

The effect of retrieval cues developed during practice and rehearsal on an expert singer's long-term recall for words and melody

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We examined a singer's recall for the words and melody of a work with small ensemble and investigated the extent to which this was predicted by practice and rehearsal 18, 32, and 42 months earlier. The singer video-recorded nine practice/rehearsal sessions with the conductor as accompanist over four weeks. She subsequently noted the locations of decisions made during practice (musical features) and those that were retained as cues for retrieval when the piece was performed (individual and shared performance cues). Regression analysis showed that these determined the nature and amount of practice and rehearsal. Crucially, distance from musical features and performance cues also affected recall, suggesting that different kinds of practice influence the way they function as "landmarks" and "triggers."

Keywords: landmarks; memory; performance; singing; triggers

The longitudinal case study method is used to investigate the development of performers' mental representations for music. One key aspect of the formation of mental representations is the development of performance cues. These are the basic, interpretive, and expressive features of the music to which the musician pays attention during practice and rehearsal and which, as a result, become "landmarks" when the piece is performed. This has been investigated through a number of case studies, involving the analysis of solo performers' video-recorded practice sessions, verbal commentaries, and post-performance annotation of musical scores. Participants to date have included a classical pianist (Chaffin *et al.* 2002), a jazz pianist (Noice *et al.* 2004), and a cellist (Logan *et al.* 2007).

Although long-term recall has been studied for many years there have been comparatively few investigations of long-term recall for music. The present study extends the first author's research on singers' learning and memorization of the words and melodies of songs (Ginsborg 2002, Ginsborg and Sloboda 2007). It also builds on a study of the development of an expert singer's and conductor's shared performance cues in the course of individual practice and collaborative rehearsal based on a content analysis of talk cross-referenced with post-performance annotations of the musical score (Ginsborg *et al.* 2006a, 2006b). Its aims were to examine the singer's long-term recall for the words and melody of Stravinsky's *Ricercar 1*, for soprano and small instrumental ensemble, 18, 32, and 42 months after performance from memory, and to investigate the extent to which this was predicted by practice.

METHOD

Participants

Jane Ginsborg, the first author, is a former professional singer; she has worked with the pianist and conductor George Nicholson for more than 30 years, performing as a duo and as members of a variety of ensembles.

Materials

Ricercar 1 (c. 4 minutes), for solo soprano and ensemble, is from Stravinsky's *Cantata* for two solo singers, women's choir, and small instrumental ensemble.

Procedure

Towards the end of 2003 the singer video-recorded five individual practice sessions (4 hours, 13 minutes) and four joint rehearsals (2 hours, 47 minutes) with the conductor. Three ensemble rehearsals (57 minutes) were not recorded or analyzed. A public performance of the complete *Cantata*, conducted by George Nicholson, with the first author as solo soprano, was given on 16 December 2003.

Soon after this performance the participants annotated multiple copies of the musical scores, independently, to show their understanding of the formal structure of the piece, features requiring basic, structural, and interpretive decisions during rehearsal, and musical "landmarks" used as individual performance cues (PCs). They then discussed and reported the landmarks they had used as shared performance cues (SPCs).

The singer wrote out one free recall during the preparation period, gave four complete performances from memory, and made several further written free recalls subsequent to the performance before each period of work on data analysis, writing up, or presenting this project. The first free recall (FR1) was made between the last two rehearsal sessions (words and rhythms only). In the course of the penultimate rehearsal, the singer and conductor, playing the piano, gave two uninterrupted performances of the piece. The singer made one error in one performance and two errors in the other (99.6% and 99.2% accuracy, respectively). The final rehearsal included an uninterrupted performance in which the singer accommodated to two errors made by the conductor. The public performance was accurate in all respects.

The singer made seven further free recalls after the public performance. In each case she wrote down as much as she could remember of the words and melody. The versions she notated were then compared with the score. The fifth free recall, in June 2005, was the first to yield more than one or two trivial errors (FR2). In August 2006 and June 2007, 32 and 42 months after the performance, the singer made and analyzed two more free recalls (FR3 and FR4).

RESULTS

The musical features and performance cues noted by the singer were used as predictor variables in a regression analysis to determine their effects on her behavior (see Table 1).

Errors were analyzed in practice and rehearsal and in the four free recalls. In FR1, words and rhythms were notated with 92% accuracy. Most errors (70%) concerned the recall and notation of rhythms. In FR2 there was a significant decrease in recall ($t=5.47$, $p<0.0001$): 75% of the piece was recalled correctly. Around half the errors (44%) involved omitting the words while preserving the melody, and 46% involved omitting the words and melody altogether. In FR3, there was a very slight, non-significant decrease in recall: 72% of the piece was recalled correctly. Errors included durations (21%), forgetting the words but preserving the pitch if not the rhythmic/durational components of the melody (28%), and forgetting both words and melody altogether (51%). There was a further, near-significant, decrease in recall in FR4 ($t=1.87$, $p=0.06$): 66% of the piece was recalled correctly. The majority of errors were durations (26%), forgetting the melody but preserving the words (12%), and omitting words and melody simultaneously (57%).

