Gender Differences in Speechreadability

Nicola Daly and John Bench
School of Communication Disorders
La Trobe University

Hilary Chappell
School of Linguistics
La Trobe University

Gender differences in the speechreadability of talkers were investigated. Twenty-four (12 male and 12 female) normally-hearing subjects speechread 12 talkers (6 female and 6 male) on videotape without sound over two occasions. Female talkers were speechread significantly more accurately than male talkers. There was a significant interaction between speechreader gender and occasion. Female speechreaders' scores increased significantly more than male talkers' scores did from Occasion 1 to Occasion 2. The findings are discussed with regard to sociolinguistic and nonverbal communication literature, and the implications for speechreading tests and aural rehabilitation.

Speechreading (lipreading) is a form of communication used primarily when the auditory signal is reduced or degraded in some way, usually by hearing loss or competing noise, and hence when hearing alone does not permit adequate perception of the speech signal. Thus, as the auditory channel is degraded, the visual channel becomes more important (Berger, 1972). Although speechreading assists individuals with normal hearing in speech perception, it is seldom as important to them as it is to those with a hearing loss (Bench, 1992).

Wong, Taaffe, and Lowell (1958) discussed the variables contributing to communication by speechreading, concluding that the efficiency of speechreading is

Nicola Daly is a doctoral student in the School of Communication Disorders, Dr. John Bench is Director of Studies in the School of Communication Disorders, and Dr. Hilary Chappell is a Senior Lecturer in the School of Linguistics. The mailing address for La Trobe University is Bundoora, Victoria 3083, Australia.

Requests for reprints should be sent to Nicola Daly, School of Communication Disorders, La Trobe University, Bundoora, Victoria 3083.

a function of three factors: the talkers, the speechreading materials, and the speechreaders. To date, most research on speechreading has concentrated on speechreading ability (Berger, 1972). However, in reviewing the sparse literature concerning the role of the talker in speechreading, Lesner (1988) concluded that the variability of talker intelligibility is a major factor contributing to the difficulty of speechreading.

As part of the development of a videorecorded speechreading test (Bench, Doyle, Daly, & Lind, 1993), eight experienced speechreaders discussed what constituted speechreadability in a videotaped sample of 40 talkers. These talkers were second generation monolingual speakers of Australian English with equal numbers of males and females. On a number of occasions the speechreaders commented that the female talkers were easier to speechread than the male talkers. These comments led to the formulation of the research question investigated in the study reported below.

Gender as a variable in speechreading has been more thoroughly investigated with respect to speechreader gender than talker gender. Several studies have identified gender differences in the speechreading ability of speechreaders (Dancer, Krain, Thompson, Davis, & Glenn, 1994; Johnson, Hicks, Goldberg, & Myslobodsky, 1988; Markides, 1980; Plant & Macrae, 1981; Wong et al., 1958). In all cases, adult female speechreaders speechread sentences significantly more accurately than adult male speechreaders.

There is very little research investigating gender differences in talkers. However, there is a large body of nonverbal communication and sociolinguistic literature suggesting the existence of talker gender differences in favor of female talkers. When the auditory channel is not clear enough to allow speech recognition by hearing alone (as in a speechreading task), both visual and vocal nonverbal communication assumes greater importance (Ijsseldijk, 1988; Jacobs, 1982). In her review of research concerning gender differences in nonverbal communication, Hall (1984) concluded that, overall, females are better encoders of nonverbal behavior. These findings suggest that the performance of speechreaders will be better with female rather than male talkers.

Hall (1984) found a significant gender difference when comparing studies of both visual (e.g., facial expression, gesture) and vocal (e.g., intonation, stress) nonverbal cues. There was a larger gender difference in favor of females for visual cues than for vocal cues. Because the auditory channel is usually less clear than the visual channel in speechreading, the findings concerning visual versus vocal nonverbal cues provide further support for the hypothesis that female talkers are easier to speechread than male talkers.

