

The influence of listeners' singing experience and the number of singers on the understanding of sung text

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An important aspect of perceiving sung music is understanding the words. Previous research has suggested several factors affecting the intelligibility of sung text. This study investigates two of those factors: the number of singers and the singing expertise of the listener. We expected more singers to cause greater variability in the acoustic signal and be harder to comprehend. Listeners who are themselves experienced singers are more likely to be attuned to factors affecting singers' diction and were expected to be better than non-singers at understanding the sung text. Forty eight participants, half accomplished singers and half self-reported non-singers, listened to four 8-bar unaccompanied songs twice (in order to test for familiarity) and wrote out the texts as they heard them. Two performances were given by a soloist, two by a trio of singers in unison. Participants were significantly better at understanding the words on the second hearing than the first, and singers significantly better than non-singers overall. There was no effect of the number of singers. Hence familiarity and singing experience both benefited sung text understanding. An effect of the number of singers may be more apparent when comparing a soloist with a choir.

Keywords: singing; intelligibility; expertise; ensemble; lyrics

Much music is sung, whether accompanied or *a cappella*, and whether solo or ensemble. An important aspect of perceiving sung music is the extent to which the words can be understood. Much of the existing empirical research on intelligibility has focused on isolated vowels sung by solo singers, at various pitches (Sundberg 1987, Benolken and Swanson 1990, Hollien *et al.*

2000). Recently, however, Collister and Huron (2008) compared the intelligibility of solo sung versus spoken whole words, investigating consonant confusions as well as vowels. Their results showed many more identification errors for sung words.

Intelligibility is clearly an issue, however, for groups of singers such as choirs: Fisher (1991) developed a research-informed “articulatory diction development method” in response to the finding that “approaches to choral diction...are based primarily on tradition and personal preference” (p. 270); Racette *et al.* (2000) suggest that choral singing may be more effective than solo singing for improving word intelligibility (for aphasics) since it “may entrain more than one auditory-vocal interface” (p. 2571), while Emmons and Chase (2006) argue that, in the interests of better diction, consonants should be “approximated” and vowels modified.

Two years ago, we reported the results of a survey of listeners’ views on factors that might affect the intelligibility of sung text (Fine and Ginsborg 2007a). Almost 400 open-ended statements were provided by 94 respondents, most of whom devoted much of their music listening to vocal and choral music, and stated that the intelligibility of sung text was important to them when listening to lyrics in their own, or another language. We had suggested four possible broad categories of factor, relating to performer(s), environment, listener, and music and/or lyrics. As expected from the research on intelligibility cited above, a third of all statements concerned performer-related factors including articulation, diction and enunciation, breathing and phrasing, communicating text, expression and stage presence, voice quality, and range. One additional factor suggested was “choral ensemble.”

We then explored the effect of expertise. Our respondents were roughly equally divided between experts (professional, semi-professional, and student singers, and some singing teachers) and non-experts (amateur singers and non-singers) (Fine and Ginsborg 2007b). The singing teachers—perhaps as they are in the business of improving singers’ skills, including intelligibility—made the highest proportion of performer-related statements.

We are now investigating some of the factors nominated by our survey respondents in subsequent empirical research, in order to increase our understanding of how to enhance the intelligibility of sung text and improve singers’ diction through more effective vocal pedagogy. The present study investigates two factors: (1) number of singers and (2) listeners’ experience of singing. More singers are likely to cause more variability and “noise” in the acoustic signal, thus making its decoding and understanding more difficult; indeed, some questionnaire respondents reported that choirs are generally harder to understand than solo singers. If listeners are themselves experi-

enced singers, they are more likely to be attuned to factors affecting singers' diction, and they may be better than non-singers at resolving the acoustic signal into recognizable words.

Our aims were, therefore, twofold. First, we asked if sung text is harder to understand when performed by a group of singers rather than a soloist. We predicted that a single singer would be easier to understand than multiple singers, even when singing in unison. Second, we investigated the extent to which the listener's singing experience affects his or her ability to understand sung text, even when the piece of music is unfamiliar. It was hypothesized that expert singers would be better at comprehending sung text because of their own experience of singing words.

METHOD

Participants

There were 48 participants (15 M, 23 F), with a mean age of 36.2 years (one participant did not give her age). Half were self-reported singers (mean age=36.9 years) and half self-reported non-singers (mean age=35.6 years).

Materials

Four songs, consisting of 8-bar melodies in duple time by Glinka and Hundley, were used. Texts by Shanks and Purdy were set respectively to two of these songs. A sequence of numbers interspersed with short words ("and," "no," and "the") were set to the same melodies to create the other two songs. All four songs have been used in previous research on singers' memory (Ginsborg 2002). The songs were recorded both by a solo soprano and by a trio (F, M, M) singing in unison. All stimuli were recorded in the same room at 48 kHz, 24 bit resolution onto a digital audio workstation, and then encoded as mp3 files at a constant bit rate of 320 kilobits per second (kbit/s). The microphone was a Neumann KM130 omnidirectional condenser placed about 30 cm from the singer(s). All songs were unaccompanied. Stimuli were played to participants as mp3 files on a laptop using its internal speakers. All participants stated that the stimuli were loud enough.

