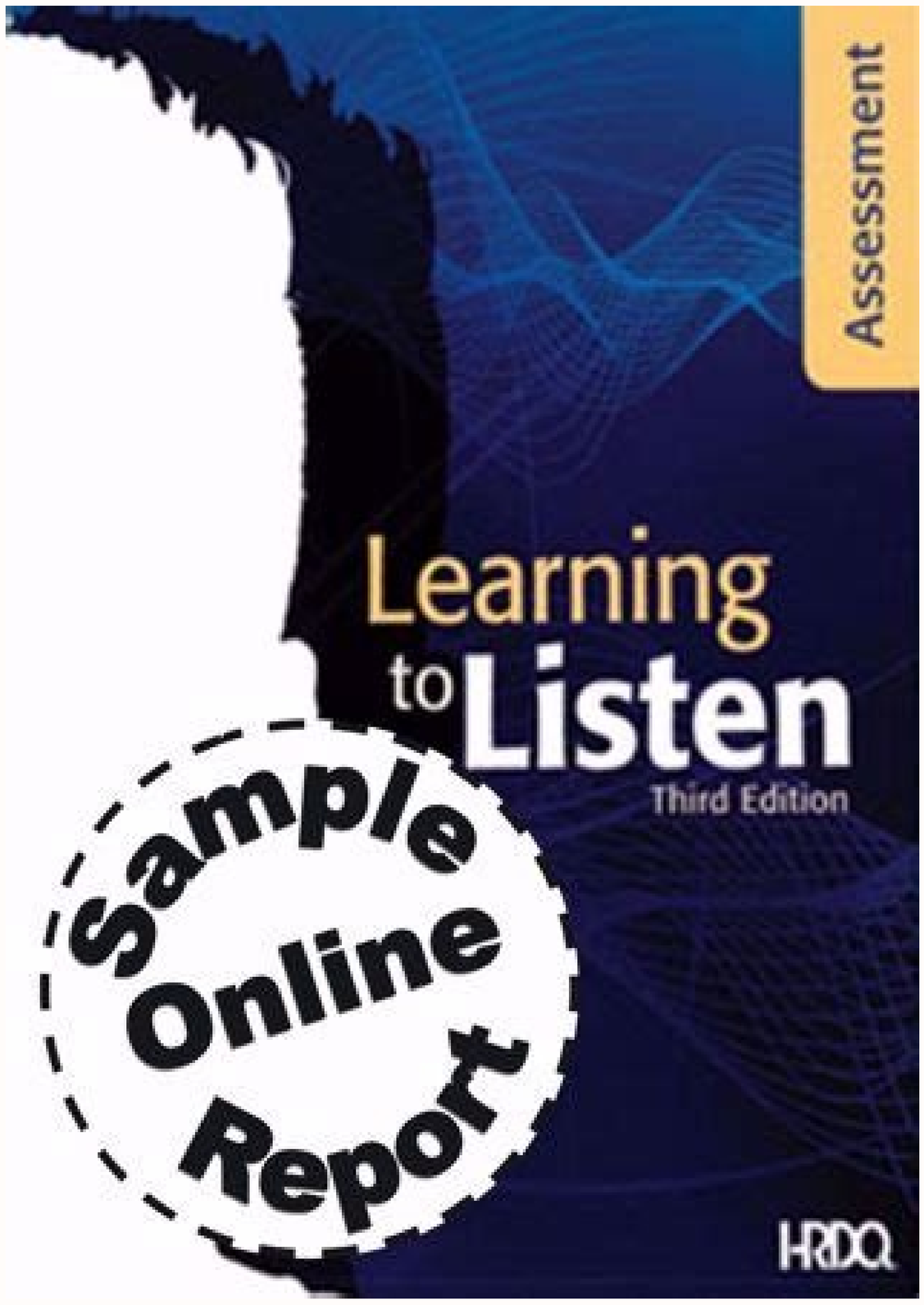

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Hearing impairment and audiovisual speech integration ability: a case study report

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Research in audiovisual speech perception has demonstrated that sensory factors such as auditory and visual acuity are associated with a listener's ability to recognize words and combine auditory and visual speech cues. This case study report examined audiovisual integration using a newly developed measure of capacity in a sample of hearing-impaired listeners. Capacity assesses how well two sources of information are integrated, and has been shown to be highly predictive of audiovisual speech recognition in normal-hearing individuals. It has not, however, been employed with hearing-impaired listeners nor individuals who require amplification to communicate effectively. Capacity was assessed for sentence recognition in seven hearing-impaired listeners fitted with hearing aids. Results revealed that capacity decreased for auditory-visual speech recognition when the auditory signal was amplified. These individuals exhibited a wide range of capacity values, and participants who demonstrated the greatest capacity also had the highest visual-only sentence recognition scores. Overall, capacity values suggest that amplification may have altered the way in which participants integrated auditory-visual speech information. Future investigations should examine capacity for auditory-visual speech in larger samples of hearing-impaired listeners with more diverse audiometric configurations.

