The Effects of Listeners' Control of Speech Rate on Second Language Comprehension

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Speech rate has been identified as a major factor affecting listening comprehension Despite the common-sense belief that slower rates facilitate listening comprehension, empirical studies have yielded contradictory findings

A review of previous studies of speech rate and listening comprehension revealed methodological problems Using a novel approach and recent developments in computer technology, this study examined the issue of speech rate and listening comprehension from a different perspective By giving the control of speech rate to the students and by attending to individuals instead of groups, this study concluded that (a) when given control, students' listening comprehension improved and (b) improved listening comprehension was achieved by slowing down the speech rate

INTRODUCTION

In recent years, there has been a growing body of research on the effects of speech modification on L2 listening comprehension (Chodorow 1979, Chaudron 1982, Chaudron and Richards 1986, Blau 1990, Derwing 1990, Griffiths 1990a, 1990b, Rader 1991, Cervantes and Gainer 1992, Chiang and Dunkel 1992) While the studies have not turned out many consistent findings on this topic, they have uncovered the complexity of the issue First, speech can be modified in various ways alternation of syntax (Blau 1990, Cervantes and Gainer 1992), change of lexis (Chiang and Dunkel 1992), variation of presentation style (Dunkel 1988), and modification of speech rate (Griffiths 1990a, 1990b, Rader 1991) Second, to further complicate the issue, speech modification is only one of many factors that interact to affect listening comprehension Listeners' prior knowledge and language proficiency, for example, are two other factors frequently considered by researchers (Chiang and Dunkel 1992) The present study focused on the effect of one type of speech modification alteration of speech rate

Speech rate has long been proposed as an important factor affecting communication between native speakers (NS) and non-native speakers (NNS) of a language (Chaudron 1982, Derwing 1990, Griffiths 1990a, 1990b, Rader 1991) It has been a common belief among second language learners and teachers that a slower speech rate would facilitate NNS listening comprehension (see Flaherty 1979, Griffiths 1990a, 1990b, Rader 1991, Rivers 1968) This common-sense belief, albeit theoretically logical and intuitively appealing, has not found uniform empirical support

A slowed speech rate is frequently cited as a facilitative characteristic of foreigner talk and teacher talk in the Second Language Acquisition (SLA) literature (Henzl 1973, 1975, 1979, Dahl 1981, Chaudron 1988, Derwing 1990) Chaudron (1988) reviewed ten studies in which a modification of speech rate was noted Henzl (1979) examined the WPM of two stories told to NSs, advanced NNS learners, and beginning NNS students by teachers of Czech, English, and German A general tendency to slow down for NNSs was observed Similar results were obtained in a study by Steyaert (1978) in which six English teachers were asked to tell two stories to a group of intermediate-level English learners and a group of NSs Dahl (1981) conducted a slightly different study In this study, ESL teachers and naive NSs were asked to give instructions to NSs and NNSs The subjects (the ESL teachers and NSs) only heard their intended addressees reading a passage on a tape, but had no actual contact with them Despite the lack of interaction, all subjects spoke more slowly when their instructions were intended to be directed to beginner NNS learners

Although rate adjustment has been frequently observed among NSs when communicating with NNSs, some researchers suggest that the adjustment seems to have little practical effect on NNS' comprehension Derwing (1990), for example, conducted a study that questioned the effect of the notion that 'if you slow down, they will understand better' In her study, Derwing, first had her 16 NS subjects watch a short film after having shown them a list of comprehension questions The subjects were also told that it was their responsibility to ensure that their listeners would be able to answer the questions After the film, the 16 NSs (referred to as narrators in the study) were taken to a room to meet their partners (first a same-sex NNS listener, then a NS listener) The task was for the narrator to describe the film to the listener The experimenter asked the listener to respond to the comprehension questions orally after the description Based on their respective listeners' (NNSs) performance on the comprehension questions, narrators were divided into two groups successful (listeners all had comprehension scores of over 50 per cent) and unsuccessful (listeners all had comprehension scores of less than 50 per cent) Derwing (1990 307) concluded

> There was rate change in the successful group, as their rates to NSs and NNSs were both significantly faster than the unsuccessful group's rate to NNSs There was no significant overall correlation of rate with success (communicative success), but the correlation between the degree of rate adjustment and success approached conventional levels of significance, it is interesting to note that the direction of the former correlation was positive ($r =$ 37, $p =$ 16), while the direction of the latter was negative ($r = -$ 48, $p =$ 06), just the opposite of what one would expect according to conventional wisdom