Procedure

Participants first completed a short questionnaire asking about their singing experience and how much they listened to sung music. They heard a short practice stimulus (4-bar melody in duple time), and then listened to four of

the eight melodies, two solo and two ensemble. The exact melodies used were counterbalanced, so each stimulus was heard by 24 participants.

Each test stimulus was presented twice and the participants were instructed to write down the words they heard sung. On the first hearing of each song, a pause was given after each line to allow the participant to catch up (as the focus of the study was perception rather than memorization ability). The second time through, the stimulus was played without breaks. Different pens were used on each hearing so that writing differences by hearing were apparent during subsequent scoring.

The productions were then scored as follows. An error was counted for every word missing or incorrectly heard, and for each additional word. Incorrect order of words or numbers was not counted as an error, as memory was not being tested. Errors were then subtracted from the total number of words in the song (varying from 22 to 27), and then the performance score was transformed into a percentage, used in the analyses below.

RESULTS

The participants were asked for their singing experience on a 5-point Likert scale (1=non-singer, 2=occasional singer, 3=keen amateur singer, 4=semi-professional singer, 5=professional singer). They were split into two groups (24 had answered 1-2, 24 answered 3-5). On average, the singers had sung for 22.8 years, tended to rehearse for 3.7 hours per week, and reported listening to sung music 6.9 hours per week. On average, the non-singers had sung for 0.9 years, did not rehearse at all, and reported listening to sung music for 10.5 hours per week.

Mean performance data (understanding sung text) are shown in Table 1. A mixed Analysis of Variance (ANOVA) was carried out. The within-subject variables were number of singers (solo vs. ensemble) and hearing (first vs. second). The between-subject variable was singing experience (singer vs. non-singer). The dependent variable was % performance score. Hearing was highly significant ($F_{1,46}=82.13$, $p<0.001$), with better performance on the second hearing (94.8%) than the first (90.1%). Singing experience was also significant ($F_{1,46}=5.95$, $p<0.02$), with singers scoring 94.1% and non-singers scoring 90.8%. However, number of singers was not significant (92.9% solo, 92.0% ensemble).

The relationships between experience and performance factors were investigated. Overall performance significantly correlated with singing experience ($r_{48}=0.31$, $p<0.05$), number of years singing ($r_{48}=0.33$, $p<0.05$), hours of singing per week ($r_{48}=0.45$, $p<0.01$), and number of hours listening to sung

Table 1. Sung text understanding performance (mean percentage data).

	<i>Solo</i>		<i>Ensemble</i>	
	<i>First hearing</i>	<i>Second hearing</i>	<i>First hearing</i>	<i>Second hearing</i>
Singers	92.1	96.4	91.3	96.6
Non-singers	89.3	93.9	87.6	92.5

music per week ($r_{48}=-0.31$, $p=0.05$). Not surprisingly, singing experience also correlated with years singing ($r_{48}=0.84$, $p<0.001$) and number of hours singing per week ($r_{48}=0.77$, $p<0.001$). When the singers and non-singers were investigated separately, the only significant correlations were, for singers, age and years singing ($r_{23}=0.84$, $p<0.001$) and, for non-singers, overall performance and hours listening to sung music ($r_{24}=-0.53$, $p<0.01$), which was unexpectedly a negative correlation.

It was notable that certain words were more often misheard than others. A preliminary survey shows the following words were misheard or omitted by more than a quarter of the participants ($n=12$): “run,” “fields,” “still,” “no,” “the,” and “are.” In particular, non-numeric words were often missed in the number stimuli, perhaps due to the lack of semantic context. The patterns of words misheard varied slightly between the solo and the ensemble stimuli.

DISCUSSION

Overall, participants could understand the sung words well (92% accuracy). The hypothesis that experienced singers would find it easier to understand sung text than inexperienced or non-singers was supported, both by more accurate text identification for singers than for non-singers and a significant correlation between singing experience and overall performance. This may be because singers are used to producing sung text themselves, and therefore better attuned to understanding text sung by others. They will also have experience of being in rehearsals and performances, and hearing others sing while knowing the words themselves, forging a stronger connection between the words and their sung acoustic signals.

However, the results do not support the hypothesis that ensemble singing is harder to understand than solo singing, with no significant difference in performance evident between the two conditions. This may be because the three singers involved all concentrated on making diction as clear as possible so there were few substantial differences between the stimuli in the acoustic signal. Another possible reason is that ensemble effects only really become apparent when there are many singers (even small choirs normally contain at

least eight singers). These results are considered inconclusive and are not sufficient to reject the hypothesis; further study will be undertaken with larger ensembles, and also consider the effect of harmony versus unison singing. Hearing the song for a second time significantly improved intelligibility and underlines the importance of familiarity and repeated hearings on listeners' ability to understand sung text. However, there were certain words that were still hard to understand on the second hearing. In future studies, it would be interesting to investigate the acoustic properties of these words and also the effects of the presence or absence of semantic context on intelligibility.

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