The planning behaviours of musicians engaging traditional and non-traditional scores

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The study investigated the planning strategies of university music students learning a traditionally and non-traditionally notated (graphic notation) score. After completing a modified form of the SPQ, participants read two musical scores on a PC, one line at a time. Reading times for each line were taken, as were reaction times to a secondary probe. At the completion of each score, participants verbalised how they would go about learning the score to a level of performance competence.

Protocols were scored for the presence of higher-level, mid-level and lower-level strategies, and for the level of focus in planning. Path analyses, with planning focus as the outcome measure, were conducted for each score. In both sets of analyses, reference to higher-level processing strategies predicted a higher planning focus, while a deep approach predicted higher-level strategy use. For the traditional score, surface learning was a negative predictor of high-level strategies, while a longer reading time was a positive predictor of higher-level strategy use. For the non-traditional score, both high- and mid-level strategies predicted a higher focus while low-level strategies predicted a lower focus. Familiarity with graphic notation, through mid-level strategies, also predicted focus. The implications of the results for the teaching of music are discussed.

Introduction

In a previous report (Cantwell & Millard, 1994), we investigated the possibility that the level at which musicians form intentions in learning new music may relate to factors beyond the ability to simply "read" or decode musical score. Using Biggs' (1987a) description of "surface" and "deep" learners, we highlighted the discriminative power of these approaches in describing the way in which secondary school music students approached the learning of new musical score. Consistent with expectations, students reporting a surface approach to learning typically addressed technical matters of notation and rhythm, whilst ignoring higher-order features relating to the "musicality" of the scores. Students reporting a deep approach to learning, on the other hand, consistently alternated processing attention between both higher-order and lower-order elements of the score, suggesting the possession and use of a greater variety of cognitive strategies than was evident among the surface students. The subjects in that study were all within the novice range of musical competence, as measured by the Australian Music Examination Board (AMEB) standards. While qualitative differences were apparent between the "surface" and "deep" subjects' responses to the musical scores, the responses were nonetheless within the typical parameters of novice-like outcomes. That is, better respondents were aware of the "musical character" of the target scores, but did not extend their understandings to embrace genre-related attributes of the score (cf. Colley, Banton, Down & Pither, 1992; Gromko, 1993). These differences were consistent regardless of the difficulty level of target scores. Given that the target scores in that study could be discriminated on the basis of conventional and unconventional musical forms (within traditional notation), the study was unable to establish whether the observed individual differences in attentional focus would also be evident amongst more musically expert populations, and whether these would interact with score difficulty.

In the present study we expand upon the findings of the Cantwell and Millard (1994) report by moving beyond case studies to investigation of the planning behaviours of a cohort of 53 university-level music students. Specifically, we propose a causal model (see Figure 1) in which prior knowledge and experience in musical learning (as indicated by AMEB score and by level of familiarity with graphic notation), preferred approach to learning (as indicated by Biggs' (1987) SPQ) are presumed to influence the attentional behaviours of musicians (as indicated by reading and reaction times to lines of musical score), the nature of strategy use, and through these, the quality of musical planning. Each of these hypothesised indicators of musical planning are discussed below.

Figure 1: A causal model for musical planning

[Figure available from authors on request}

Approaches to learning: There is a strong corpus of research indicating differential learning outcomes associated with particular approaches to learning (Biggs, 1993; Cantwell & Moore, in press; Marton, Carlsson & Halasz, 1992; Marton & Saljo, 1976; Volet & Chalmers, 1992; Watkins & Hattie, 1992). The deep approach, for example, is marked by an intention to understand content in a structurally complex way, while the surface approach is marked by a desire to simplify structural complexity to a point of minimally acceptable competence (e.g. Biggs, 1979; Cantwell, in press; Marton & Saljo, 1976). For musicians, possession of a deep approach is therefore more likely to be associated with a perception of musical meaning that goes beyond notational reproduction. As all subjects in the present study may reasonably be described as technically competent musicians (by AMEB standards), we may well expect that a major point of individual difference in intention formation in learning new music lies in the more sophisticated assumptions of the musical epistemology which a deep rather than surface approach to musical learning may represent. If it is the case that "deep" musicians are epistemologically more likely to see complex possibilities in music, then it becomes reasonable to further speculate that the depth of cognitive engagement will be greater, that the corpus of cognitive strategies called upon will be greater, and that the structural quality of planning focus will indicate greater complexity of musical concerns. Moreover, by incorporating the less common non-traditionally notated score into the design of the study, the possibility of more automated access to traditional score as an explanation for higher quality planning is able to be tested.