Another approach to this issue has been to directly measure the influence of speech rate on listening comprehension Instead of focusing on the characteristics of NS's speech behavior, researchers like Roger Griffiths studied NNS's listening comprehension Griffiths (1990b) reported a study in which he had 15 'lower-to-intermediate' Japanese learners of English listen to three texts at three rates moderately fast (app 200 WPM), average (app 150 WPM), and slow (app 100 WPM) The subjects were asked to answer fifteen true–false questions after each passage Each of the 15 subjects had a chance to listen to all three passages at all three rates Griffiths found that 'lower scores were obtained at the fastest SRs (speech rates) on all three texts and that the lowest mean score was consequently obtained at that rate' (1990b 326) Griffiths confirmed his main hypothesis Mean listening comprehension test scores for passages delivered at slow (100 WPM) would be significantly higher than for passages delivered at a moderately fast rate (200 WPM) However, the result did not support his hypothesis that a slower rate (100 WPM) would be more comprehensible *than a normal speed (150 WPM) In 1991, Griffiths (1991) reported a similar* study in which stories were used The three speech rates were slow (app 127 WPM), average (app 188 WPM), and fast (app 250 WPM) A more significant difference was found between comprehension at slow and fast rates

However, the positive effects of slower rate on listening comprehension found by Griffiths were not supported by other researchers Blau (1990 752), for example, found that mechanically reducing the velocity of speech from faster (170 WPM) to slower (145 WPM) did not enhance the listening comprehension of Polish or Puerto Rican learners 'except at the lowest level of L2 proficiency'

Rader (1991) obtained similar results in a Spanish as second language context *The listening materials used in her study were three native Spanish broadcast* narratives recorded by a native Spanish speaker from Chile The three texts were recorded at the rate of 160, 153, and 155 WPM respectively, which were considered the normal speed Through use of sound editing software, the three texts were each expanded 135 per cent and 150 per cent The three texts were consequently slowed down to 122, 113, and 119 WPM (expansion of 135 per cent) and 108, 98, and 108 WPM (expansion of 150 per cent) Rader found that although there was a difference among the overall means across texts for the three word rates (0 per cent = 16 76, 135 per cent = 21 04, and 150 per cent = 19 83), the difference did not reach a statistically significant level The result of an ANOVA did not suggest a significant effect of word rate either ($p <$ 05, $F(2, 87) = 1\ 6$) Thus, she concluded 'It appears that the speech expansion of the three Spanish texts did not facilitate the listening comprehension of third-quarter university Spanish students ' (Rader 1991 95)

The current study explored the issue from a slightly different angle Instead of focusing on the effect of different rates predefined by the researcher or the characteristics of speakers' speech behavior, the present study looked at the effects of listener's control of speech rate on comprehension In other words, it was not designed to establish a correlational relationship between speech rate and listening comprehension by manipulating the speech rate, instead it was intended to detect the effects of speech rate by allowing the listener rather than the speaker or researcher to modify the speech rate

THE STUDY

Design

The conflicting findings in the previous studies suggest that the issue with speech rate is far from settled and, perhaps more importantly, an alternative approach of investigation would be more productive One of the most troubling aspects of speech rate faced by previous studies was the definition of 'faster', 'slower', and 'normal' speeds Due to vast individual differences in language proficiency, memory capacity, listening habit, and processing strategy of language learners, there cannot be an objective 'normal' speed Any labeling of a particular speed as 'normal' or 'faster' can only be the perception of one individual or a relatively small group of individuals This becomes evident when the wide discrepancy among the speech rates used in the previous studies is considered For example, Griffiths had two different 'average speeds' in his two studies 150 WPM and 188 WPM respectively, Rader's normal rate was set at about 155 WPM, while in Blau's two experiments, the normal speeds were 170 WPM and 200 WPM respectively

The subjective nature of speech rate definition presents at least two challenges to researchers First, it renders cross-study comparison virtually impossible If 200 WPM is considered fast in one study and normal in another, it should not be surprising that the results are different Second, it makes the measurement of group change in performance of listening comprehension of speech delivered at different speed meaningless Hypothetically, a person understands best at his or her ideal speed For a host of reasons, it is difficult, if not impossible, to find an ideal speed for a group of listeners If that ideal speed is not found, it is arguable that no matter how slow the rate is, the listener will still have trouble comprehending the message As a result, one could argue that in Derwing's study, although some NSs used a slower rate when narrating to NNSs, the slower rate could still have been too fast for the listeners In Griffith's and Rader's studies, the so-called 'fast' rate could have been just 'normal' for some listeners, 'fast' for some others, or even too slow for others Conversely, their 'slow' rates could have been 'fast' for some and 'normal' for others Having every subject listen at the same speed and then averaging the comprehension scores of the subjects is in fact denying individual differences

With this in mind, the author took a different approach to the problem In the present study, the listeners were provided the opportunity to modify the speech rate so that each individual could find an ideal speed for himself or herself The effect of speech rate was measured by the listeners' behavior of modification instead of their comprehension This also helps to minimize the confounding effect of individual differences (e g language proficiency) Previous studies took great pains to control language proficiency and other variables of the learners so as to separate the effect of speech rate from that of other variables While the effectiveness of such control is open to question, allowing the listener to select rates makes such control unnecessary Let us assume that individuals want to achieve the best comprehension they can and we know that listening comprehension results from the interaction of many factors proficiency, prior knowledge, speech rate of the message, etc For each particular listener, we can safely assume that her or his internal variables such as language proficiency and prior knowledge would not vary greatly at a certain point in time (e g while listening to one message) What varies are external factors content, speech rate, delivery style, for example So the fluctuation in comprehension can be attributed to variation in these factors If a listener wishes to achieve better comprehension, she needs to manipulate one or all of these variables When speech rate is the only factor allowed for listener manipulation and if it truly has an effect on comprehension, we can hypothesize that the listener will modify it If the speech rate does not affect comprehension at all or it ceases to make a difference, we assume the listener will stop varying it Thus, whether and how listeners vary the speed would more appropriately reveal the effect of speech rate

