From child to musician: skill development during the beginning stages of learning an instrument

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Psychology of Music 2005 33: 5
DOI: 10.1177/0305735605048012

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Psychology of Music

Psychology of Music

Society for Education, Music and Psychology Research
vol 33(1): 5–35 [0305-7356 (200501) 33:1: 5–35]
10.1177/0305735605048012
www.sagepublications.com

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ABSTRACT This article reports on a three-year longitudinal study with 157 children in school grades 3 and 4 (aged between 7 and 9 years), who commenced learning an instrument in one of eight school music programmes. The children were administered tests at the end of each school year to assess their abilities to perform rehearsed music, sight-read, play from memory, play by ear and improvise, and interviews were completed with the children's mothers in order to calculate how much practice they had accumulated on their instrument. Data were also obtained to help clarify the quality of mental strategies the children adopted when performing. Findings extend previous research on skill acquisition by proposing that conceptions based on the amount of practice undertaken or that focus exclusively on children's ability to reproduce rehearsed literature from notation are inadequate to understanding the early stages of instrumental development. It is proposed that a more coherent explanation comes from understanding the range of strategies children employ when performing and that the sophistication of children's mental strategies provides an important means for understanding why some progress effortlessly in contrast to others who struggle and fail. Conclusions highlight the importance of helping students to develop a repertoire of task-appropriate strategies that will enable them to think musically when performing challenging tasks on their instrument.

KEYWORDS: *evaluation, improvise, measurement, play by ear, play from memory, practice, sight-read, strategies*

For research in any discipline there are many questions to be answered, but often these can be distilled into just a few fundamental, but extremely important issues. For researchers interested in the beginning stages of learning a musical instrument, two of the most basic concern the extent to which musical progress is sequenced and orderly, and why some children's progress appears to be effortless in contrast to others who struggle.

In order to shed light on these two issues, this article reports on a longitudinal study involving young musicians across the first three years of learning a musical instrument. The major purpose of the study was to clarify the quality of mental strategies the children adopted when performing and the quantity of practice they had accumulated as a means of examining how these *mental* and *physical* aspects of skill acquisition impacted on their overall music performance development.

The importance of mental strategies

Research on children's metacognition and strategy use has been an important component of education research for more than two decades (Bruning et al., 1999). The research shows that once children enter school they become increasingly capable of monitoring and controlling their own cognition through planning and executing memory strategies that facilitate their own learning (Moely et al., 1992; Moely et al., 1995). The quality of children's mental strategies therefore helps to explain how successful they will be with their schooling (Harris and Pressley, 1991; Siegler, 1996) with high achievers being characterized by their capacity to choose and apply appropriate strategies, which in turn help them learn faster because they are able to integrate new knowledge and skills more quickly (Bjorklund, 2000).

Unfortunately, there has been far less interest in this topic from researchers studying the development of young children's skill in playing a musical instrument. Exceptions include Hallam's (1997) efforts to clarify the differences between novice and expert musicians. She found that practice is most purposeful and self-determined when students acquire a range of task-oriented strategies to draw upon (Hallam, 1997; see also Barry and Hallam, 2002). Other work by Cantwell and Millard (1994) provides valuable information about 'surface' and 'deep' approaches used by young music learners and suggests that learners should be cued to adopt higher levels of processing after rudimentary skills in playing the instrument have been established.

As an extension of the above research, investigations of intermediate and advanced level musicians have sought to clarify what musicians do as they complete a range of performance tasks. For example, working with 101 high school wind players, McPherson (1993, 1995a, 1997) undertook a content analysis of their reflective comments to describe what they think about before beginning to play, which he could compare with their scores on measures designed to test their ability to perform by sight, from memory, by ear, and by improvising. McPherson (1997) reports significant correlations ($p < .001$) between scores on each of the measures and the mental strategies the students used to prepare for and monitor their performance. The practical implication underpinning this line of research is that young learners should be exposed to a range of visual, aural and creative performance skills to help extend and challenge them in different ways, so that they learn how to

coordinate their ears, eyes and hands. This is consistent with a variety of long-standing teaching methodologies that emphasize the need to 'proceed from sound to symbol, not from symbol to sound' (Mainwaring, 1951a: 12), even though this principle is often not incorporated into actual teaching practice (McPherson and Gabrielsson, 2002).

The influence of practice

Some of the most important research on performance skill acquisition has focused on the quantity and quality of practice with evidence suggesting that experts undertake vast amounts of practice over a period of more than 10 years to perfect their skills to mastery level (Ericsson et al., 1993; Williamon and Valentine, 2000). Ericsson et al. (1993) coined the term 'deliberate practice' as a means of studying goal-oriented, structured and effortful facets of practice in which motivation, resources and attention determine the amount and quality of practice undertaken. They argue that a major distinction between professional and amateur musicians (and perhaps successful versus unsuccessful learners) is the amount of deliberate practice during the many years required to develop instrumental skills to a high level (Ericsson, 1997). Highly skilled musicians exert a great deal more effort and concentration during their practice than less skilled musicians, and are more likely to image, monitor and control their playing by focusing their attention on what they are practising and how it can be improved (Ericsson, 1997).