Prior Knowledge: The role of prior knowledge as an explanatory factor in complex problem solving has been emphasised in a number of recent studies (Cholowski & Chan, 1992; Hassebrock, 1992; Schmidt, de Volder, de Grave, Moust, & Patel, 1989). These studies have indicated that the possession of highly structured and complex schemata within a domain acts as a positive predictor of problem-solving performance within that domain. In the present study we use two measures of prior knowledge. The first is a general measure of musical competence - the AMEB level. This measure combines indicators of both theoretical knowledge and performance related achievement. Attainment of the highest levels of AMEB (Associateship and Licentiate) are generally seen as indicative of expertise. Certainly by the middle grades (perhaps 3rd and 4th Grades) assumptions of notational fluency may reasonably be drawn. It may be expected that those musicians who have attained higher levels of musical expertise as indicated by the AMEB level should engage novel music with more sophisticated intentions than would be the case of the more novice-like musician. The second measure of prior knowledge was a self-report measure of familiarity with non-traditional graphic notation - a 20th century musical form bereft of traditional forms of notation (Brindle, 1975). The use of this form of notation allows us to examine planning behaviours of musicians in a context where the traditional patterns of notation are unavailable as an aid to higher-level processing - therefore to some extent negating technical elements of expertise. It would be assumed that those musicians reporting higher frequencies of contact with the genre would be more likely to use such experience as an interpretative aid. However, unlike traditional musical scores, the idiosyncratic nature of the notation in graphic notation precludes the use of specific score related schemes as a form of pattern recognition. Thus we may reasonably expect musicians reporting a deep approach to musical learning to place greater effort on ascribing meaning to the non-traditional symbols.

Depth of cognitive engagement: Previous research in the area of cognitive load in learning has suggested that an individual's attentional behaviour may vary as a functional of the relative importance of the information being attended to (D'Ailly, Murray and Corkhill, 1995; Reynolds, Shepard, Lapan, Kreek & Goetz, 1990; Lapan & Reynolds, 1994; Sweller, 1988). Reynolds et al (1990) suggest three aspects to selective attention: that information elements are initially processed to a minimal degree and then evaluated for importance; that attention is distributed amongst information elements according to perceived importance; and as a consequence of extra attention, important elements are better learned than unimportant elements. Reynolds et al (1990) describe two traditional measures of depth of engagement in selective attentional terms: reading time for each unit of information as a reflection of the duration of attention; and reaction time to a secondary task as a reflection of the intensity of attention. In the present study, we would expect differences in selective attentional behaviours both as a reflection of both approaches to learning and quality of prior knowledge, and as an indicator of complexity of strategy use.

Quality of strategy use: The progression I learning from simpler to more complex understandings has been linked I the literature to the availability and use of an increasingly sophisticated strategic repertoire (Alexander, 1992; Prawat, 1991; Weinstein & Mayer, 1986). Weinstein and Mayer (1986) argued that there is a hierarchical and spiralling relationship between strategy use and content concerns. They suggest that what differentiates simpler and more complex learning outcomes is the nature of the encoding process (equivalent in this study to the level of planning focus). For any given level of encoding, Weinstein and Mayer argue that congruent forms of a basic strategic repertoire may be repeated. In this study, we identify three levels of strategy use (labelled low-level, mid-level and high-level) which we see as variants of common strategy types as applied to lower and higher levels of encoding. For example, the strategies of association (Rathus, 1986; low-level), linking (Phye & Sanders, 1992; mid-level) and interpretation (Shaffer, 1995; high-level) strategies may be linked in the way new information moves from a relatively untransformed to an altered or transformed state. The strategies of rote learning (Shehan, 1987; low-level), chunking (Large, Palmer & Pollack, 1995; mid-level) and patterning (Smith, 1992; high-level) indicated an increase in the size of the units being encoded. Strategies such as no response/avoidance (Faerch & Kasper,1983; low-level), sight reading (Barry, 1992, low-level) and trial-and-error (Fu, 1995; low-level) show little active organisation and selection of material in planning, whereas speed alteration (Hallam, 1995; mid-level), scanning (English, 1992; mid-level) and prioritising (Volet & Chalmers, 1992; high-level) are more involved with understanding how the task may best be tackled. Lastly, external recourse (Karabenick & Knapp, 1991; low-level), research (Newman, 1990; mid-level) and monitoring (Schraagen, 1993; high-level) strategies demonstrate the move from dealing with the entire problem externally through to conscious control of questioning, use of appropriate resources and exploration when necessary. We argue in the present study that the quality of strategy use evident in student protocols will be reflective of approach to learning, quality of prior knowledge and depth of cognitive engagement, and will in turn indicate the quality of the planning focus.