The four listening conditions

Four different listening conditions were designed to examine the effect of speech rate on L2 listening comprehension What was manipulated in the four conditions was the amount of control the listeners had over speech rate and repetition (see Table 1)

Table 1 Types of listener control in four conditions

Type of control	C1	C2	C3	C4
Speed	No	Yes	Yes	No
Dynamic	No	No	Yes	No
Repetition	No	No	Yes	Yes

Condition 1 was the least flexible in terms of listener control It was presented at a speed of approximately 185 WPM Condition 1 consisted of 20 individual sentences followed by 20 multiple-choice items The subjects were asked to listen to each of the 20 sentences and complete its accompanying test item They started each item by clicking the 'Play' button to listen to a sentence After listening to each sentence, the subjects were asked to choose from the four given choices the one that was closest in meaning to the sentence they had just heard For example, a subject hears 'Please turn in the key to your room before you leave' and reads on the computer screen

(A) Please lock your room when you leave
(B) Turn the key to the left to enter your room
(C) Please return your room key before leaving
(D) You must leave your room by four o'clock

Choice (C) is closest in meaning to the sentence 'Please turn in the key to your room before you leave', hence the correct answer is (C) The subjects were instructed to indicate the correct answer by clicking the mouse on the intended choice

In this condition, each sentence could only be listened to once, although the subjects were allowed to go back to change their answer They were not allowed to vary the speed, nor were they allowed to repeat the sentences The content and presentation order of Condition 1 was the same for all participants

Unlike in Condition 1, the listening materials used in Conditions 2, 3, and 4 were coherent passages (see Appendix 4) instead of separate sentences A total of four passages (three test passages and one calibration passage) were used in Conditions 2, 3, and 4 The length of the passages ranged from 15 to 20 sentences Except for the calibration passage used in Condition 2, each passage was followed by five multiple-choice test items To minimize the possible effect of the differences among the passages, the computer program controlled the presentation order so that each of the three test passages had the same chance to be presented in each of the three different conditions (Condition 2, 3, or 4) In other words, not every subject listened to the same passage in the same condition Table 2 illustrates the presentation order of the listening materials

Table 2 Presentation order of listening materials during experiment

	Condition 1	Condition 2		Condition 3	Condition 4
Subject 1	20 Sentences	Calibration	Passage 1	Passage 2	Passage 3
Subject 2	20 Sentences	Calibration	Passage 2	Passage 3	Passage 1
Subject 3	20 Sentences	Calibration	Passage 3	Passage 1	Passage 2
Subject 15	20 Sentences	Calibration	Passage 1	Passage 2	Passage 3

Condition 2 was more flexible in terms of control over speech rate In Condition 2 the subjects had the opportunity to select the speech rate they desired Condition 2 consisted of two passages a calibration passage and a test passage The calibration passage was designed to assist the subjects in finding their own 'ideal' rate of comprehension There were six textually connected sentences in the calibration passage As with all the test passages, the calibration passage could be listened to at one of the six sampled speeds (see Table 3) Each subject was instructed to find the rate that best suited him or her To determine their individual 'ideal' speech rate, the subjects experimented with the different speech rates by clicking the 'Faster' or 'Slower' button on the computer screen Should a subject fail to decide on an 'ideal' speed before the whole passage ended, he or she could listen to the passage again by clicking on the 'Repeat' button Once subjects decided on their 'ideal' speech rate, they would indicate this by clicking the 'Done' button

Having selected a speed, subjects would go to the test passage The test passage was selected from the three possible test passages by the computer program This passage was delivered at the speed the subject decided upon when listening to the calibration passage The subjects could not change the chosen speed while listening to the test passage nor could they repeat any parts of the passage The test passage could only be played once

Condition 3 allowed the greatest subject control In Condition 3, the subjects could change the speech rate while listening to a passage by clicking on the 'Faster' or 'Slower' button That is, the speech rates used in this condition were dynamic Whenever subjects felt a lack of comprehension, they could reduce the speed Conversely, they could increase the rate when they felt it was too slow For technical reasons, the speed could only be changed per sentence, which presented a potential problem for the experiment The effect of the speed change was delayed until the sentence following the problem sentence The change of speed might not be beneficial in terms of understanding that sentence *per se*, thus making it difficult to detect the effect of speech rate To counter this problem, the subjects were allowed to repeat the whole passage or any part of the passage The subjects could click the 'Repeat All' button to listen to the entire passage again while varying the speed, or click on one of the numbered sentence buttons to hear its corresponding sentence at the speed they selected