Complementing studies on expert performers is evidence suggesting that this same principle applies to earlier stages of development. The most substantial account comes from Howe, Davidson and Sloboda (1998), who studied a group of 257 young learners between the ages of 8 and 18, before concluding that 'practice is a direct cause of achievement level rather than merely a correlate of it' (p. 405).

SAMPLE

Before commencing the study, the researcher gained formal ethics clearance through his university and also the state department of education. Contacts were made with music teachers from eight schools, to recruit children who were about to start learning an instrument. The researcher organized information sessions to talk about the study and to distribute information so that parents and their children could make an informed decision about whether or not to participate. As a result of these sessions and the information supplied, 157 children and their parents agreed to take part.

At the beginning of the study, the children were all in school grades 3 and 4, and aged between 7 and 9 years. The participating schools represented a range of inner city and suburban primary schools and differing socio-economic regions within Sydney, Australia. Instruction on the ensemble instruments for the eight schools normally involved one or two music

ensemble rehearsals each week plus a small group or individual lesson on the instrument. All eight schools taught the children using popular method books such as *Standard of Excellence* (Kjos Music Company) and *Essential Elements* (Hal Leonard Corporation) and this material was supplemented by additional technical and solo repertoire that was covered during the individual or small group lessons on the instrument.

Most of the children (76%) started learning clarinet, trumpet, flute or saxophone (see Table 1). The drum and percussion students (8%) participated in all interviews but were not included in the performance measures. The sample consisted of 87(55%) girls and 70(45%) boys.

TABLE 1 *Instruments studied*

Instrument	*N*	%
Clarinet	35	22
Trumpet	33	21
Flute	28	18
Saxophone	24	15
Baritone and French horn	14	9
Drums and percussion	13	8
Trombone	9	6
Tuba	1	1

By the end of the first school year, 131(84%) of the children were continuing to learn their instrument, and this declined to 109(69%) by the end of the second school year and tailed off to 107(68%) by the end of the third school year (see Table 2).

TABLE 2 *Distribution of children across the three years who continued, ceased or moved*

	Year 1		Year 2		Year 3	
	N	%	*N*	%	*N*	%
Continued playing	131	84	109	69	107	68
Ceased playing	24	15	42	27	44	28
Moved away (left study)	2	1	6	4	6	4

As shown in Table 3, 81(52%) of the children were 'novices' who had never learnt an instrument previously, 43(27%) had learnt another instrument such as piano, but ceased instruction by the time they commenced their band instrument, and 33(21%) were continuing on a second instrument (94% piano) along with their new school ensemble instrument. The vast majority of the children with former instrumental experience played either piano or electronic keyboard (86%), and a small number played strings (4%)

or woodwind instruments (6%), while one child had received formal singing lessons. Very few (4%) had learned more than one other instrument, and for these children it was either recorder or another woodwind instrument such as the flute as a second instrument to the piano. There was a significant difference ($F(1, 72) = 21.15$, $p = .001$) in the number of months of musical involvement with the previous instrument between those who had learned but ceased prior to commencing their new instrument and those who continued playing while taking up the ensemble instrument as a second instrument. Children who ceased their instrument before taking up the new instrument had averaged 12 months of learning (SD = 7.70), whereas children who continued playing had been playing for an average of 21.81 (SD = 10.66) months.

TABLE 3 *Distribution of novice players, with children who had previous musical experience*

Novice players		Ceased other instrument		Continuing other instrument	
N	%	*N*	%	*N*	%
81	52	43	27	33	21

Procedure

DEVELOPMENT OF THE MEASURES

The philosophy underpinning the study was an unease with conceptions of musical achievement that focus on children's ability to perform repertoire from notation which they have practised at home. The problem with this conception is that it is possible to learn a piece of music through mindless drill and practice with little or no understanding of the task (Lehmann and Davidson, 2002); what Schleuter (1997) refers to as 'button-pushing' students 'to whom notation indicates only what fingers to put down rather than what sounds are desired' (p. 48).

More than 60 years ago, Mainwaring (1941) argued for a broader view of musicianship that included not only being able to perform from notation, but also being able to play by ear and improvise, while more recent work (McPherson, 1993, 1995a; McPherson et al., 1997) has resulted in the defining of five aspects of music performance relevant to understanding children's abilities to perform music:

- *Perform rehearsed music:* Using notation to provide a faithful reproduction of a pre-existing piece of music that has been practised over multiple rehearsals.
- *Sight-read*: Accurately reproducing music from notation that has not been previously seen or heard.
- *Play from memory*: Providing a faithful reproduction of a pre-existing

piece of music that was learned from notation but performed without notation.
- *Play by ear*: Reproducing a pre-existing piece of music that was learned aurally without the aid of notation.
- *Improvise:* Creating music aurally without the aid of notation.

