CONTEXT-DEPENDENT MEMORY: IMPLICATIONS FOR MUSICAL PERFORMANCE

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The theory of context-dependent memory was initially developed by McGeoch (1942) to account for the apparent forgetting of information. According to this theory, forgetting is explained as a failure to retrieve stored information rather than actual decay or disappearance of memories. When information is initially memorized, various aspects of the external environment, as well as a person's internal physiological state, are encoded along with the data. Physical characteristics of the environment may include: lighting, acoustics, room dimensions, objects or people in the room, décor, and ambient sound. These environmental features, regardless of whether they are important or incidental to the memorized material, serve as reminders. The theory notes that recall may be difficult if the external or internal environments have changed significantly since learning. Psychologists studying context-dependent memory have been primarily interested in the memorization of verbal material; however, it is possible that memory for musical material may be similarly affected.

Results of studies investigating context-dependent memory have frequently shown that memory for information learned in one environment (e.g., the classroom) is improved when remembering takes place in the same or a very similar setting. Conversely, when remembering is attempted in a different environment, the ability to recall diminishes (Godden & Baddeley, 1975; Smith, 1979; Smith, Glenberg, & Bjork, 1978). If these findings are extended to the memorization of music (Mishra, 2000), the physical surroundings that serve as the primary practice room will elicit the highest level of remembering. A memorized piece of music will be performed with the fewest memory slips in the familiar practice setting. Further, it may be predicted that more memory lapses will occur in alternate environments, such as concert halls.

In addition to a change of environmental context, performance situations are often accompanied by changes in internal physiological states—primarily an increase in anxiety levels. The term "state-dependent memory" is used when physiological or mood states are altered rather than physical environment. Other terms such as "mood-dependent memory" and "music-dependent memory" are used to refer to specific instances of state- or context-dependent memory. Studies of state-dependent memory, again often measuring recall of verbal information, demonstrate that changes in emotional states, as well as drug states, affect memory (see Eich, 1995a, for a review of state-dependent memory and Eich, 1989, for a review of drug effects). More memorized information is retrieved when the emotional state is the same or similar to the learning mood. It may be predicted that the change in anxiety levels between practice (when generally low-levels of anxiety occur) and performance (often accompanied by higher anxiety levels) will affect the ability to perform memorized music.

The theory of context-dependent memory may have serious implications for the performance of memorized music. Changes that often occur between practicing and performing a piece of music may increase the chances of a memory lapse. Avoiding these potential context effects is extremely important to a performing musician.

Because recall has been shown to increase in settings that are similar to the learning environment, it naturally follows that performing in locations and moods that are similar to those at practice will facilitate memory. To benefit memory, many teachers and performers advocate dress rehearsals in the performance context or in situations that would approximate a performance (Binkowski, 1985; Jordan-

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Anders, 1995; Magrath, 1983). Conversely, approximating the learning environment at the time of the performance should also facilitate memory.

Visualization

Context effects can be eliminated simply by imagining or seeing pictures of the initial learning environment (Smith, 1979; 1984). However, imagining a familiar location unrelated to the learning environment does not appear to aid memory (Smith, 1979). Musicians may be able to use the successful technique of mental imagery to facilitate performance memory. Presumably, a connection is established between the memorized material and characteristics of the background surroundings. Features from the learning environment serve to cue the recall of information, which was learned in that location. It then follows that increasing the number of physical cues associated with the memorized material will increase the chances of retrieving the information. Connecting the learned material with multiple context cues ensures that, at the time of performance, sufficient memory aids will be available.

Diversifying Rehearsal Locations

Rehearsing in multiple contexts facilitates memory—even if recall is attempted in a completely novel environment. Thus, if practice occurs in multiple rooms as it did in Smith's studies (1982; 1984; Smith, Glenberg, & Bjork, 1978), forgetting caused by the novel setting will diminish compared with repetitions in only one location. In all likelihood, features in the novel environment had been encountered in one or more of the rehearsal locations, thus making aspects of the learning and performing contexts similar. Musicians may benefit from practicing in many different rooms and different environments prior to a performance. Even if rehearsals are not possible in the actual performance context, practice in the multiple environments may reduce errors due to an altered setting. Distributing learning among various locations may facilitate memory just as distributing learning over time may be beneficial.