Condition 4 was designed to collect baseline information of the effect of repetition so as to make the results of Condition 3 more interpretable In Condition 4, the passage was delivered at the speed of approximately 194 WPM The subjects were allowed to repeat the passage (either in part or in its entirety), but they could not vary the speed

In each condition, after listening to the passage, the subjects were asked to complete five multiple-choice questions

Modification of the listening materials

The listening materials (see Appendix 4) used in this study were adapted from the January 1992 Test Of English as a Foreign Language (TOEFL) (Sheng 1992) Two major modifications were applied to the passages speed and unit size The original speed of these passages was approximately 194 WPM First, each passage was time expanded or compressed on an analog machine (Speech Stretcher) to slow down or speed up its rate In other words, both the syllables and pauses were either lengthened or shortened The basic increment of compression and expansion rate was 25 per cent With the original speed as 100 per cent, a 25 per cent compression reduced the speech time to 75 per cent of the original In other words, a passage that was originally spoken in one minute would be delivered in 45 seconds A 25 per cent expansion would then increase the speech time by 25 per cent, which made a one-minute passage 75 seconds long Likewise, 200 per cent expansion would double the time in which a passage was originally delivered (Table 3)

The other major modification was the unit of recording Originally in TOEFL each passage is delivered as one unit In order to make the speed changeable,

Table 3 Sampled speeds

Speed	Time rate (%)	Sentences	Passage 1	Passage 2	Passage 3	Mean
One	75	262	255	263	253	258
Two	100	197	192	196	190	194
Three	125	157	153	157	152	155
Four	150	131	128	131	127	129
Five	175	112	109	108	109	110
Six	200	98	96	98	95	97

Note All rates are presented in terms of words per minute (WPM)

smaller units had to be used Ideally, technology permitting, it would be better to change the rate 'on-the-fly', i e at any moment while the passage is playing, like changing the volume on a TV However, since it is still technologically difficult (if not impossible) to do so, the passages were digitized on a per-sentence basis Each sentence of a passage was digitized as a separate unit so that students would be able to change speed between sentences

The original comprehension questions in the TOEFL were used to measure comprehension in the study A questionnaire (Appendix 3) was used to collect the listeners' reaction to different speech rates An interview was also conducted for this purpose

The experiment package was then programmed in Hypercard 2 1 All listening materials were digitized with Hypercard Audio and stored in separate files Due to the large amount of disk space required and for the sake of accessibility, the package was put on a network server During the experiment, the materials were accessed through Apple file sharing All responses made by the students were scored and sorted by the local computer and sent back to the server

Hypotheses

Based upon the assumptions that speech rate affects NNS's listening comprehension and that a slower rate facilitates L2 comprehension, the study expected to find

1 Subjects achieve higher scores in conditions where they can control the speech rates,
2 Subjects vary the speech rates when they have the control,
3 Where the subjects achieve higher scores, the speech rates are slower

Participants

The participants in this study were 15 non-native speakers of English from six different countries China, Colombia, Korea, Taiwan, Turkey, and Venezuela Ten of the students were enrolled in an intensive English training program at the University of Illinois at Urbana-Champaign The other five were graduate students at the same university The participants' proficiency in English ranged from intermediate to advanced The study did not attempt to control proficiency for the reasons discussed earlier in this section

Procedures

The experiment was conducted on an individual basis since there was no need to have every subject participate at the same time in the same place For each subject, the experiment started with a brief explanation of the experiment and a demonstration of necessary mouse skills A practice session with the different types of buttons to be used in the experiment was designed to help subjects practice mouse skills and become familiar with the format of the experiment Subjects also had a chance to experiment with the headphones and adjust the volume during this session

When ready, subjects clicked the 'Start Experiment' button to begin the experiment The four conditions were presented in the order of 1, 2, 3, and 4 Following Condition 4, subjects completed a questionnaire, which gave them the opportunity to respond to four questions on a five-point scale and write some comments about the experiment The students chose from the five choices (Strongly Agree, Agree, No Opinion, Disagree, and Strongly Disagree) by clicking the corresponding button

Immediately after the experiment, an interview was conducted to solicit the students' impressions and opinions of the experiment

RESULTS

Subjects comprehended better when they had control of speech rate

A comparison of the means of comprehension scores in the four different conditions suggests that the students received higher scores in conditions where they had control over speed (Condition 2 and Condition 3) than in conditions where they had no control over speed (Condition 1 and Condition 4) This tendency is