For children to become competent musicians, they need to be able to develop their capacity to 'think in sound' by being able to aurally represent in their minds what they see, hear or wish to create on their instrument (McPherson, 1995b; Schleuter, 1997). One way to test whether they are developing these capacities is to examine how well they are able to perform in the five ways detailed above, so that different dimensions of their abilities to coordinate their eyes and ears with the fingerings necessary to perform on their instrument can be examined.

In order to adapt the techniques used in previous investigations for beginning instrumentalists, revised measures from the researcher's earlier studies (McPherson, 1993, 1995a, McPherson et al., 1997) were piloted with a group of 18 beginning instrumentalists in school grades 3 and 4 who were attending a school music camp. Because the new measures were to be used with children at the end of their first school year, nine months after starting, as well as at the end of school years 2 and 3, the researcher trialled a number of tasks considered appropriate for this range of ability levels. Results for the children's performances were analysed and discussed with two other colleagues before selection of the final tasks for each of the measures used in the main study.

MAIN STUDY

Data were collected from individual interviews and administration of the musical tasks with the learners, in addition to structured interviews with the children's mothers. The children were interviewed immediately before commencing instruction and then completed additional interviews and the performance measures at the end of their first, second and third school years (i.e. after 9, 21 and 33 months of learning). During the individual sessions with the researcher at the end of each year, all performances were recorded digitally using a minidisk recorder attached to a professional quality microphone.

Each mother was interviewed around the time her child was given an instrument and then another nine times during the following three years. The interviews with the children and their mothers covered a broad range of topics, and were typically conducted on an individual basis for the children and on the telephone for the mothers.

Estimates of accumulated practice were calculated in hours for each year of the study, based on the mother's reports of her child's practice across the year. This involved a series of questions during the phone interviews that

sought information on how many days a week each child typically practised and for how long. Using this information the researcher was able to compile monthly records of how much practice had been accumulated, which were then summed to provide an estimate for each twelve-month period.

PERFORMANCE MEASURES

A series of tasks were designed to assess the children's ability to perform in five ways.

Performing rehearsed music

In a letter and phone call before the individual research sessions, parents were asked to help their child choose a piece that the child liked and could perform best from the literature he or she was learning at the time. Instructions requested that the piece should 'show the child off' in terms of his or her ability to perform a piece of music that had been rehearsed over recent weeks.

Scoring in the first year was according to a 20-point scale from .5 to 10. To help arrive at an overall assessment, judges were asked to consider the difficulty of the repertoire being performed, the perceived overall standard of the selected work (i.e. range, tone quality, rhythmic accuracy, pitching and difficulty of the piece), and how musically the piece was performed. Before scoring the second- and third-year performances, the researcher re-heard a selection of performances in the previous years, and then built on the scoring system devised for year 1. For example, whereas the scores for year 1 ranged from .5 to 10, in year 2 they ranged from 1 to 17, and in year 3 from 2 to 23. This system allowed the researcher to establish ceilings for years 2 and 3 that adequately reflected the increasing skill of the children across the three years of the study.

Sight-reading

The Watkins-Farnum Performance Scale (WFPS) (Watkins and Farnum, 1954) was used to assess sight-reading ability. This standardized measure was given to each child using the two available equivalent forms. Form A was administered after the first school year, Form B at the end of the second school year and Form A again at the end of the third school year.

Using the WFPS, the evaluator follows the music as the student performs a series of increasingly difficult short pieces, and places a cross in each measure in which the musician makes an error. An important reason for choosing the WFPS was the scoring method that focuses the evaluator's attention on reading ability to the exclusion of other factors (such as those used to assess the children's ability to perform rehearsed music). Assessment is based on accuracy of performance in the categories of pitch, rhythm, slurring/articulation, tempo, observation of notated expression markings, pause/fermata and repeats.

Playing from memory

This measure consisted of five memory tasks in which the children were asked to study the musical notation of a melody they had not seen before for 30 seconds and then perform the piece twice after the notation had been removed. This measure attempted therefore, to examine how well the children could form a mental representation of the score in their minds as they studied the notation, and then transfer this information into the instrumental fingerings needed to perform the melody back from memory. Scoring for each of the three years was achieved by totalling the separate scores using an 11-point scale (0 to 10) for consistency and accuracy of both pitch and rhythm.

Playing by ear

For the four playing by ear tasks, the children were told the starting note of a melody they heard performed four times from a CD recording, after which they were asked to perform the piece twice exactly as sounded on the recording. This task examined the children's ability to transfer the mental image of the melody they had just heard into the instrumental fingerings necessary to perform this back by ear. As for the previous measure, the scoring method for the four test items included separate scores for consistency and accuracy of pitch and rhythm, scored from 0 to 10, which were summed to provide a total score for each task.

Improvising

Children were asked to play the opening of a given phrase and to continue by making up a complete melody (i.e. motif item), and also to improvise a piece on their own that had a beginning, a middle and an end (i.e. complete piece item). The directions for each task were that the ending of the piece they improvised should sound finished.