Keywords: audiovisual speech integration, hearing impairment, capacity, processing speed, speech reading, hearing aids

INTRODUCTION

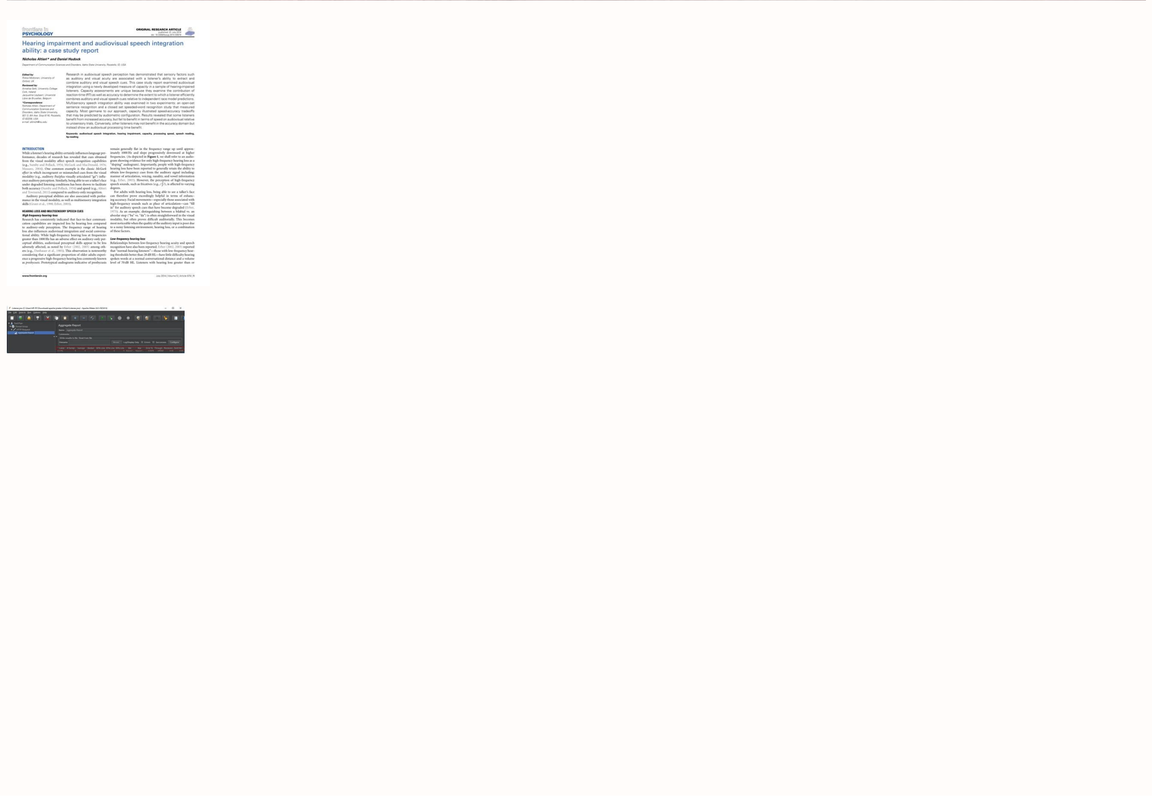
While a listener's hearing ability certainly influences language performance, decades of research has revealed that cues obtained from the visual modality also facilitate speech recognition (e.g., Sumby and Pollack, 1954; Erber, 1969; Grant and Seitz, 2000; Tye-Murray et al., 2007). One common example is the classic McGurk effect (McGurk and MacDonald, 1976) in which a visual /ga/ paired with an auditory /ba/ is usually perceived as "da" when presented at a moderate signal-to-noise ratio. Auditory-only speech understanding under degraded listening conditions has been shown to facilitate significantly when visual speech cues are available (Sumby and Pollack, 1954; Grant and Seitz, 2000) compared to auditory-only recognition. Individual perceptual abilities can be estimated with a variety of measures of auditory as well as visual sentence recognition (Grant et al., 1998; Watson, 1998).

