Imaging the music: A context-specific method for assessing imagery ability

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This study compared timing profiles of live and mental performances to determine if such an approach could provide a context-specific and objective indication of musicians' imagery abilities. Of further interest was how performance on this type of task may relate to scores obtained on standard imagery use and vividness measures. Thirty-two music students were recruited from the Royal College of Music (RCM). They first completed two imagery use and vividness measures, followed by two live and two mental performances of a two-minute extract of their choice. Following the generation of timing profiles for each performance, correlations were calculated within and between the two performance conditions. These were normalized by conversion to Z-scores and then compared with results obtained from the imagery use and vividness measures. While all participants achieved a significant correlation between the timing profiles from the live performance condition, only 17 did so within the mental performance condition. When comparing the timing profiles between the two conditions, 22 obtained significant correlations. Significant correlations emerged between the imagery vividness measures and Z-scores from the live performance condition, while amount of time spent employing imagery significantly correlated with Z-scores from the mental performance condition.

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Prior to the development and implementation of mental skills training programs for musicians, it is necessary to generate an accurate assessment of their skills and abilities. However, assessment of musicians' mental skills, imagery included, is not straightforward. A number of self-report questionnaires for assessing imagery vividness currently exist, yet they have been

criticized for lacking objectivity. In addition, research would suggest that imagery ability is comprised of three distinct features: vividness, controllability, and accuracy of reference (Denis 1991).

One potential alternative to self-report questionnaires employs temporal comparisons between live and mental performances, also termed mental chronometry, as employed by Repp (1999a, 1999b) and Wöllner and Williamon (2007). These researchers proposed that by removing sensory feedback during performance, insight could be gained into the strength and content of musicians' mental images. The use of chronometric comparisons between live and mental performances is also based upon work from human movement sciences which suggests that imagery processes are mediated by neuronal mechanisms similar to those used in perception (Mellet *et al.* 1998).

While previous research would indicate that musicians are capable of performing works with similar timing profiles across repeated performances, results derived from studies employing mental chronometry caution that there is variability among musicians' ability to perform such a task, particularly in the absence of kinaesthetic feedback (c.f. Repp 1999a, 1999b, Wöllner and Williamon 2007). Due to these varying results, musicians' ability to perform this type of chronometric task successfully is still somewhat unclear, as is the range of factors that may help or hinder their ability to do so.

Given the current state of understanding surrounding musicians' imagery use and abilities, this study sought to investigate the efficacy of a context-specific and objective method for assessing musicians' imagery abilities. In particular, timing profiles of live and mental performances were compared to determine if such an approach could be a valid indicator of imagery ability and vividness. Of interest was how performance on this type of task may relate to scores obtained on standard imagery use and vividness measures.

METHOD

Participants

Thirty-two undergraduate and postgraduate music students were recruited from the RCM. The sample comprised 11 men and 21 women, ranging in age from 20-28 years (mean=22.29, median=22.0, SD=2.20). In terms of the participants' year of study, 4 were year 1 undergraduates, 6 were in year 2, 14 were in year 3, 4 were in year 4, and 7 were postgraduates. For their instrument groupings, 7 were pianists, 9 were vocalists, 12 were string players, and 4 were woodwind and brass players.

Materials

In order to gain an understanding of the participants' previous experience with imagery and mental rehearsal, as well as their mental approaches to practicing and performing in general, a survey was developed to ascertain the types of mental activities in which the participants engage in relation to their musical activities. Participants were also asked to provide an approximate indication of the amount of time they engaged in each type of mental strategy or activity per week, how long they had been using the particular activities, and how skilled or effective they were in using each of them by rating themselves on a scale from 1-7, with 7="very skilled."

The randomized short version of Betts Questionnaire upon Mental Imagery was employed to assess imagery vividness (Betts QMI, Sheehan 1967). This is a 35-item self-report questionnaire in which participants are asked to rate on a 7-point Likert-type scale the strength or vividness of suggested sensory experiences, with 1="perfectly clear and vivid" and 7="no image present at all." Each of the senses is addressed, including sight, sound, taste, smell, movement, and interoceptive and exteroceptive sensations. As per the standardized instructions, participants were asked to imagine a particular sensory experience and then to rate the vividness of the image created. Responses are summed for a total questionnaire score as well as scores for each of the subcomponents. A lower score indicates a greater level of imagery vividness.

Finally, a mental chronometry task was developed with the aim of providing a contextually relevant, empirical measure of imagery ability that extends beyond self-report measures. The full procedure for this task is described below.