In the first year, improvisational ability was assessed using a global 21-point scale (from 0 to 10 with .5 intervals) for each of the two tasks that were then summed and, as for the Perform Rehearsed Music scores, establishing ceilings for years 2 and 3 that adequately reflected the increasing skill of the children. The scores of zero in year 1 were given to two children who stated that they could not think of anything to play. Paired comparisons of scores with identical markings were re-heard after marking each year group so that the marks could be adjusted to ensure consistency across the three years. As for previous measures developed by the researcher, evaluative criteria deemed appropriate for assigning a global mark included instrumental fluency, musical syntax, creativity and overall musical quality (see further, McPherson, 1995a).

ESTABLISHING RELIABILITY ESTIMATES

After the study was completed, the researcher devoted time to scoring each

child's performance on each of the five measures, and separately for each of the three years, to ensure that he was not influenced by any of the previous year's performances nor the children's performances on any of the other measures. After having scored all tasks on each of the five measures, he then prepared a data file that allowed him to sort scores for each task. To ensure that performances across the three years were equivalent, he then undertook a paired comparison of performances, so that he could be sure that the same performance standards in years 1, 2 and 3 were allocated identical scores.

To gauge inter-judge reliability, 50 performances on each task of each measure were randomly selected from all performances across the three years and burned onto a CD that was given to an independent evaluator. Inter-judge reliability coefficients for the five measures were all acceptable. The highest reliability scores were for sight-reading (.94), followed by performing rehearsed music (.92), playing by ear (.90), playing from memory (.88) and improvising (.80). The reliability estimates for the WFPS were consistent with previously published reliability estimates (Watkins and Farnum, 1954; Stivers, 1972).

Cronbach alpha indications of internal consistency show acceptable internal consistency across the three years for the three measures that had more than one item. For the five tasks on the playing from memory measure, each performed twice (i.e. 10 items), the alphas were .95, .94, and .94 for administration of the test in years 1, 2 and 3 respectively. For playing by ear, which included four tasks each performed twice (i.e. eight items), the alphas were .94, .91, and .92 across the three years. The improvisation measure consisted of two tasks, performed once each. Correlations between these two tasks were all significant ($p < .01$) with coefficients of .72 in year 1, .86 in year 2, and .93 in year 3.

Results

PROGRESS ON THE FIVE PERFORMANCE SKILLS

Descriptive statistics for the five measures are shown in Table 4, and provide indications of the range of abilities that the children achieved across the three years of the study. It is important to note that some children had made very little progress by the end of years 2 and 3, and even failed to achieve the standard of some of their peers who had received substantially higher scores at the end of their first nine months of learning. As an indication, 4(4%) of the year 3 children had not reached the mean score of the year 1 sample for Perform Rehearsed Music. For the other skills it was 18(19%) for sight-reading, 8(8%) for playing from memory, 11(11%) for playing by ear, and 19(20%) of the year 3 sample for improvising. A chi square analysis, between the children who had and had not ceased instruction by the end of the study, and the top and bottom 50 percent of scores on each of the measures, shows that the children who scored in the bottom half of the sample in year 1 for

TABLE 4 *Descriptive statistics for the five measures*

	N	Mean	SD	Minimum	Maximum
Perform Rehearsed Music					
Year 1	124	5.28	2.04	0.5	10
Year 2	101	8.51	2.67	1	17
Year 3	97	10.88	4.05	2	23
Sight-read					
Year 1	124	14.74	10.55	0	50
Year 2	101	23.95	12.55	1	63
Year 3	97	29.49	14.42	0	65
Play from Memory					
Year 1	124	82.56	36.47	0	159
Year 2	101	115.29	33.34	2	172
Year 3	97	130.49	33.74	6	199
Play by Ear					
Year 1	124	82.99	33.99	0	153
Year 2	101	106.24	26.73	0	156
Year 3	97	117.25	28.40	10	160
Improvise					
Year 1	124	4.99	3.44	0	16
Year 2	101	8.91	5.71	0	33
Year 3	97	10.01	6.77	1	40

the skills of sight-reading and playing by ear, were significantly more likely to cease instruction (Sight-read: $\chi^2 = 11.49$, d.f. = .1, $p < .001$; Play by Ear: $\chi^2 = 5.07$, d.f. = 1, $p = .02$).

The next part of the analysis sought to determine the extent to which the children's scores on each of the five measures improved significantly across the three years. Results for the five ANOVA show that the children's scores improved significantly for each measure (Perform Rehearsed Music: $F(2, 319) = 99.71$, $p = .000$; Sight-read: $F(2, 319) = 46.61$, $p = .000$; Play from Memory: $F(2, 319) = 55.86$, $p = .000$; Play by Ear: $F(2, 319) = 37.59$, $p = .000$; Improvise: $F(2, 319) = 27.40$, $p = .000$). Post hoc calculations using the Bonferonni test show that these scores improved for each measure from years 1 to 2, and for all skills except improvising from years 2 to 3.