Distributed vs. Massed Learning

Generally, massed practice (or "cramming") is criticized as an inefficient way of learning (Baddeley, 1999; Underwood, 1961; Underwood, Kapelack, & Malmi, 1976). Distributing learning, on the other hand, with time intervals between each instructional session, promotes recall of verbal information (Smith, 1982; Smith & Rothkopf, 1984), as well as musical information (Rubin-Rabson, 1940). It has been theorized that slight changes occur in physiological and mental states between each rehearsal. Thus, information is learned in multiple internal environments. As with multiple physical environments, the chances of the internal state at the time of performance resembling a practice state increase with the number of different rehearsal contexts. While musicians appear to memorize music faster using massed practice, retention is greater for performers who distributed practice over time. This is particularly true for younger, less experienced musicians (Rubin-Rabson, 1940). Based on these findings, it may be predicted that novice performers will likely be affected to a greater degree by a change of context than advanced musicians who have played in multiple settings during their careers.

Ability Level and Task Difficulty

Though students are not generally affected by changes in classroom contexts (Saufley, Otaka, & Bavaresco, 1985; Spear & Riccio, 1994), students with low abilities may rely more on environmental cues to aid recall of information than higher ability students, both due to the perceptual similarities of various classrooms and to the multiple environments in which studying takes place (Abernethy, 1940; Wright & Shea, 1991). Higher-ability students are able to remember as much information regardless of changes in their surroundings. It is unclear from the research conducted to date whether context dependence is influenced by actual student-ability levels or by the specific types of experiences that higher ability students are likely to encounter. More accomplished musicians tend to have more performing experience in a variety of contexts and a greater familiarity with the performance literature than less accomplished musicians.

Familiar material, which is remembered in a different context in which it was learned, is not likely to be affected by a change of setting (Dalton, 1993). Unfamiliar material, however, may be difficult to remember in surroundings different from the learning situation. Familiar information has probably been encountered in a number of environments and is, therefore, less likely to be forgotten even in a novel context. Familiar material also tends to be easier to perform than relatively unfamiliar material.

Task difficulty (which may be comparatively greater for novice musicians), as well as experience, may also affect memory (Wright & Shea, 1991). Simple motor tasks can be similarly executed, regardless of whether a

situational shift occurs between learning and performing. However, the more difficult muscular movements are affected when contexts are changed (Anderson, Wright, & Immink, 1998; Wright & Shea, 1991). The change of setting generates more errors in kinesthetic performance. Thus, difficult passages in the music may be more susceptible to mistakes when surroundings change. Simplifying the performance may reduce contextual effects. One way to simplify the performance is to use memory aids, such as notation.

Context-dependent memory may only affect memorized performances and not pieces played with the aid of notation. A clear difference exists in the effects of altered contexts on recognition and recall. Free-recall tasks commonly show that a change of context results in greater amounts of forgetting. However, rarely do recognition tasks show the same pattern (Godden & Baddeley, 1980; Smith, 1986). A similar amount of information can be recognized regardless of the retrieval location. The more difficult task of free recall, which may be equated to the performance of memorized music, does not present any visual memory aids. However, recognition is a much easier task than recall because presented features act as memory cues. Musical notation serves to cue memories for the piece of music, thus making environmental cues unnecessary. The presence of notation during a performance decreases the difficulty level in comparison to performing the music from memory, thus reducing the influence of a shift in environmental or internal states.