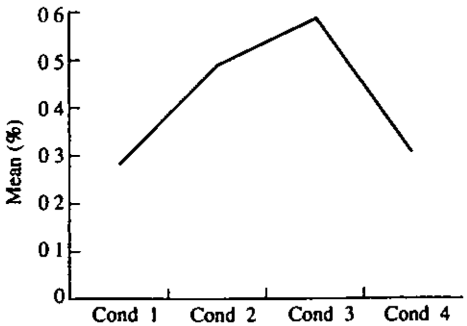

Figure 1 Means of comprehension scores in four conditions

clearly illustrated in Figure 1, which plotted the percentage of means in the four conditions As shown in Figure 1, the students' performance increased as they had more control of speed and repetition An *F*-Test of multiple means was performed to compare the scores obtained by the participants in the four conditions The result suggests that the difference among the four conditions is statistically significant (see Table 4)

Post-hoc tests (Newman-Keuls method) suggest that at $a = 0\ 05$ level, the differences between more flexible conditions (Conditions 2 and 3) and less flexible conditions (Conditions 1 and 4) were significant (see Table 5) In other words, the subjects performed better when they had control over speech rate and repetition than when they did not have control It is also important to note that although the subjects achieved higher scores when they had control over both speed and repetition (Condition 3) than when they had control over speed only (Condition 2), the difference was not statistically significant

Individual performance in each of the four conditions confirms the hypothesis as well Table 6 summarizes individual performances in the four conditions into six patterns Every student did better or the same when they had control over speech rate (Condition 2 and Condition 3) than when they did not have the chance to vary the speed (Condition 1 and Condition 4) Of the fifteen subjects, eleven (73 per cent) achieved a higher score in Condition 3 than in Condition 4, the other four subjects' scores were the same in the two conditions, none received a score lower in Condition 3 than in Condition 4 Seven of the fifteen (47 per cent) subjects did better in Condition 2 than in Condition 4, only one (6 per cent) did not do as well as in Condition 4, the rest (40 per cent) obtained the same scores in both conditions

Table 4 Results of F*-test of scores in four conditions*

Condition	One	Two	Three	Four	*F*
Mean	1 15	2 47	2 93	1 53	13 54*
SD	0 42	1 06	1 03	0 64	
df	3 (top)	56 (bottom)			

* $p < 0\ 0001$

Table 5 Post-hoc tests results

	Vs	Difference	Critical difference
Condition 1	Condition 4	0 45	0 62
	Condition 2	1 32*	0 75
	Condition 3	1 79*	0 83
Condition 4	Condition 2	0 87*	0 63
	Condition 3	1 33*	0 75
Condition 2	Condition 3	0 47	0 63

* $a = 0\ 05$

Table 6 Patterns of individual performance

Pattern of performance	Student number
C3 > C2 > C4 > C1	4
C3 > C2 > C4 = C1	3
C3 = C2 > C4 > C1	15
C3 = C2 > C4 < C1	13
C3 > C2 = C4 > C1	7, 8, 10, 12, 14
C3 > C2 = C4 < C1	9
C3 = C2 = C4 > C1	11
C3 > C2 < C4 > C1	1
C3 < C2 > C4 < C1	5
C3 < C2 > C4 > C1	2, 6

Note C1 = Condition 1, C2 = Condition 2, C3 = Condition 3, C4 = Condition 4, > meaning score in one condition higher than, < meaning score in one condition lower than, = meaning same scores in two conditions Student number = the ID numbers of the students whose scores in the conditions fall in that pattern

The subjects varied speech rates when possible

In Condition 2, where the participants were given the opportunity to choose a speed that best suited them, the mean speed (141 WPM) used was much lower than that in Condition 4 (195 WPM) The same was true in Condition 3 (128 WPM) compared to Condition 4 The rates used for each passage in the four conditions show the same tendency

The relationship is more obvious when the speeds used by each individual participant are analyzed In Condition 2, fourteen of the fifteen subjects (83 per cent) used a speed slower than the preset 'normal' (194 WPM) speed None of them used a faster rate The rates used in Condition 2 for all three passages ranged from 109 WPM to 192 WPM, but most chose the speed with a 25 per cent expansion (152–155 WPM) The speeds used in Condition 3, where participants were allowed to change the rate while listening, are even more interesting The speeds used ranged from 95 WPM (200 per cent expansion) to 194 WPM (0 per cent expansion) Fifty-three per cent (8 out of 15) varied the speed two to three times during the task, but the average was slower than the 'normal' speed (194 WPM) The rest (7) remained at a speed slower than the preset 'normal'

Also worth mentioning is the number of times passages were repeated in Condition 3 and 4 While under both conditions, the participants had the opportunity to repeat the message, the number of repetitions in Condition 3 is much smaller than in Condition 4 (8 vs 18) In Condition 3, eight subjects repeated once, whereas in Condition 4 thirteen subjects repeated from one to three times Comparing the students' performance in Conditions 1 and 4 suggests that repetition improved comprehension But as the difference between means in Conditions 2 and 4 indicates, the effect of repetition on comprehension is smaller than that of the speed

To summarize, the participants' comprehension was overwhelmingly higher when they had control over the rate of speech than when they did not When *they had control, the general tendency was a slowing down of the speech rate* However, it is important to mention that the degree that each student slowed down the rate varied