Even though a majority of children improved across the three years, it had become apparent in the research sessions that some had not been able to keep up with their peers – a finding consistent with observations made from the analysis of Table 4. Consequently, to provide information on individual differences over time (i.e. rates of improvement or deterioration) the children's scores were converted to a percentage based on the range from the lowest to highest score across the three years on each of the measures. To gauge the

extent of these differences, year 1 results for each skill were subtracted from year 2, and year 2 from year 3 results, so that the mean percentage change between years could be calculated.

As is evident in Tables 5 and 6, the mean percentage increase from years 1 to 2 ranged from 9.4 percent to 14.88 percent, and for years 2 to 3 from 2.63 percent to 10.78 percent. The mean differences between the five skills were significant for both year groups (Years 1 to 2: $F(4, 511) = 2.72$, $p = .029$; Years 2 to 3: $F(4, 490) = 5.24$, $p = .000$), with the greatest improvements occurring for the skill of playing from memory across years 1 to 2, and playing rehearsed music across years 2 to 3, and the least improvement occurring in both year groups for the skill of improvising.

Tables 5 and 6 also indicate the percentage of children whose scores decreased, remained the same or deteriorated from years 1 to 2 and years 2 to 3. The most marked improvement occurred for the skill of performing rehearsed music, where only 1 percent of the sample in year 2 received the same scores as in year 1, and only 1 percent of the children deteriorated in skill from years 2 to 3. This result is in contrast to the other four skills, where the pattern of improvement was distinctly different. For example, 8 percent of the children in year 2 actually received lower sight-reading scores than their

TABLE 5 *Differences in performance scores from year 1 to year 2*

	Differences between year 2 minus year 1		Largest decrease (%)	Largest increase (%)	Decreased (%)	Same (%)	Increased (%)
	Mean	SD					
Perform Rehearsed Music	12.95	7.22	0	36.96	0	1	99
Sight-read	13.24	10.83	–7.69	41.54	8	5	87
Play from Memory	14.88	13.63	–23.62	60.30	11	0	89
Play by Ear	12.76	15.64	–43.75	49.38	16	1	83
Improvise	9.40	11.99	–18.75	60.00	13	7	80

TABLE 6 *Differences in performance scores from year 2 to year 3*

	Differences between year 3 minus year 2		Largest decrease (%)	Largest increase (%)	Decreased (%)	Same (%)	Increased (%)
	Mean	SD					
Perform Rehearsed Music	10.78	8.62	–2.17	36.96	1	6	93
Sight-read	8.74	11.88	–20.00	43.08	20	2	78
Play from Memory	8.76	14.33	–24.62	76.38	23	4	73
Play by Ear	8.33	15.97	–42.50	73.13	21	1	78
Improvise	2.63	14.01	–35.00	55.00	38	8	54

year 1 results, and this increased to 20 percent of the sample in year 3. In year 2 and year 3, 11 percent and 23 percent respectively deteriorated in their playing from memory abilities. The most marked results were for the skills of playing by ear and improvising, where a sizeable percentage of the students either received the same or a lower score in year 2 (as compared to year 1) and year 3 (as compared to year 2).

As shown in Table 7, Pearson Product Moment correlations between scores across the years ranged from .92 (years 2 and 3) for performing rehearsed music down to .46 (years 1 and 3) for improvising. Comparing the years 1 and 2 and years 2 and 3 correlations shows that children who performed poorly or well relative to their peers in year 1 tended to perform similarly in years 2 and 3. The stronger pattern of correlations suggests that this trend was most evident for the visual skills of performing rehearsed music and sight-reading, followed by the aural skills of playing from memory, playing by ear and finally the creative skill of improvising.

TABLE 7 *Pearson correlations between scores across the three years*

	Years 1 and 2	Years 1 and 3	Years 2 and 3
Perform Rehearsed Music	.79**	.71**	.92**
Sight-read	.83**	.74**	.87**
Play from Memory	.67**	.62**	.75**
Play by Ear	.67**	.62**	.70**
Improvise	.56**	.46**	.61**

** $p < .01$

Strategies used when performing

As highlighted in the review of literature, a body of evidence exists on school-age children's use of strategies when completing a range of tasks in academic learning. To date, however, little has been achieved in defining and clarifying children's use of strategies when learning to perform on a musical instrument.

A pilot study included work to refine the procedures used in the main study. However, during the pilot it became obvious how difficult it was to collect reliable data on the use of improvisational strategies from beginning instrumentalists. Whereas the children were able to provide specific comments for questions about the other four skills, their responses to how they completed the improvisation measure were less secure and more vague. Because of this difficulty and to keep the research sessions to a reasonable length so that the children would not become bored or tired, it was decided not to ask the children about the strategies they used when improvising.

PERFORMING REHEARSED MUSIC STRATEGIES

There appear to be many parallels, with some important differences, between how children work individually to complete their school homework and study for exams, and how they practise their instrument to prepare a piece for a performance.