HEARING LOSS AND MULTISENSORY SPEECH CUES

Research (e.g., Grant et al., 1998; Watson, 1998; Grant and Seitz, 2000) has consistently indicated that due to their contained spectral information, visual speech cues are highly correlated to auditory-only perception. The frequency range of hearing loss has also been shown to influence auditory-only speech perception (Hogan and Turner, 1998). Specifically, high-frequency hearing loss of 55 decibels hearing level (dB HL) or greater (Hogan and Turner, 1998) has an adverse effect on auditory-only perception. Auditory-only speech recognition has been shown to be adversely affected, as noted by Erber (1972, 1974) among others, when the hearing loss is greater than 70 dB HL. Research has also revealed that a significant proportion of older adults report difficulty understanding speech in everyday communication situations (Pichora-Fuller and Souza, 2003). Presbycusis, the most common cause of hearing loss in older adults, is typically characterized by a progressive, bilateral sensorineural hearing loss that affects the higher frequencies more than the lower frequencies (Gates and Mills, 2005). Presbycusis is usually gradual in onset and is generally symmetrical in both ears (Gates and Mills, 2005). Hearing loss associated with presbycusis can also be exacerbated by background noise (Tun et al., 2009). Because presbycusis typically affects the higher frequencies, it is difficult to distinguish between consonants that are primarily differentiated by high-frequency information (e.g., /f/ vs. /θ/ and /s/ vs. /ʃ/). Vowels, which are typically more intense and of longer duration than consonants, are usually not affected by presbycusis (Gates and Mills, 2005). Consonants are generally less intense and of shorter duration than vowels (Gelfand, 1998). Consonants are also more susceptible to the harmful effects of background noise than vowels (Gelfand, 1998). Consonant information is primarily located in the higher frequencies, while vowel information is primarily located in the lower frequencies (Owens et al., 1972; Gelfand, 1998). Owens et al. (1972) found that consonants accounted for 74% of errors in speech understanding for 124 hearing-impaired listeners with sloping sensorineural hearing losses. Consonants are also more vulnerable to the effects of reverberation than vowels (Gelfand, 1998). Reverberation is a complex acoustic phenomenon that consists of direct sound, early reflections, and late reflections of sound that persist in a space after the original sound source is removed (Nabelek et al., 1989). Reverberation can have detrimental effects on speech understanding for listeners with hearing loss (Nabelek et al., 1989). Lastly, consonants are generally weaker in the visual domain than vowels (Owens and Blazek, 1985). Consonants produced at the front of the mouth, such as /b/, /f/, /v/, and /m/, are usually more visually salient than consonants produced farther back in the throat, such as /k/ and /g/ (Owens and Blazek, 1985). Thus, consonants are typically more difficult to perceive auditorily and visually than vowels.

Case Frequency Hearing Loss

Research has demonstrated that high-frequency hearing acuity and speech recognition have also been impaired (Owens and Blazek, 1985). Reported high-frequency hearing losses have been associated with difficulty understanding Mandarin tones (Xu and Zhou, 2011), word recognition (Vestergaard, 2003), and sentence recognition (Hogan and Turner, 1998). Hogan and Turner (1998) found that high-frequency hearing losses of 55 dB HL or greater affected auditory-only speech recognition for 124 hearing-impaired listeners. Specifically, participants with high-frequency hearing losses were found to be significantly poorer than participants with normal hearing sensitivity or participants with low-frequency hearing losses. Vestergaard (2003) found that high-frequency hearing losses were associated with poorer consonant identification for 20 hearing-impaired listeners. Xu and Zhou (2011) reported that 15 hearing-impaired listeners with high-frequency hearing losses had difficulty discriminating Mandarin tones. Owens and Blazek (1985) found that consonant errors increased substantially for 30 hearing-impaired listeners with high-frequency hearing losses. Specifically, participants with high-frequency hearing losses were found to have difficulty with consonants that contained primarily high-frequency information, such as /f/, /θ/, /s/, /ʃ/, /k/, /g/, /d/, and /t/. Consonants with hearing loss poorer than or equal to 70 dB HL were rarely identified correctly. Consonants with hearing losses poorer than 90 dB HL were rarely identified correctly. Owens and Blazek (1985) also found that participants with high-frequency hearing losses made consonant errors that were predictable by acoustic configuration. Results revealed that some listeners made errors that were predictable by the manner of articulation, such as plosives, fricatives, or affricates. Conversely, other listeners may not benefit in the accuracy domain but instead show an audiovisual processing time benefit.