Students' self-report

In the questionnaire following the listening tasks (see Appendix 3), the participants were asked to report whether slower speeds helped their comprehension To the statement 'Slower speeds helped my listening comprehension', four answered 'Strongly Agree', seven responded with 'Agree', one chose 'No Opinion' as his or her response, two said 'Disagree', and one did not answer Taking 'Strongly Agree' and 'Agree' as 'yes', then we have 79 per cent of the respondents reporting that 'slower speeds helped their listening comprehension' To summarize, the data supported the hypothesis that when given control, students will use a slower speed to ensure comprehension, and that slower speeds do help listening comprehension (For more detailed data see Appendix 2)

In conclusion, the results supported the expectations of the study First, the students changed the speech rate when given control Second, in controlled situations, the students achieved better comprehension than in non-controlled situations Finally, all participants reacted positively to the use of computers to control speech rate

DISCUSSION

While the findings that speech rate indeed affected listening comprehension and that slower rate yielded better comprehension are not necessarily surprising, the approach taken in the study can be of significant value for both future investigation of this issue and for developing listening activities for language learning The final section discusses some implications the study may have for future research and materials development

Implications for future research

Allowing the listener to control speech rate and looking at the listener's modification behavior provides a different, perhaps more accurate, view of the effect of speech rate on listening comprehension than detecting the effect by measuring group differences in situations where researcher or speaker manipulate the rate In the following paragraphs, this point is further illustrated within the context of the findings of the present study

The results of the study suggest that slower speeds improved listening comprehension and are thus consistent with the conventional wisdom concerning the relationship between speech rate and comprehension the slower the speed, the better the comprehension It is, however, difficult to draw this conclusion because the matter is more complex than it may at first appear

First, the phrase 'slower speeds' is a problematic one in that it does not define anything concrete Unless a reference speed is identified, the phrase is meaningless To make the phrase more meaningful, one question must be answered slower than *what*?

A reference speed can be found from either external or internal sources An external reference speed can be established as the word per minute or syllable per second at which a message is delivered It is a pausological or physical measurement Within this framework, the 'fastness' or 'slowness' of an aural message is defined by the researcher based on either group statistics or his own perception

Using group statistics, researchers can determine the 'normal speed' at which people speak by averaging the rates found in a random sample That 'normal speed' is then set as the reference to judge whether a speed is 'slow' or 'fast' or 'normal' Such an objective reference is helpful only when it is the result of a well-structured survey and kept consistent so that everyone knows what it means Unfortunately, to the best knowledge of this author, such a reference speed does not exist The reference speeds used in previous studies (e g Griffiths 1990a, 1990b, 1991, Rader 1991) were arbitrarily chosen by the researchers Three different reference (labeled 'normal', 'average' in the studies) speeds (approximately 153 WPM in Rader's, 150 WPM and 188 WPM in Griffiths' two separate studies) were used in the three studies cited earlier In this case, it is quite meaningless to say that slower speeds helped or did not help listening comprehension because the perception of speed varies from one person to another

Whether a speed is fast or slow is the result of the interaction between the pausological quality of the speech and listener-internal factors Due to the variations among second language learners, the same passage can be perceived as 'slow' or 'normal' or 'fast' The speed used by the participants in the present study ranged from 95 WPM to 192 WPM Since the participants were told to use the speed that best suited them and since their scores suggested when they selected their own speed their comprehension improved, it can be assumed that the speed used was the ideal speed for each of them Based on the results of the study, I would argue that 'reference' is inside the learner, rather than in the passage

In light of the above argument, it appears that the reason Rader (1991) and Derwing (1990) did not find a significant improvement in comprehension when 'slower speeds' were used is not because the relationship does not exist, but because the speeds used did not match each individual's internal 'reference' The effect may well have been concealed by 'ceiling' and 'floor' effects What might have happened is that all the rates used were so fast for some subjects that they could not understand regardless of the differences among the speeds Their comprehension reached the floor Or for some subjects, all passages were so slow that their comprehension reached the ceiling In either case, there would be no difference in comprehension among the passages As a result any effect of speech rate on comprehension would not have been detected

It is, therefore, extremely important to realize that one cannot expect to reliably examine the influence of speed without letting the listener control the speed In other words, in order to better understand how speech rate is related to listening comprehension, researchers should consider students as unique individuals, who operate with different perceptions and internal references

Implications for developing listening activities

Few would disagree that authentic materials and comprehensible input are essential for effective language learning In recent years, thanks to progress in satellite and telecomputing technology, the availability of authentic audio materials has increased dramatically Access to foreign news broadcasts, for instance, via either satellite or the Internet is no longer a problem The problem is how to make it comprehensible to the learner One way is to allow the listener to vary speech rate, as the present study suggested Ideally as more and more audio materials are digitized, a computer program can be developed to allow the learner to change the speed of any message at any time at a mouse-click, as piloted in the study reported here