The number of possible strategies children can use to rehearse music from notation is potentially limitless. At the beginning of the study however, the researcher reviewed literature dealing with children's homework, as this facet of learning has an extensive body of literature and was considered appropriate for investigating the use of the children's time at home as they practised their instrument, particularly as at the time of commencing their instrument the children were encouraged by their instrumental tutors to practise about five times a week, for about 20 minutes for each practice session.

Interviews were undertaken with the children at the end of each school year (i.e. when the performance measures were administered). These interviews included a number of questions about how the students organized their time and structured their activities when practising. Each year, the children were asked the same questions, so that any changes in their behaviour could be mapped across the three years. Some questions included checklists where the children were asked to tick any comment that applied to them. Other questions were open-ended, and allowed them to elaborate and thereby provide longer, more detailed answers.

Based on a review of literature and discussions with three colleagues, the following four distinct organizational and improvement strategies were identified as being important to the development of children's ability to perform rehearsed music.

Organizational strategies

1. *Keeping track of what is to be learned:* in terms of whether the child actively uses a practice diary to take notes about what needs to be practised and how to practise. This issue was considered important based on evidence that self-regulated learners are more likely to monitor and control their learning (Zimmerman, 1994, 1998, 2000), especially through the use of notes and diary entries (Hong and Milgram, 2000). In the end of year interviews, the children were asked at separate times in their interview to explain how they kept track of any new pieces they were required to learn, whether they had a practice diary, and whether they actively kept a record in their diary of what they were learning and the problems they were experiencing with their learning. As a cross check, the researcher asked to see the children's diary, so that he could see for himself whether the children were using it to write in comments themselves about what they had to learn, as well as any issues that they needed to keep in mind as they practised. Responses to these questions were coded in terms of

two separate categories. The first related to children who had a practice diary and used this diary to actively keep track of what they were learning. The second category related to whether the child had a diary but did not normally take notes about what needed to be practised.

2. *Order of practice*. Evidence by Hong and Milgram (2000) suggests that the order in which students complete their homework is influenced by their personal interests and own individualized working style. Two characteristic working styles were hypothesized to emerge: (a) a more strategic style, where students focus on the repertoire they need to practise first in order to improve before moving on to pieces they enjoy playing, and (b) a less strategic style, where students focus on pieces they can already play and enjoy most, rather than repertoire that has been assigned by the teacher which they need to learn. It was anticipated that the more strategic style would be associated with a faster rate of skill acquisition. For this strategy, the children were asked to explain to the researcher what they spend most of their time practising, what they believed to be the most important thing to do when practising, as well as how they structure their practice in terms of new literature they have to learn for the next lesson as compared to pieces that they may already know and enjoy continuing to play. Analysis of the responses resulted in the identification of two categories according to whether the children tended to start their practice by focusing on the pieces they were asked to learn for the next lesson before moving on to pieces they enjoyed playing, or started with literature they enjoyed playing before moving on to pieces they needed to learn.

Improvement strategies

3. *Practising to improve*: The children were asked how often they play a piece through that they cannot yet play and are having difficulty learning. This issue was considered important based on interviews with the teachers before the commencement of the study suggesting that persistence in the face of difficulties might be one of the more important indicators of long-term achievement. It has also been reaffirmed subsequently in case study analyses of the home practice habits of children involved in this study (Pitts et al., 2000; McPherson and Renwick, 2001; McPherson and Zimmerman, 2002). For this question, the coding involved four distinct categories. The lowest category was an orientation to play hard pieces just once during each practice session (e.g. 'I play my pieces through just once. I want to get them over with'; 'If I'm going really well I play it a few times. If it's bad then I only play it once, except I know it should be the other way around'). Comments for the second category involved playing the piece a couple of times with little evidence of any concentrated effort (e.g. 'I do each piece about twice, out of habit'). The third category involved comments indicating that the player would play the piece a few

times until it had improved (e.g. 'I try to make it better by playing it over and over'), while the final category comments came from children who displayed a more concentrated ability to refine their playing (e.g. 'First I play it once and see how good I am, then I practise it again and again until it's at a standard that I can take to my tutor').

4. *Self-correction strategies:* A final series of questions sought to determine what the children reported doing when they made a mistake. The children were asked closed and open-ended questions related to this issue, in order to categorize them along a continuum going from a tendency to ignore errors, to trial and error practice without a clear goal for correcting the performance, to more sophisticated strategies such as playing slower and gradually building up speed or stopping to think about how the music should go before strategically trying to apply this knowledge in order to correct the problem. Comments from children who were asked to explain what they do when they make a mistake were coded into four categories. The first included comments that displayed a sense of hopelessness or lack of persistence (e.g. 'I usually give up and keep going'; 'I don't try to fix it, I go through everything once'); the second consisted of references to superficial trial and error practice (e.g. 'If I get it right I move on, otherwise I'll play the mistake over once or twice'); the third, a more concerted effort to correct the problem (e.g. I go through the section and find the trouble spots, and I go over them really slowly and then speed them up'); and the final category, showing evidence of a more developed capacity to think strategically and reflectively together with a more deliberate attempt to refine the playing (e.g. 'I try to think about how my teacher played it, then go back over it slowly and then speed it up'; 'I play slowly, play the section with different rhythms and think about it before I play it again').