Level of Anxiety

Internal states, such as higher anxiety levels, do appear to affect less experienced performers (Hamann, 1984; Hamann & Sobaje, 1983). While an increase in anxiety levels during a performance may be expected, anxiety levels increase to a greater degree when music is performed by memory (LeBlanc, 1994; Leglar, 1978). Interpreting the results in light of context-dependent memory research, changes in anxiety levels between practice (lower anxiety levels), and performing (higher anxiety levels) may result in more performance errors. While performing with musical notation tends to be easier than playing from memory, the task of performing may still be very difficult for less experienced musicians. The novice, then, may still be susceptible to changes in internal states. Performances in anxiety states dissimilar to practice may result in a higher number of errors. In studies of anxiety, higher levels of anxiety are often induced by the addition to the environment of an audience (Hamann, 1982; Hamann & Sobaje, 1983; Leglar, 1978). The presence of an audience serves to change both the physical characteristics of a room and internal anxiety levels (LeBlanc, Jin, Obert, & Siivola, 1997).

Eich (1995b) has argued that physical environments are associated with internal mood states. Thus, a change in physical environment also changes internal state. Context-dependent memory is a subset of state-dependent memory, specifically mood-dependent memory. Musicians may be affected by a change in physical surroundings only because the settings are associated, possibly by conditioning, with a certain mood or emotion. Musicians may associate a concert hall with increased anxiety levels and a practice room with reduced anxiety levels. A change in physical context would then result in a change of internal context as well.

Though experienced performers may be able to extricate themselves gracefully from a memory lapse, slips in memory can be devastating to younger performers, who simply may have to stop and restart the piece. The problem with memory slips is that they can happen at unexpected moments. Further, a performer could have played a piece of music perfectly from memory during a dress rehearsal and then have a devastating memory slip in performance. It is difficult to prevent what cannot be predicted. Yet, various activities may reduce memory lapses in performances.

Preconcert Performance

One activity which may help solidify memory and prevent memory slips in performance is a preconcert performance. Many teachers hold a dress rehearsal or a master class to give students a "dry run" at their piece. Generally, these preconcert performances take place in front of a small, sympathetic audience who will be uncritical of memory slips or technical errors. The audience can be friends, family, or even the family pet or a tape recorder. Even a small, sympathetic audience will engender performance anxiety, which may help "set" a memory (Street, 1987). Performances should also take place in as many locations as possible, e.g., churches, school music classes, and school choirs (Magrath, 1983). De Sesa (1986) advocated simulating as closely as possible the performance setting, even down to the lighting, applause, bowing, order of program, and intermission. Duplicating the performance setting during practice is a way of duplicating the disruptions that could possibly throw off concentration and lead to a memory slip. This same idea motivated Foster (1992) to encourage students to practice with the "television on, conversation in the background, or younger siblings running through the room" (p. 43).

The concept of practicing the performance is an

informal extension of the preconcert performance. An audience is not generally present when a performance is practiced, but the performer practices everything as if it were the performance. Magrath (1983) even suggested wearing the shoes that will be worn in performance. For pianists, the performance instrument may be unfamiliar—an added distraction. Ideally, the performance piano has been played by the performer even if just prior to the performance, but this is not always the case. To prevent memory slips due to distractions caused by playing a different instrument, Magrath (1993) advocated performing on as many different pianos as possible. If a pianist has played on many different instruments, performing on an unfamiliar instrument will be less problematic.

Summary

Regardless of whether the physical environment or the feelings of the performer change at the time of a concert, the shift may result in a marred performance. However, even though performances commonly occur in a different location than practices do, changes in location do not necessarily result in more memory slips. Anticipating the performance environment and varying practice settings may aid memory and reduce any effects a change of location may have. Many musicians, especially advanced performers, may not be greatly affected by context-dependent memory because experience appears to limit context effects. Thus, studies of context-dependent memory may have greater implications for younger, less experienced musicians.

Younger musicians should be encouraged to practice onstage prior to a performance and to perform for friends and family in order to replicate as closely as possible the performance experience. Practicing in a performance hall may prevent lapses in memory that might not have occurred during practice. If it is not possible to practice in the concert hall, students should be encouraged to practice in many different rooms. Distributing practice over many different environments and over a period of time may help the student cope with the novel performance environment. Further, imagining the learning environment just prior to a performance may benefit the musician. The more alike the performance and learning situations are, the less likely that forgetting will occur.

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