In summary, the study investigates individual differences in the way musicians approach and plan the learning of new musical score. Specifically, we investigate whether approach to learning (as indicated by Biggs' (1987b) SPQ), prior knowledge (as indicated by AMEB levels and familiarity with graphic notation), depth of cognitive engagement (as indicated by reading times and reaction times), and quality of strategy use contribute significantly to the quality with which musicians plan to learn conventional and unconventional musical score.

Method

Subjects

Participants in the study included 53 Conservatorium of Music students from an Australian university. There were 20 males and 33 females in the sample. Ages ranged from 17 to 45 years (mean 20.70, sd 4.67). The level of musicianship for each student was indicated by standards of the Australian Music Education Board (AMEB). The levels ranged from 4th Grade to Licentiate. A wide range of instrumentation was represented, including string (11 participants), wind (10), brass (9), keyboard (14) and voice (9). Participants also reported on their level of familiarity with 20th century graphic notation. Of the 53 participants, 23 indicated very little familiarity, 6 indicated some familiarity, 7 indicated a moderate level of familiarity, while 6 were familiar and 10 indicated they were very familiar with graphic notation. For technical reasons relating to the gathering of reaction time and reading time data, the effective sample size for analyses reported here was reduced to 49.

Materials

Study Process Questionnaire: A modified and shortened version of Biggs' (1987b) Study Process Questionnaire was used. Six items from each of the deep and achieving scales (three motive and three strategy items for each) were modified to be specific to learning in music. This required only slight changes of wording. (e.g Surface: I think it is enough to learn most musical scores by rote, going over and over them until I know them by heart. Deep: I feel that virtually any style of music can be highly interesting once I get into it.) In order to confirm the construct validity of the modified deep and surface scales, a series of congeneric analyses were conducted using LISREL (J"reskog & S"rbom, 1993) procedures. The analyses confirmed the structure of both scales (Deep: Chi square with 8 degrees of freedom = 7.64, $p = .47$; GFI = 0.97, AGFI = 0.92; Surface: Chi square with 7 degrees of freedom = 2.56, $p = .92$; GFI = 0.99, AGFI = 0.96). Scale scores were then obtained using the factor score regressions to calculate a weighted deep score and a weighted surface score.

Reading Times: All participants were initially exposed to the scores via computer screen. The computer was an IBM compatible PC 386 running in monochrome mode. Each line of score appeared on screen on keyboard command. The lines were presented cumulatively - that is, the first line remained on screen as the second line was added and so forth until all six lines appeared on screen. The time between commands for new lines was automatically recorded to the 100th of a second. The reading times for each line were then averaged to obtain the measure of Average Reading Time for each score.

Reaction Times: While reading the score, students also responded to a secondary probe (in this instance a "beep" from the computer) by pressing the space bar on the keyboard. Initial trialing indicated that a set 4 second interval for the secondary probe allowed for sufficient data per line without imposing undue interference. Reaction times were automatically recorded to the 100th of a second. The reaction times for each line were then averaged to obtain a measure of Average Reaction Time for each score.

For both reading time and reaction time data, there is inherent measurement error due to both delay and random error. D'Ailly, Murray and Corkhill (1995) suggest that both the size (mean of 10ms and +/- 5ms respectively) and randomness of these error sources allow us to assume a non-significant contribution to results.