Procedure

Following completion of the survey and questionnaire, the participants were requested to perform a 2-minute extract of their choice that was at a public performance standard. The participants first gave two live performances of their chosen extract followed by two mental performances of the same extract, tapping a light metal object upon a desk to indicate the beats of the piece as they imagined themselves performing it. All performances, live and mental, were recorded using a Tascam portable stereo audio recorder.

Initial data preparation involved the generation of mean scores and standard deviations for the survey and questionnaire, as well as relevant individual items or subscales within them. For the mental chronometry task, the inter-onset-intervals (IOIs) for each of the four performances were extracted to produce timing profiles. Following the creation of timing profiles, similar-

ity between the IOIs of the two performances within each of the two conditions was assessed using one-tailed Pearson correlations. One-tailed Pearson correlations were next used to assess the similarity of the IOIs between the two conditions. All correlations were normalized by conversion to Z-scores for use in further analyses with the imagery use and vividness measures.

RESULTS

When asked to identify the types of mental strategies or activities that the participants employed as part of their regular practice activities, imagery was identified most often (n=20 of 32). Of those who cited regularly employing imagery, they reported using it for an average of 25.95 minutes per day (SD=28.54), that they had been using it for 6.48 years (SD=5.87), and rated their effectiveness with imagery at 4.80 out of 7 (SD=1.28). Within this, the participants reported singing or hearing their music in their minds, memorizing music away from their instruments, and playing on a surface other than their instrument (or "finger practice").

For the Betts QMI, the participants obtained a total mean score of 89.66 (SD=26.09). The potential range for this questionnaire is 35-245, with a lower score indicating greater imagery vividness. The participants' ability to imagine sounds (auditory sub-component) and movements (kinaesthetic sub-component) were the senses achieving the greatest vividness on this measure, while the participants' ability to imagine smells (olfactory sub-component) achieved the least amount of vividness.

When considering the participants' performance on the mental chronometry task, all 32 participants achieved a significant correlation between the IOIs of the two live performances. When examining the mental performance condition, however, only 17 participants achieved a significant correlation. Comparing the IOIs between the two conditions, 22 of the 32 participants yielded a significant correlation between the two conditions.

Comparing the results from the different assessment measures (see Table 1), a significant positive correlation emerged between the amount of time per day that the participants reported employing imagery and their ability to perform consistently within the mental performance condition. A significant positive correlation also emerged between the participants' self-rated ability to engage in imagery and their ability to give multiple temporally similar performances within the live performance condition. A link between imagery vividness and ability within the live performance condition was also found with the Betts QMI. The normalised Z-scores from the live performance condition achieved significant negative correlations with total scores from the

Table 1. Significant Pearson correlations between the Z-scores derived from the mental chronometry task with the imagery use and vividness measures.

	Live performance condition	*Mental performance condition*	*Between conditions*
Imagery: Mins. per day used	0.31	0.46*	0.07
Imagery: Self-rated ability	0.42*	0.36*	0.25
Betts QMI Total score	-0.35*	-0.01	-0.13
Betts QMI Auditory	-0.54**	-0.06	-0.14
Betts QMI Visual	-0.40*	-0.10	-0.02
Betts QMI Gustatory	-0.36*	-0.13	-0.23

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Betts QMI as well as the subcomponents of visual, auditory, and gustatory imagery. As lower scores on the Betts QMI indicate greater levels of imagery vividness, negative correlations indicate a promising connection.

DISCUSSION

For 63% of the participants, imagery formed a significant part of the practice activities. Within this, auditory and kinesthetic imagery were the senses for which the participants reported the greatest amount of vividness. Within the mental chronometry task, while all participants were able to give two performances of comparable timing profiles within the live performance condition, some musicians were less able to do so with the removal of sensory feedback in the mental performance condition, supporting results from previous investigations of this type. Based upon examination of the results from the three assessment measures, the three scores derived from the mental chronometry task appear to provide an indication of either imagery vividness, controllability, or accuracy of representation, supporting the proposal that imagery ability is comprised of three distinct features (Denis 1991).

Possessing high levels of vividness and control over their imagery should be of great importance for musicians, and while previous research would suggest that greater imagery ability facilitates enhanced performance quality (McIntyre *et al.* 2002), this link within music needs to be explored more fully. Having reliable methods for accurate assessment of imagery ability is central within this. Lastly, these findings support recommendations for the use of a mixed-methods design when assessing musicians' imagery use and abilities,

with a mental chronometry task such as that employed here adding an element of objectivity to these investigations.

Acknowledgments

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