Sociolinguistic research shows that men and women use language differently (e.g., Coates, 1993; Graddol & Swann, 1994; Kramer, Thorne, & Henley, 1975; and Pauwels, 1987). Thorne and Henley (1975) summarized many research studies demonstrating that, when there are phonological variants in a language,

women more often choose the form closer to the prestige or "correct" way of talking than do men of the same social class, age, and level of education. There is evidence that Australian women also follow this trend in their language use (e.g., Bradley & Bradley, 1979; Horvath, 1985; Ingram, Pittam, & Newman, 1985; Mitchell & Delbridge, 1965; Shnukal, 1982; Shopen, 1978). Guessing (or prediction) has been shown to be an important part of speechreading (Lyxell & Ronnberg, 1987), and it seems likely that females' more standard use of language would make their utterances comparatively easier to predict, and hence easier to speechread, especially in initial encounters.

Petkovsek (1961) concluded that female talkers were easier to speechread because they used freer expression and more gesture, and lipstick drew attention to their lips. Berger and DePompei (1977) surveyed adults who were hearing impaired. Results showed that male and female respondents agreed in their assessment of the general speechreadability of male talkers, but that male respondents found female talkers more difficult to speechread than did female respondents. Talker gender was specifically, if briefly, investigated by Aylesworth (1964). He concluded that there was no significant difference on a speechreading test as a result of talker gender. However, only 4 talkers (2 female and 2 male) were used, each speechreader saw only 1 talker, and the talkers were speech-and-hearing (i.e., non-naive) students. Hence the validity of Aylesworth's conclusion is questionable.

There is strong support in the sociolinguistic and nonverbal communication literature for the notion that, on the whole, female talkers are easier to speechread than male talkers. However, to date very few studies have thoroughly investigated this hypothesis. Therefore, the aim of this study was to investigate the hypothesis that female talkers are easier to speechread than male talkers.

METHOD

Speechreader Subjects

Speechreader subjects were 24 volunteer first-year university students (12 females and 12 males). All were Australian-born Anglo-Australians and monolingual speakers of English. They were between 18 and 50 years of age, with a median of 22.5 years for females and 23.5 years for males. Subjects were required to pass standard visual and auditory screening tests (described below). All subjects reported that they had never speechread without sound before, and had no special knowledge of speechreading.

Talker Stimuli

Twelve talkers (6 male and 6 female) each presented one list of 16 short everyday sentences (BKB/A [Bamford-Kowal-Bench/Australian version] Sentence Lists; Bench & Doyle, 1979) on videotape. The talkers were second-generation

Australian monolingual speakers of English, selected from a pool of 40 talkers by a panel of 8 speechreaders who were hearing-impaired. The 12 talkers used in this study were those talkers whom the panel judged to be relatively easy to speechread (Bench, Daly, Doyle, & Lind, 1995). The reason for this criterion was that the ultimate aim of the talker selection process was to choose talkers for a speechreading test based on the BKB/A Sentence Lists. (For a discussion of this process see Bench et al., 1995.)

Six of the BKB/A Sentence Lists were used. The sentence lists each contained between 51 and 54 key words (the words carrying the main semantic content). These sentence lists were, by design, equivalent in syntactic structure and used vocabulary from a common pool. They were derived from language samples of 8- to 15-year-old children who were hearing impaired, and are therefore known to be within the semantic and syntactic capabilities of such children and also of persons with normal hearing, aged from 6 years upwards (Bench & Bamford, 1979). The set of male talkers presented the same six sentence lists as the set of female talkers. The talkers were tertiary-educated university staff dressed uniformly in a blue crew-neck sweatshirt. They wore no makeup and were clean shaven. None of the talkers was experienced in talking for formal speechreading. The males were aged 23 to 57 (mean 39.1) years. The females were aged 27 to 46 (mean 38.0) years.

Talkers were videorecorded in color in a sound-treated room, against a black backdrop with a National/Panasonic A2 camera and a Portapack. A 1,500 W halogen floodlight was used as a fill light to provide even lighting across the talkers' faces. The camera was sited 2 m from the talkers, and was adjusted to include the talkers' heads and shoulders only. Talkers were asked to speak in their natural speaking style, a bit slower than usual, as if giving a lecture or telling a story. The videotapes were subsequently edited to include an 8 s blank screen between sentences. Two seconds of videotape showing the talkers' faces before they began to speak was used as a cue to alert the speechreaders.