Table 1. Effects of predictor variables on singer's behavior during practice.

| Type of feature/ PC | Predictor variable | Sessions 1-3, 5 (singer alone) | Session 6 (with conductor) | Session 8 (singer alone) | Sessions 9, 12, 15 (with conductor) |
|------------------------|--------------------|----------------------------------|----------------------------|--------------------------|-------------------------------------|
| Structur. | Start section | S 0.20*** | S 0.35*** | S 0.25*** | S 0.44*** |
| | Switch | | | R -0.16* | R -0.15* |
| | Start phrase | R 0.18* S 0.63*** P -0.17* | S 0.23* | S 0.47*** | S 0.16* |
| Basic | Prepare | S 0.30*** | | R 0.21* S 0.23** | P 0.15* |
| | Words | R 0.14* | | R 0.20** | R 0.15* |
| | Breath/Tech. | | P 0.16* | R 0.23** | |
| Interpret. | Words (meaning) | | | | R 0.16* |
| Express. | Express. | S -0.17*** | P 0.20* | | |
| Basic PC | Prepare PC | S -0.18** | | R -0.29** S -0.17* | |
| | Tech. PC | | | S 0.13* | |
| Interpret. PC | Words PC | | R -0.34*** | R -0.32*** | R -0.30** |
| Basic SPC | Arrival/off SPC | P 0.38*** | P 0.40*** | P 0.59*** | P 0.30*** |
| Express. SPC | Express. SPC | | S -0.22* | | |
| R ² | Repetitions | | | 0.14** | |
| R ² | Starts | 0.62*** | 0.25*** | 0.42*** | 0.21*** |
| R ² | Stops | 0.20*** | 0.22*** | 0.37*** | 0.12*** |

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

Regression analyses showed the extent to which accuracy could be predicted by serial position (distance) from structural features and performance cues as predictor variables and (a) accuracy in practice and rehearsal and (b) the four free recalls as criterion variables (see Table 2).

DISCUSSION

The significant effects of the predictor variables on the singer's starts, stops, and repetitions during practice and rehearsal establish the validity of the reports. Thus, structural features predicted behavior in all groups of sessions: positive effects indicate, for example, that practice segments were more likely to begin at the starts of sections. Negative effects indicate starting or stopping

Table 2. Effects of serial position from predictors on accuracy during preparation for performance and free recall.

| Type of feature/PC | Predictor variable: Serial pos. from | Accuracy during practice and rehearsal | Free recall 2 (June 05) | Free recall 3 (August 06) | Free recall 4 (June 07) |
|--------------------|--------------------------------------|--|-------------------------|---------------------------|-------------------------|
| Structur. | Start section | | | | -0.20** |
| | Switch | | -0.24*** | -0.21** | |
| | Start phrase | 0.26*** | | | |
| Basic PC | Tech. PC | | 0.37*** | 0.14* | |
| Basic SPC | Score SPC | | | 0.38*** | |
| | Arrival/off SPC | | | 0.15* | 0.20** |
| Express. SPC | Express.SPC | | 0.15* | -0.24*** | |
| R ² | | 0.10** | 0.15*** | 0.24*** | 0.16*** |

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

around (either before or after) rather than *at* the specific location of a feature or cue, thus enabling it to be rehearsed in context. While structural and basic features predicted behavior throughout the sessions, a progression can be noted from behavior predicted by basic performance cues in the early individual practice sessions to behavior predicted by interpretive performance cues in the sessions with the conductor. It is worth noting that the singer recalled a high proportion of the piece correctly, 18, 32, and 42 months after the performance given in December 2003. Analysis of the effects on errors in free recall of serial position from features and performance cues, however, suggest that they function as *landmarks* and *triggers*. Landmarks are the locations of features and cues at which there are negative serial position effects. Recall is best at the landmark and worsens with increasing distance. Triggers are features and performance cues producing positive serial position effects, indicating that recall is worst at the trigger but improves with increasing distance. As predicted from earlier research, structural features functioned as landmarks in all three recalls while performance cues—basic, individual, and shared—functioned as triggers. It may be that the individual “technical” performance cues operated at a procedural level. When the singer was actually performing, singing aloud, the cue related to a physical motor activity; when she wrote out what she remembered of the words and melody, the cue itself was not remembered as it had been in performance. Similarly, the shared performance cues related to coordination with the conductor. In the absence of the other musician,

memory at the location of the cue was poorer than memory for what followed. We would argue that landmarks relate to the explicit recall of declarative knowledge demonstrated by the ability to write out the melodic line of the score after as long a period as three and a half years. Triggers, conversely, relate to the implicit recall of procedural knowledge, which should be easier to demonstrate in live performance.

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