Traditionally-notated Score: The score used in this study was taken from Cantwell & Millard (1994). The score was composed by the first author to reflect a difficult, but nonetheless manageable, musical problem for competent musicians. It was written in traditional western notation, in a modern or avant garde style. The score was atonal in nature, and included frequent time signature shifts and challenging rhythmic structure. The absence of a set form, tempo, dynamic and articulation markings provided a wide scope for personal interpretation. The score is 24 bars in length (six lines), with a pitch range of an octave and two notes (middle C to Eb and octave above) which is not technically demanding for any of the participants in the study. The score is reproduced in Figure 2.

Graphically-notated Score: This score was composed by the first author in 20th century graphic notation using recognised symbols associated with the style (Brindle, 1975). In this genre, the performer is more or less free to view and interpret the pitches, ranges, dynamics and so forth provided on the score unless detailed instructions are written by the composer. The symbols are a written guide to the piece, and hence rarely are two performances ever the same. The various shapes, lines and squiggles suggest not only pitch as in traditional notation, but often also indicate changes in timbre, volume and tempo. A musician is required to express the emotion, objective or message of the piece through careful consideration of all the elements, rather than playing whatever comes and hoping for the best as in chance music. The score is also six lines long, but without bar lines. There are no specific clef signs, time signatures, definite pitches or tempo indications. The score is reproduced in Figure 3.

Procedures

After obtaining informed consent, all participants were tested individually in a practice room at the Conservatorium. Subjects were first introduced to the computer procedures. Practice time was given to ensure all technical aspects of completing the tasks were mastered. All subjects then completed the demographic information and SPQ on line. Procedures for reading the scores were then explained, and further practice time given. When subjects indicated understanding of the procedures, the scores were read on line, and reading and reaction times recorded automatically. At the completion of each score, the subjects were given a hard copy of the score, and were asked to indicate how they would go about learning that score to a level of performance competence. Some probing was used (e.g. How would you go about learning this piece of music? Are there any other things you might do to learn this? Can you explain why you would do this? Is this normally the way you would go about learning new music?). All verbalisations were audio recorded, and later transcribed for analysis. The tasks generally took no more than 20 minutes to complete.

Scoring

Planning Strategies: All protocols were analysed for the presence of low-level, mid-level and high-level strategies. The types of strategies identified, and their categorisation, were derived from the student learning literature, particularly that literature examining the role of prior knowledge in learning. Fifteen strategy types were identified. The lower level strategies included simple association, rote learning, trial and error, non-response or avoidance, sight reading, and external recourse. Mid-level strategies included speed alteration, chunking, linking, scanning and research. High-level strategies included interpretation, patterning, prioritising, and monitoring. A summary of these strategies with scored examples is included in Table 1.

Planning focus: Following broadly on Biggs and Collis' (182) seminal work on the SOLO

Taxonomy and Cantwell and Millard's (1994) application of this to musical planning, a seven level taxonomy of planning foci in learning new musical score was developed for this study. The objective of the taxonomy was to categorise both the quality and the comprehensiveness of musical thinking as evident in the planning protocols. The taxonomy ranged from irrelevancy at the lowest level, through concern with musical elements only, to concern with the whole score, interpretation of the score and ultimately the contextualisation of the score within the broader musical domain. Details of these levels, along with scored examples, are provided in Table 2. All scoring was conducted by the first author, and cross validated by expert musicians form the Conservatorium.

Table 1: Scoring criteria for planning strategies

Table 2: Scoring criteria for levels of planning focus

(Tables available from authors on request}

Results

As noted earlier, the study aimed to investigate the role of approaches to learning (Surface and Deep approaches), levels of prior knowledge (AMEB level and Prior familiarity with graphic notation), depth of cognitive engagement (Reading times and Reaction times) and strategy use (Low-level, Mid-level and High-level) in explaining the level of planning focus in learning traditionally-notated and graphically-notated score. Zero-order correlations were used to describe the individual relationships between variables. Path analytic techniques were used to describe the relationships among all variables in explaining the level of planing focus for each score. Due to the limited sample size for these analyses (n=49), path analyses were conducted using multiple regression procedures rather than the more optimal structural equation modelling techniques. All analyses were conducting using the Statistica for Windows (v5.1) program (Statsoft, 1995). Descriptive statistics for all variables included in the analyses are summarised in Table 3.