Procedure and Experimental Design

Each speechreader watched two sets of videotaped stimuli (one set of male and one set of female talkers). The order in which the two sets of talkers (male and female) were viewed was counterbalanced, as practice or fatigue effects were considered possible. This issue was addressed by a break between the viewing of the first and second set of talkers, and latin squares within a crossover design (Maxwell, 1958). In the crossover design, the speechreader subjects were randomly assigned to one of two groups. The first group viewed female talkers on the first occasion and male talkers second; the second group viewed male talkers first and female talkers second (see Figure 1).

A latin square (6 speechreaders × 6 talkers × 6 talker orders) was used to balance the orders in which the 6 talkers in each set were viewed, such that each speechreader saw the talkers in a different order. Two latin squares (one for male

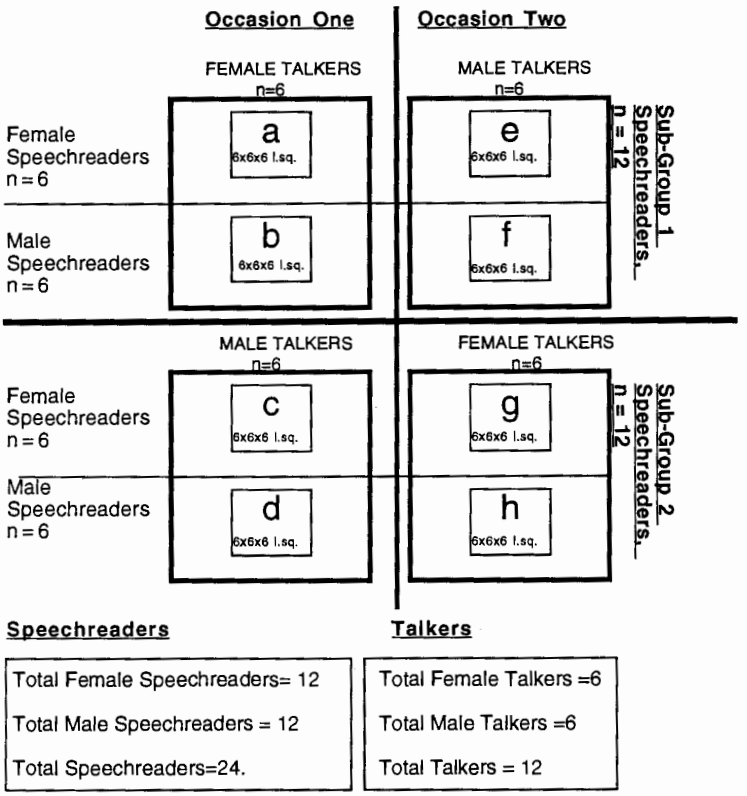

Figure 1. Latin squares in the cross over design.

and one for female speechreaders) were used in each of the four cells of the cross-over design. Thus, in total, eight $6 \times 6 \times 6$ latin squares were used (latin squares *a* to *h* in Figure 1), two in each of the four cells. Four groups of 6 speechreaders (24 speechreaders in total: 12 female and 12 male) were needed to complete one phase of the design. Two 45-min appointments were made for each speechreader, a minimum of 1 week, and a maximum of 2 weeks apart. In the first appointment, subjects' eyesight and hearing were screened (20/30 on the Snellen Eye Chart at 3 m and 20 dB HL at 0.5, 1, 2, and 4 kHz respectively). Subjects then individually viewed the first set of talkers. Each talker appeared on a separate VHS videotape cassette, which was played without sound on a 55 cm Samsung monitor at a distance of 2 m in a softly lit, sound-treated room. After each sentence the speechreaders spoke their responses. They were encouraged to guess if they were not sure. The responses were recorded by a person (ND) sitting next to the speechreader. The recorder agreement determined in a separate small-scale study

was 87.3% (Bench, Daly, Doyle, & Lind, 1994). In the second appointment, the subjects were reminded of their task, and then viewed the second set of talkers. Viewing conditions and response recording were as for the first set of talkers. The speechreaders were not told that the male and female talkers presented the same sentence lists until after viewing both conditions.