Extent report example. Extent report methods. Aventstack extent report example. How extent report works.

Creating the pages objects first, we need to create some pages objects that we are going to exercise during our tests. In this publication (long delayed) I would like to demonstrate how to use extensions as a listener for testang. I will show him to do it using a webdriver selenium test that uses the pattern of piagina. My tests cover the starting functionality of the application session, so I have created piginal objects for the session starting, the error pages where it lands when it makes an inception of incorrect session and the Starting page (the ViewPage account account) where it ends when the session start action is successful. You can also use the following qualifiers to mark the test with the adventstack category: T: Aventack Label: Aventack assign the device the classifiers below will assign your test with an SGS and iPhonex device: the qualifiers will continue to assign your Anshoo as author: Changelog version 4.0.0 launched on September 30, 2018 Initial the eclipse project that I have created to demonstrate the above can be downloaded here. Ireporter Ireporter adapters are activated when all the tests in their suite are finished. The source files of the pãrgina object are included in the eclipse project that can be downloaded at the end of this publication. The resulting report can be seen here. Extentitedlisteneradapter As the name implies, this is a listener of Itesenar, who creates reports at 1 level: test, since this is an implementation of Itstlistener, the report will be updated after the end of a test. Creating the tests to demonstrate the functionality of reports, I have created three tests: a test that performs a successful session start: this passes a test that performs an beginning of unsuccessful session, where the verification of the error message returns the returns the "This" also passes a test that performs an beginning of unsuccessful session, where the verification of the error message goes back failure: This fails the tests are seen asvisory: Public Class Logintest {Webdriver Driver; @Beforesuite public void setup () {{{ = new Firefoxdriver (); Driver.manage (). Timeouts (). Implicitlywait (10, timeunit.seconds); } @Parameters ({"incorrectusername", "incorrectspasword"}) @test (description = "performs an beginning of session without ã Ã © xito and verifies the resulting error message (passes)") public void testfailinglogin) {loginpage lp = new new loginpage (controller); ErrorPage EP = LP.incorrectlogin (User name, incorrect step by step); Affirm. } @Parameters ({"incorrectusername", "incorrectspasword"}) @test (description = "performs an beginning of session without ã ã Ã © xito and verifies the resulting error message (failure)") public void failingtest) {Loginpage Lp = News loginpage (controller); ErrorPage EP = LP.incorrectlogin (User name, incorrect step by step); Affirm. } @Parameters ({"correct uname", "correctpassword"}) @test (description = "performs a successful session start and verify if the general description of the accounts is open") public void testsuccessphullo Username, string incorrectpassword) {loginpage lp = Newnenpage Loginpage (controller); AccountsverViewpage aop = lp.correctlogin (username, incorrect step by step); Affirm.assertequals (aop.isat (), true); } @Aftersuite public void satoldown () {driver.quit (); }} Quite simple, truth? Assign test attributes to assign attributes to your tests (label, author or device), it is necessary to decorate @test (groups = {}). More examples can be found more examples about how to use the listener of the reports. See here for more details. This report lists all the approved tests, then all the failed tests and finally all the tests that They omitted during execution. By default, each test group is assigned as category or label. IntLestListerClassadapter (itstlistener) extensifiedlisteneradapter (itstlistener) (itstlistener) (IRPORTER) IRPORTERERIREUITENSERADAPTER (IRPORTER) Each listener in this section can be added to its test class or base: @listeners (extentitedlistenerclassandapter.class) Mytests of pãºblica {@test public void test () {... "extens -Aadapter-Aadapter is the official testang complement that makes all heavy lifting for you and can generate information in multiple levels. The report will be generated when all your tests have finished executing. Pãºblica class {@test (groups = {"tagame", "t: another-tagame", "a: savior", ",", ",", "," d: device me "}) public void test1 (string User, string password) {affirm.assertrue (True);} @test (groups = {"tagame", "tag: another-tagname", "author: Athorname", ",", ",", ",", " ",", ",", ",", ",", "device: device me"}) public void test2 (chain user, chain password) {affirm. }} test1 and test2 both use the same attributes: Tagame: It will be assigned as a category (category assignment ()) t: another-tagname, label: another-tagname: it will be assigned as a category to: now, author: Raze will be assigned as author: device me, device: device me: it will be assigned as a default device assignment label, all groups are assigned as labels. By adding A: o The author: qualifiers, the test can be marked with an author. When adding D: o Device:, the test will be marked with a device. Because of this, only a report from the end of the suite will be generated. }} or to your suite file: < /ayente listeners>

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