The final combined strategy use scale used for the skill of performing rehearsed music consisted of the four traits, equally weighted and added together to form a summed total.

SIGHT-READING STRATEGIES

Previous work with young intermediate and advanced-level musicians has identified basic strategies that help distinguish between their sight-reading abilities (McPherson, 1994). For example, good sight-readers tend to seek information relevant to an accurate interpretation prior to commencing their performance, by actively checking the time- and key-signatures and scanning the music to maximize comprehension and to identify possible obstacles (see McPherson, 1994).

As a result of this work, similar techniques were used with the children involved in the current study. After completing the last item that they were capable of playing on the WFPS, the children were shown the next example

on this measure, but this piece was unexpectedly covered immediately before they began playing so that they could be asked to describe what they were thinking in the seconds before they commenced their performance. A content analysis of the children's comments resulted in the identification of five strategies that were deemed important for efficient sight-reading. These included studying the first measure of the music to gain a sense of how the piece commenced, actively searching to find the key- and time-signatures, establishing an appropriate tempo by thinking about how the piece should sound, and scanning the entire work to identify possible obstacles, so that the piece could be played in an appropriate style and tempo that would help facilitate an accurate performance. The sight-reading strategy scale consisted of allocating a mark when a child reported any of the five strategies and then summing these to form a total score.

Table 8 shows the percentage of students across the three years who reported each of the five strategies. With the exception of establishing an appropriate tempo between years 2 and 3, all percentages increase. This may suggest that this strategy becomes more automatic as students gain proficiency on their instrument. However, it was still deemed appropriate to include this item in the final strategy scale based on the types of comments supplied by the children. For example, the children in year 3 who reported establishing an appropriate tempo before starting tended to be those players who were more strategic with their preparation (e.g. 'The last one was really hard, so I thought about how fast I could play it to get the hard parts in the second line').

TABLE 8 *Sight-reading strategies across the three years represented in percentages*

	Year 1 (%)	Year 2 (%)	Year 3 (%)
Studying first measure	25	49	60
Identifying key-signature	23	36	56
Identifying time-signature	45	50	53
Establishing an appropriate tempo before commencing performance	17	40	26
Scanning music to identify obstacles	5	14	20

PLAYING FROM MEMORY STRATEGIES

Based on earlier work (McPherson, 1993, 1997) which has helped to clarify the mental strategies young musicians employ when preparing to perform from memory, the children were asked, immediately after their performance of their last item on the playing from memory measure: 'Can you tell me exactly how you memorized that melody; what did you do in your mind as you studied the notation?'

Content analysis of the responses to this question identified five distinct strategies that the beginners used to memorize music from notation. For the purpose of this analysis, the five strategies were identified as representing either a conceptual, kinaesthetic or musical approach to the task, as follows:

Conceptual

- *Mental strategy 1:* Independent of the instrument and how the melody would sound. Children in this category tended to think about the contour of the melody and whether it went up or down, or the letter names of individual notes. For some children this involved trying to 'take a photograph' of the musical score. Indicative comments include:

  > I was trying to write the notes in my mind but it didn't work so I tried each bar separately.
  > I was just looking at it to see what notes were where. I was saying things like: 'The bars are different, there are two that are not crotchets.'
  > I picture them in my mind. I take a photograph and keep it in my mind. That's what my mum told me to do with phone numbers.

- *Mental strategy 2:* Independent of the instrument but involving the chanting of rhythm or letter names of the notes. A typical response was for the child to demonstrate what he or she was doing by chanting out aloud the approximate rhythm of the piece. Alternatively, the child might read or say the notes to him- or herself, for example:

  > I was trying to say it and get it stuck in my mind. I keep looking at it and saying the names of the notes over and over.

- *Mental strategy 3:* Trying to sing the melody but not explicitly linking this with instrumental fingerings. Often this involved chanting the rhythm or pitch with a rough contour and breaking the music down into individual segments (often as a single measure rather than a phrase). For example:

  > I was humming it to myself and trying to remember the notes. My singing wasn't very accurate.

Kinaesthetic

- *Mental strategy 4:* Trying to chant the rhythm or pitch with rough contour while fingering the melody through on the instrument, either in sections or from beginning to end. This strategy became obvious each time a child demonstrated to the researcher what she or he was doing. For example, one boy said:

  > I was just going through it like this [then chants the rhythm of the melody while demonstrating how it would be fingered on the instrument].

Musical

- *Mental strategy 5:* These children demonstrated their ability to link the sound of the melody to instrumental fingerings by mentally rehearsing

as they studied the example in addition to processing the notation holistically by working from the beginning to the end of the piece in the way it would be performed. As might be expected, children who reported this strategy displayed the most well-developed capacity to coordinate their eyes, ears and hands.

> I was singing it through while I was playing it on my instrument. Like this. [The child demonstrates mental rehearsal of the music by singing the melody out aloud while fingering it through on the instrument]. I kept doing this over and over until you covered the music and asked me to play it back.