Scoring Speechreading Accuracy

There were 318 key words in the sentences in the six lists presented. Thus two scores (one for female talkers and one for male talkers) out of 318 were given for each speechreader. These scores were marked with the Loose Key Word method described in Bench and Bamford (1979). Using this method, a word is scored as correct if the root of the word is given correctly; however, credit is not given for homophonous words.

Results and Analysis

The means and standard deviations of scores for the 12 talkers are listed in Table 1. The number of key words in the sentences spoken by each talker varied from 51 to 54; therefore, in order that the scores may be compared they were adjusted to represent scores out of 50 key words. Mean speechreadability scores for female talkers ranged from 4.4 key words correct (kwc) to 12.1 kwc. Mean

Table 1

Means and Standard Deviations of Speechreadability Scores From 24 Speechreaders for Individual Talkers

Talker	Mean	Standard deviation
Female		
Talker 1	7.84	5.42
Talker 2	11.57	5.97
Talker 3	4.44	4.58
Talker 4	8.41	5.13
Talker 5	4.44	3.56
Talker 6	12.11	7.53
Male		
Talker 7	2.98	2.55
Talker 8	5.90	4.56
Talker 9	4.12	3.68
Talker 10	9.68	5.77
Talker 11	4.25	3.43
Talker 12	7.19	4.25

Note. Scores from a total of 50 key words.

Table 2
Means and Standard Deviations of Speechreading Scores

Source of score	Mean	Standard deviation
Female talkers	51.83	29.22
Male talkers	36.38	22.05
Female speechreaders	50.83	26.17
Male speechreaders	36.04	25.93
Occasion 1	40.00	22.00
Occasion 2	48.00	31.00
Subgroup 1 speechreaders	38.25	21.02
Subgroup 2 speechreaders	49.96	30.85

Note. Scores from a total of 318 key words.

speechreadability scores for male talkers ranged from 3.0 kwc to 9.7 kwc. These scores, which were relatively low due to the fact that the task was visual only, are comparable to the scores obtained by Bench et al. (1994).

In total, 24 speechreaders viewed two sets of talkers, resulting in 48 speechreading scores. These scores represent scores from 6 sentence lists, with a total of 318 key words. The means and standard deviations of scores for the two talker genders, the two occasions, the two subgroups of speechreaders, and the two speechreader genders are summarized in Table 2.

Scores for subgroups of talkers, speechreaders, and occasions are shown in Tables 3 and 4.

Speechreading scores were analyzed in a 3 × 2 factorial analysis of variance

Table 3
Means and Standard Deviations of Speechreading Scores from Occasions and Speechreader Gender

Source of score[a]	Mean	Standard deviation
Occasion 1		
Female speechreaders	44.00	18.03
Male speechreaders	35.58	24.73
Occasion 2		
Female speechreaders	57.67	31.70
Male speechreaders	39.17	28.55

Note. Scores from a total of 318 key words.
[a] $n = 12$ for each group.

Table 4

Means and Standard Deviations of Speechreading Scores from Occasions, Speechreader Genders, and Talker Genders

Source of score	Mean	Standard deviation
Occasion 1 Female speechreaders Female talkers	42.50	14.01
Occasion 1 Male speechreaders Female talkers	40.83	27.21
Occasion 1 Female speechreaders Male talkers	45.50	22.65
Occasion 1 Male speechreaders Male talkers	30.33	23.20
Occasion 2 Female speechreaders Female talkers	77.00	32.35
Occasion 2 Male speechreaders Female talkers	47.00	30.11
Occasion 2 Female speechreaders Male talkers	38.33	16.35
Occasion 2 Male speechreaders Male talkers	31.33	27.20

Note. Scores from a total of 318 key words.

(see Table 5). Between-subject variables were talker gender order (TGO) (Subgroup 1 speechreaders saw female talkers and then male talkers, Subgroup 2 speechreaders saw male talkers and then female talkers); speechreader gender; the within-subject variable was occasion (1 and 2). The variable of most interest in this paper is that of talker gender which is represented by the interaction between TGO and occasion on Table 5.