Table 3: Descriptive Statistics for all variables in analyses

(Tables available from authors on request)

Zero-order relationships

Tables 4 and 5 show the intercorrelations among all variables used in the analyses involving the traditionally notated score and those involving the graphically notated score respectively.

Intercorrelations involving level of planning focus: For the traditional score, a higher planning focus was related to a greater reference to mid-level and high-level strategies, to a longer average reading time per line, and to the reported use of a deep approach to learning. Higher level planning was also related moderately, but not significantly, to higher AMEB levels and to lower reported use of a surface approach to learning. For the graphic score, a higher planning focus was related to a greater reference to mid-level and high-level strategies, to prior familiarity with graphic notation, and to the reported use of a deep approach to learning.

Table 4: Intercorrelations among variables used in the analysis of the traditionally notated score

Table 5: Intercorrelations among variables used in the analysis of the graphically notated score

(Tables available from authors on request)

Intercorrelations involving low-, mid- and high-level strategies: For the traditional score, reference to higher-level strategies was significantly related to reference to mid-level strategies, to a longer average reading time per line, to a lower reported use of a surface approach, and moderately, but not significantly, to a higher reported use of a deep approach. Reference to mid-level strategies was significantly related to reference to high-level strategies, to a longer average reading time per line, to a higher AMEB level and to the reported use of a deep approach to learning. Reference to low-level strategies was unrelated to any other variable. For the graphic score, reference to higher-level strategies was significantly related to reference to mid-level strategies, to prior familiarity with graphic notation, and moderately, but not significantly, to the reported use of a deep approach to learning. Reference to mid-level strategies was significantly related to reference to high-level strategies, to prior familiarity with graphic notation, to a higher AMEB level and moderately, but not significantly, to the reported use of a deep approach to learning. Reference to low-level strategies was unrelated to any other variable.

Intercorrelations among other variables: Only one significant correlation was evident amongst all other variables, with a reported use of a deep approach also linked with the reported use of a surface approach. There was also a moderate, but not significant relationship between the reported use of a deep approach and AMEB level. Specific to the traditional score was a moderate, but not significant relationship between the reported use of a surface approach and average reaction time per line of score.

Path Analyses with Planning Focus as the outcome measure

We proposed a three-step model in attempting to explain the quality of musicians planning processes. In this model, we predicted that "presage" factors of approaches to learning and prior musical knowledge (AMEB level and prior familiarity with graphic notation) would influence quality of strategy use (mediated by depth of cognitive engagement) which in turn would influence the quality of planning. Path analytic techniques were used to test the model. Three sets of path analyses were conducted: one for the traditional notation, and two for the graphic notation. The first analysis for the graphic notation excluded prior familiarity with graphic score in order to facilitate direct comparison with the equation for the traditional score. The second analysis included prior familiarity with graphic notation as a predictor variable.

Path analysis for the traditionally-notated score: The results of the path analysis for the traditionally- notated score are summarised in Table 6 and illustrated in Figure 2. Most apparent in the solution was the path from high-level strategies to planning focus. There was no link between planning focus and reference to either mid-level or low-level strategies. Music students who reported use of a deep approach and who spent a longer time reading each line were more likely to refer to higher-level strategies. Students reporting use of a surface approach were less likely to refer to higher-level strategies. Prior musical achievement, as indicated by AMEB level, had no significant influence on strategy use of planning focus. The equation explained 78% of the variance in planning focus ($F_{8,40} = 18.24$, $p < .0001$).