There is, however, a legitimate concern that when given the control of speech rate, the learner may always want to select the speed he or she is most comfortable with while actually being able to understand at a faster rate This can be counterproductive since eventually the learner is expected to understand messages delivered by native speakers But it is also reasonable to suggest that learners can motivate themselves to move to a faster rate because for one thing listening at a slow rate can be boring and tiresome In addition, a time limit can be imposed so that the learner will be forced to select a faster rate in order to complete a listening task

Limitations of the study

One needed improvement for this study is increased capacity for student control Future studies need to develop more sophisticated software that would provide students continuous control of speed (changing the speed 'on the fly') Such control would be more sensitive to the listener's internal reference and thus more powerful in detecting individual differences

Another potentially problematic aspect of the study was the experiment materials and instrument for measuring comprehension First, two different types of listening materials (individual sentences and coherent passages) were used in the study In hindsight, this discrepancy may have some confounding effect over the findings Second, although the multiple-choice question technique used in this study has been among the most common for language testing, it has been criticized by some as an inadequate measurement for listening comprehension A more holistic instrument (e g recall protocols), or a combination of both, might produce a more accurate measurement of comprehension

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APPENDIX 1

Students' performance in four conditions

ID	C1	C2		C3			C4	
	Score	Score	Speed	Score	Speed	Repetition times	Score	Repetition times
01	1	1	127	2	153/128	0	2	1
02	0 8	4	152	2	153	1	2	1
03	1	2	152	3	153	1	1	1
04	1 6	4	152	5	194/153/128	1	3	1
05	0 8	4	109	3	110/127	0	0	0
06	0 6	2	192	1	127	1	1	1
07	0 6	1	155	2	127	0	1	1
08	1 8	2	155	3	152/127/109	0	2	1
09	2	2	109	4	95	1	1	1
10	1 2	2	109	3	109	1	2	2
11	1	2	153	2	153	0	2	0
12	0 8	2	128	3	153/128	1	2	1
13	1 2	3	153	3	153/128	0	1	1
14	1 4	2	153	4	153/128	1	2	3
15	1 4	4	128	4	128/97	0	2	3
Mean	1 15	2 47	141	2 93	128		1 53	
SD	0 42	1 06	22 97	1 03	19		0 64	

Note Speed in Words Per Minute

APPENDIX 2

Students' response to the follow-up questionnaire

St No	R1	R2	R3	R4
1	C	B	B	B
2	C	A	A	B
3	B	A	A	B
4	A	A	A	A
5	*	*	*	*
6	B	B	B	B
7	C	B	B	C
8	B	B	C	B
9	B	B	B	B
10	B	C	D	B

St No	R1	R2	R3	R4
11	B	C	D	B
12	B	B	B	B
13	B	B	B	B
14	B	D	B	C
15	B	A	A	B

Note St No = student number, R1 = response to question 1, R2 = response to question 2, R3 = response to question 3, R4 = response to question 4, * = no response

APPENDIX 3

Follow-up questionnaire

Directions Please fill out the following questionnaire based on your experience with the experiment Make the choice by clicking on the corresponding button Thank you

1 I like the way the study is designed
A Strongly Agree B Agree C No Opinion D Disagree E Strongly Disagree
2 Slower speeds helped my listening comprehension
A Strongly Agree B Agree C No Opinion D Disagree E Strongly Disagree
3 I like it that I can change the speed while listening
A Strongly Agree B Agree C No Opinion D Disagree E Strongly Disagree
4 I'd like to see this idea (control of speed) used in class
A Strongly Agree B Agree C No Opinion D Disagree E Strongly Disagree

APPENDIX 4

Transcripts of the listening materials and comprehension questions

Passage one

A Have you ever looked really closely at a snowflake?
B Sure, but they usually melt too fast for me to get a close look Why do you ask?
A I'm just curious, I was reading an article about the formation of snowflakes and I realized that I had never paid much attention to them before
B Well, there's a big variety, isn't there?
A Yeah, but they all have one of three basic forms—hexagonal cones, hexagonal plates and a branching star-shaped form
B I wonder why the forms are different Maybe because ice starts to form on dust particles with different shapes?
A Well, I thought it might have something to do with the water saturation of the air but we're both wrong The author of this article did extensive research and concluded that the shape of snow crystals is largely controlled by the temperature of the air For example, the feathery star-shaped snowflake that everyone thinks is typical occurs only at a specific temperature
B Doesn't the relative humidity have anything to do with the shapes?
A Apparently not, the effect of supersaturation is simply to alter the growth rate The greater the saturation, the faster the snowflakes form
B Hmm, next time it snows, I'll make a point of taking a closer look