Neither of the two between-subject variables (talker gender order or speechreader gender) nor their interaction produced significant *F*-ratios (see Table 5). Thus the data in this study did not show a significant difference be-

Table 5
Analysis of Variance Table

Source of variation	*df*	*SS*	*MS*	*t*	*p*
Between subjects	23				
Talker gender order (TGO)	1	1645.02	1645.02	$t = 1.40$	$= .251$
Speechreader gender (SG)	1	2173.52	2173.52	$t = 1.85$	$= .189$
TGO × SG	1	999.19	999.19	$t = 0.84$	$= .368$
SRs within TGO × SG	20	23555.25	1177.76		
Within subjects	24				
Occasion (O)	1	892.69	892.69	$t = 15.00$	$= .0009$
TGO × O (= talker gender)	1	2867.52	2867.52	$t = 48.17$	$< .0001$
SG × O	1	305.02	305.02	$t = 5.12$	$= .0349$
TGO × SG × O (= talker gender × SG)	1	67.69	67.69	$t = 1.14$	$= .299$
SRs × O/TGO × SG (or residual error)	20	1190.58	59.53	—	—
Total	47	33696.48	—	—	—

Note. SRs = Speechreaders, TGO = Talker Gender Order, SG = Speechreader Gender, O = Occasion.

tween scores from a subgroup of speechreaders who saw first female talkers and then male talkers, and scores from speechreaders who saw the reverse order. Speechreading scores from female speechreaders were not significantly different to those scores from male speechreaders. From the within-subject variables, there was a significant main effect for occasion, and significant interactions for talker gender order by occasion (talker gender), and occasion by speechreader gender. The main effect for occasion demonstrated that speechreading scores from Occasion 2 were significantly higher than speechreading scores from Occasion 1. The interaction for talker gender order by occasion indicated that the scores for female talkers were significantly higher than scores for male talkers. The interaction for speechreader gender by occasion showed that female speechreaders' scores increased significantly more than male speechreaders' scores from Occasion 1 to Occasion 2.

DISCUSSION

Results concerning the main focus of this paper, gender difference in talker speechreadability, are discussed first, followed by a brief discussion of the effects of occasion and speechreader gender. Finally the clinical implications of talker gender differences are discussed.

Talker Gender

The finding of a significant gender difference in talker speechreadability is consistent with many of the gender difference findings in sociolinguistics, which show women to be more successful communicators than men in areas other than speechreading. Holmes (1993) reviewed research investigating interactional style, the use of pragmatic particles, and the realization of speech functions. All three areas involved some linguistic form which could be quantified. In the current study the interactions were one-way in nature, that is, the talker sent the message, but the speechreader was not able to respond to the message in an interactional style. Moreover, the content and length of the message was strictly controlled. The talker could not add tag questions or other pragmatic particles. Neither could the speechreader interrupt the talker, or make requests for clarification. Thus, while the speechreading situation used in this research was rather unnatural, the findings suggest that even when many of the communication strategies which have been shown to exhibit gender differences are excluded, the 6 female talkers on videotape were still more easily speechread than were the 6 males.

Thus it appears that gender differences in speechreadability are due to differences in communication beyond the words that are spoken. Although the verbal message sent by the talkers was prescribed, the talkers were able to use their own nonverbal communication and articulation styles within the confines of their instructions to speak "a little slower than usual, as if giving a lecture, or telling a story."

A number of studies have shown gender differences in articulation amongst children (e.g., Johnson & Somers, 1979; Kenny, Prather, Mooney, & Jeruzal, 1984; Pahkala, Laine, & Lammi, 1991; Paynter & Petty, 1974; Qvarnstrom, Laine, & Jaroma, 1991). Most of these studies show girls to have superior articulation ability. In a cine fluoroscopic X-ray study of the Broad-General-Cultivated continuum used to describe Australian English, Bernard (1970) showed that average lip and teeth apertures increased from Broad Australian English to General Australian English, with the widest apertures used in Cultivated Australian English. Mitchell and Delbridge (1965) studied the Australian English dialects used by 16- to 18-year-old male and female school-leavers, and found that males used mostly Broad Australian English, whereas females used all three dialects in similar proportion. Assuming that wider mouth apertures make for easier speechreadability, these findings suggest that on average, Australian female young adults will be easier to speechread than Australian male young adults. However, these findings have not been recently confirmed with respect to talkers of Australian English in the 1990s, nor has the articulation of older adults been investigated with respect to gender differences. Nonetheless, the issue of mouth apertures may contribute to an explanation of the gender differences in speechreadability found in this paper, though measurement of such a variable is beyond the present paper.