Path analysis for the graphically-notated score: For this analysis, reference to high-level and mid-level strategies was positively related to planning focus, while reference to low-level strategies was negatively related to planning focus. Students who reported use of a deep approach were more likely to make reference to high-level and mid-level strategies, and through these engage in higher level planning. The equation explained 62% of the variance in planning focus ($F_{8,40} = 8.29$, $p < .0001$). The results are summarised in Table 7 and illustrated in Figure 3 Path analysis for the graphically-notated score including prior familiarity with graphic notation as a predictor variable: In this analysis, two significant paths were apparent. The first indicated use of a deep approach in conjunction with reference to higher-level strategies leading to a higher planning focus. The second path indicated prior familiarity with graphic notation in conjunction with mid-level strategies also leading to a higher planning focus. The equation explained 64% of the variance in planning focus ($F_{9,39} = 7.60$, $p < .0001$). The results are summarised in Table 8 and illustrated in Figure 4.

Discussion

The study investigated four aspects of planning in learning new music: the roles of approaches to learning and prior musical achievement in explaining the quality of planning; the role of depth of cognitive engagement in explaining quality of planning, the role of level of strategy use in explaining the quality of planning; and the influence of score difficulty on the quality of planning. The data giveFigure 2: Path Diagram illustrating relationships among approach scores, prior achievement, reading times, reaction times, strategy use and focal planning level for the traditionally-notated score.

Figure 3: Path Diagram illustrating relationships among approach scores, prior musical achievement, reading times, reaction times, strategy use and focal planning level for the graphically-notated score.

Figure 4: Path Diagram illustrating relationships among approach scores, prior achievement, prior familiarity with graphic notation, reading times, reaction times, strategy use and focal planning level for the graphically-notated score. (Figures available from authors on request)

Support to the findings of Cantwell & Millard (1994) in quantifying the explanatory role of non-technical factors in explaining the quality of musicians planning processes - independently of the traditional measure of technical and musical competence. There were some score-related differences in this finding, with the deep approach having a direct (if only near-significant) relationship with planning in the less familiar graphically-notated score. It seems that where the traditional symbols of musical meaning are absent, a disposition towards meaning generation acts as a partial compensatory mechanism. It was noteworthy that when prior familiarity with the graphic notation was taken into account, this aspect of prior knowledge rather than the traditional AMEB measure was linked to both high and mid-level strategy use. More significant in the data was the critical role of level of strategy use in determining the quality of planning processes. For both scores, the use of higher-level strategies (such as interpreting, patterning, prioritising and monitoring) were critical indicators of a higher level focus of musical concern in planning. Score differences indicated a slightly weaker, but nonetheless significant, role for higher-level strategies in relation to the graphic score, and an enhanced role for mid-

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Table 6: Summary of regression analyses for the traditionally-notated score

Table 7: Summary of regression analyses for the graphically-notated score

Table 8: Summary of the regression analyses for the graphically-notated score including prior familiarity with graphic notation as a predictor variable

(Tables available from authors on request)

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level strategies (such as speed alteration, chunking, linking and scanning) where automated access to notational meaning was not possible. Also critical was the role of strategy use in both scores as mediators of the influence of approach to learning. The data confirmed Cantwell & Millard's finding that, even among the more expert musicians of the current study, deep learners are more likely to address musical score at a higher level of meaning through the use of a deeper and wider array of processing strategies. Conversely, surface learners appear to be constrained to lower levels of musical analysis, reflected in the lesser likelihood of deploying higher-level meaning oriented strategies. While the general role of the measures of depth of cognitive engagement was limited in the path analyses to a relationship with high and mid-level strategies for the traditional score, other analyses (not reported here) did suggest that high deep musicians did spend more time reading each line of traditional score (consistent with the use of higher level strategies and more complex planning) and did take longer to react to the secondary probe in processing the graphic score (indicative of greater intensity of processing in unfamiliar natational contexts) than was the case for musicians reporting lower deep scores.

The data suggest to us that the ways musicians address ill-structured and challenging musical problems involves much more than technical prowess. Dispositional factors, such as approaches to learning and their associated strategic biases, may well indicate that for many music students, attention to the structure of musical knowledge may be deficient in many instructional programs. If tutors are biased in instruction towards rote repetition of score as the primary encoding method (a typical "surface strategy" employed in musical teaching), it would seem to us that the epistemological development of musicians will remain severely limited, ultimately, we would speculate, constraining musical performance to less than optimal levels. However, the extent to which these observed planning processes translate into performance remains the subject of further investigation.

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