Questions for passage one

1 What are the people discussing?
   (A) Whether or no snowflakes can be analyzed
   (B) How snowflakes are formed
   (C) What causes a snowstorm
   (D) Where the largest snowflakes can be found
2 Why has the woman brought up the subject of snowflake?
   (A) She has never seen snow before
   (B) She is conducting research on snow
   (C) She wants to make artificial snow
   (D) She has been reading about snow
3 How many basic types of snowflakes are there?
   (A) One
   (B) Two
   (C) Three
   (D) Four
4 What determines the shape of snowflakes?
   (A) The shape of dust particles in the air
   (B) The relative humidity
   (C) The temperature of the air
   (D) The geography of the area
5 What does the man say he is going to do?
   (A) Inspect snowflakes more carefully
   (B) Make a copy of the article
   (C) Write for more information
   (D) Draw diagrams of the different shapes

Passage two

Good evening, welcome to the first meeting of our spring cycling season It's a pleasure to see so many new faces here I certainly hope that most of you will soon feel right at home with our group and that bicycling will become a regular hobby for you and a part of your physical fitness routine Some of you may not realize that the state of New Jersey offers ample opportunities for bicyclists of all abilities We have rolling countryside, miles of beaches, rugged hills and valleys, and thousands of miles of little-used roads Beginners will find the shore and area south of Princeton suitable for their needs while expert riders will find that the steep trails of the region around HighPoint offer a challenge to their skill and stamina In addition, New Jersey is rich in places of historical interest The state abounds in colonial architecture, battlefields of the revolution, and other historic sites important in the early history of this country Most are carefully preserved or have been meticulously restored We organize tours to a variety of places nearly every weekend Next Saturday's tour will be a relatively easy one, from Rutgers University to the Gateway National Park Interested cyclists should meet at 8 a m in the parking lot at the corner of Hamilton Street and College Avenue in New Brunswick The minimum time for this tour is about 6 hours We will use the buddy system throughout the ride Each new rider should team up with a more experienced rider If the buddies look after each other, we can be sure that none has been left behind on the back roads You can pick up a map of Saturday's tour at the information table before the meeting this evening

Questions for passage two

1 What is the purpose of the talk?
   (A) To encourage people to participate in a club activity
   (B) To introduce a new kind of bicycle
   (C) To inform beginning cyclists about New Jersey's traffic laws
   (D) To warn tourists about bicycling on the roadways
2 According to the speaker, what makes New Jersey a good place to bicycle?
   (A) Its large number of bicycle clubs
   (B) Its geographic variety
   (C) Its network of superhighways
   (D) Its mild climate
3 Why does the speaker mention the historical sites?
   (A) Some of them are inaccessible to beginning cyclists
   (B) Some of them commemorate the development of the bicycle
   (C) They are nice places to visit on bicycle tours
   (D) They help to make New Jersey a wealthy state
4 What will some of the listeners probably do on Saturday?
   (A) Repair their bicycles
   (B) Go on a bicycle tour
   (C) Take a test about road safety
   (D) Participate in a bicycle race
5 What is the purpose of the 'buddy' system?
   (A) To save money on equipment
   (B) To instruct newcomers about bicycle maintenance
   (C) To ensure that everyone knows about the historical sites
   (D) To help keep participants from getting lost

Passage three

A Hi, Tom

B Judy, I haven't seen you in weeks Where have you been?

A In Florida

B What? Vacationing while the rest of us have been studying on campus in the February cold?

A Not exactly I spent most of my time in the water

B I don't understand

A I was on a special field trip I went with my marine biology class

B So you went scuba diving? What were you looking for? Sunken treasure?

A You might say so The sea is full of treasures All kinds of strange fascinating organisms Our class concentrated on studying plankton

B I thought plankton were too small to be seen

A That's a kind of misconception The true plankton covers a wide variety of freely floating plants and animals From microscopic one-celled organisms to larger ones such as the common jellyfish

B Jellyfish may be large enough to be seen but they're transparent, aren't they?

A Yes Most plankton have transparent tissues as a protective camouflage It makes them practically invisible to predators

B But not invisible to your biology class, I hope?

A By concentrating, I was able to see the outlines of lots of different planktonic plants and animals In fact, our professor even took photographs of glebachordata which are small oceanic snails

B How do the snails show up on the photograph if they are transparent?

A We squirted glebachordata with a harmless green dye Since particles of the dye stuck to their tissues, the snails appeared in green outline in the photograph

B That sounds like an interesting trip, but I think that if I'd been in Florida in February, I'd much rather have spent my time just swimming and lying in the sun

Questions for passage three

1 How did Judy spend most of her time in Florida?
   (A) Sightseeing
   (B) Lying on the beach
   (C) Taking photographs of the beaches
   (D) Scuba diving

2 What was Tom doing in February?
   (A) He was on a field trip
   (B) He was vacationing in Florida
   (C) He was studying most of the time
   (D) He was vacationing at home

3 What kind of class went on the field trip?
   (A) Biology
   (B) Photography
   (C) Swimming
   (D) Painting

4 According to Judy, what did her professor photograph?
   (A) Oceanic snails
   (B) Large green jellyfish
   (C) Different planktonic plants
   (D) Sunken treasure chests

5 Why is it hard to see most plankton?
   (A) They are microscopic
   (B) They move very quickly
   (C) They are transparent
   (D) They are rarely found near the surface