The effect of articulation (specifically lip movement) and two aspects of non-verbal communication (speed and facial expression) have been investigated with regard to their contribution to speechreadability (e.g., Dudich & Duff, 1977; Franks, 1979; Ijsseldijk, 1992). The methodology used in this area of research has limitations, (Daly & Bench, 1995). However, results suggest that slower speech, more lip movement, and more facial expression may improve speechreadability. Gender differences in the use of these speech behaviors has not been investigated to date.

Occasions and Speechreader Gender

The results from the present research replicate previous findings (e.g., Bench et al., 1994; Warren, Dancer, Monfils, & Pittenger, 1989) concerning practice effects. The present study involved two occasions. Scores on Occasion 2 were significantly higher than scores on Occasion 1.

This study did not find female speechreaders to be significantly better than male speechreaders as shown in many previous studies (Dancer et al., 1994; Johnson et al., 1988; Markides, 1980; Plant & Macrae, 1981; Wong et al., 1958). This result may have been due to the small numbers of subjects in this study. However, the finding of a significant interaction between occasion and speechreader gender suggests that the female speechreaders improved their speechreading ability at a faster rate than male speechreaders. This finding agrees with that of Dancer et al. (1994), who found that female speechreaders showed a practice effect whereas male speechreaders did not. (See Dancer et al., 1994, for a discussion of the possible reasons for and implications of this finding.)

Clinical Implications

The finding that women are on average easier to speechread than men may be important for designers of speechreading tests to consider when choosing talkers to present the test material. In the development of the BKB/A Speechreading Test, for example, a panel of 8 experienced speechreaders ranked 20 female and 20 male talkers on videotape for speechreadability (Bench et al., 1995). Results showed that there was significantly more agreement within rankings made of female talkers than male talkers.

The findings of Bench et al. (1995), together with those of the present study, suggest that the gender of talkers is a variable to be considered, both in the development of new speechreading tests and in the interpretation of existing ones. It must be noted that the present study uses Australian English speakers, and so results cannot be generalized beyond the Australian English speaking population. However, given the international findings, amongst Western speakers of English, of linguistic behaviors which allude to the superior speechreadability of female

talkers, it is likely that these findings will hold true among speakers of other English dialects.

In a review of 15 speechreading tests, Ijsseldijk (1988) found that the majority of tests used only 1 talker and therefore only one gender. Indeed, Ijsseldijk highlighted choice of talker as a major source of variability between the different tests reviewed. Typically the choice of talkers for speechreading tests has been arbitrary and not well documented. The authors of the BKB/A Speechreading Test have acknowledged gender as a possible variable by including 2 female and 2 male talkers, and have documented their process of selection in detail (Bench et al., 1995). For the many speechreading tests already in existence which use only one gender, the user should be aware of the possible effects of talker gender on results.

Gender difference should also be considered in speechreading training sessions, for example, ensuring that clients practice using both female and male talkers. The clinician may also find it useful to inform clients that gender differences exist in speechreadability, although care must be taken to explain that not all men are difficult to speechread, nor are all women easy to speechread.

In conclusion, the findings of this study suggest that, because people interact with both males and females in everyday life, the only true measure of speechreading ability is one using both genders of talkers. It remains to define exactly what it is that female talkers do which makes them easier to speechread than male talkers. The literature on nonverbal communication suggests that female talkers use more nonverbal cues than male talkers, which would be useful in speechreading. Other contributing factors may be articulation, speed, and facial expression. Measurements of gender differences in these factors will help to explain gender differences in speechreadability. Once quantified, such findings will be of use for the clinician to convey to the communication partners of individuals whose hearing is impaired.

ACKNOWLEDGEMENTS

The experiment described in this paper forms part of the work for the doctorate of Nicola Daly. Parts of this paper were presented at the 10th New Zealand Linguistics Conference held at Waikato University, Hamilton, New Zealand in August 1993. The authors gratefully acknowledge the assistance of Pamela Snow, Chris Lind, and anonymous reviewers for comments made on earlier drafts of this paper.

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