PLAYING BY EAR

As for the playing from memory strategies, and based on previous research (McPherson, 1993, 1997), a content analyses of the children's responses to the question 'Can you tell me exactly how you prepared to play that melody; what did you do in your mind as you listened to the recording?' after they had performed the last task on the measure, resulted in five strategies for playing by ear that could be grouped according to three conceptual, kinaesthetic and musical categories.

Conceptual

- *Mental strategy 1:* Children in this category employed a 'visual' approach by thinking independently of their instrument and how the melody would sound. Often this involved them thinking about the contour of the melody and whether it went up or down, or even how it might look if it was notated on the page. Examples of children's comments include:

  > I was thinking how many notes up and down it goes and saying to myself, it goes up, then up again, then down.
  > I was listening to the notes and trying to work out the names of the notes as they look in music.
  > I was trying to think what notes they were and thinking how they go up and down and how they would look in music.

- *Mental strategy 2:* Independent of the instrument but involving the chanting of the rhythm, or singing while trying to decide what notes these pitches might be. For example:

  > In the gap I was doing this [then chants the rhythm of the melody with very rough melodic contour].

Kinaesthetic

- *Mental strategy 3:* Trying to think about how the notes might be related to fingerings on the instrument. This was often not fluent fingering but either working in sections or groups of notes and, if there was time, piecing these together. One child remarked:

  > I tried to play the first part of the piece in the gap and when I heard it again I tried to add the next part. I was thinking about how the notes would be fingered on my clarinet.

- *Mental strategy 4:* Fingering through the melody while chanting the rhythm or pitch with a rough contour of the actual sound of the melody. Often the child tried to finger the piece through while listening to the tape, as indicated in this comment:

  > I was listening to the player and fingering it like this [child demonstrates fingering with out of tune singing]. I also played along with the recording and did it by myself during the gaps.

Musical

- *Mental strategy 5:* These children had a sense of how the notes could be reproduced on their instrument and could demonstrate how they mentally rehearsed the music either by playing along with the recording or in the gaps between performances. They displayed the most highly developed capacity to coordinate ear and hand, as evidenced by comments such as:

  > I was singing and playing it on my instrument like this [child demonstrates accurate singing while showing how she fingered it on her flute]. I did it over and over.

PREDICTING ACHIEVEMENT ACROSS THE THREE YEARS

A series of stepwise regression analyses were computed to determine how much of the children's performance achievement could be predicted by the amount of practice they had accumulated across the years and the mental strategies they employed when performing in each of the four styles of performance. The aim was to determine the relative contribution of these two independent variables on performance achievement and in so doing help to provide information that might clarify why some children progressed rapidly in contrast to others who struggled.

Table 9 provides information on the regression equation, adjusted R^2 and R^2 change for each of the 12 analyses. For each year group, the variable practice refers to the amount of practice that had been accumulated. That is, for year 1 it was the accumulated practice for the entire year, for year 2 the amount of practice accumulated for the first two years, and for year 3, the amount of practice accumulated over the first three years of playing. The variable strategy refers to the reported strategy at the time of undertaking the performance measures. That is, what the student reported on the day they completed each of the measures.

An overview of the results shows a distinct difference between the regression results for Perform Rehearsed Music, in comparison with the other three skills. For Perform Rehearsed Music, Practice entered the equation first and explained more of the variance in the children's achievement on this skill than did Strategy. The amount of variance in the children's scores explained by practice increased from 9 percent in year 1, to 16 percent in year 2, and 32 percent in year 3. In contrast, only 3 percent of the variance in year 1, 9

TABLE 9 *Summary information on stepwise regression analyses*
(a)

Perform Rehearsed Music	Model	Regression equation	Adjusted R^2	R^2 change
Year 1				
Practice	1	Perform Rehearsed Music = 4.11 + .03 Practice	.09	.09
Practice + Strategy	2	Perform Rehearsed Music = 1.86 + .03 Practice + .38 Strategy	.12	.03
Year 2				
Practice	1	Perform Rehearsed Music = 6.28 + .04 Practice	.16	.16
Practice + Strategy	2	Perform Rehearsed Music = 2.27 + .04 Practice + .47 Strategy	.25	.09
Year 3				
Practice	1	Perform Rehearsed Music = 6.34 + .03 Practice	.32	.32
Practice + Strategy	2	Perform Rehearsed Music = 1.25 + .03 Practice + .97 Strategy	.38	.06

(b)

Sight-read	Model	Regression equation	Adjusted R^2	R^2 change
Year 1				
Strategy	1	Sight-read = 10.48 + 3.70 Strategy	.11	.11
Strategy + Practice	2	Sight-read = 5.97 + 3.22 Strategy + .11 Practice	.17	.06
Year 2				
Strategy	1	Sight-read = 12.27 + 5.72 Strategy	.33	.33
Strategy + Practice	2	Sight-read = 6.60 + 4.93 Strategy + .13 Practice	.41	.08
Year 3				
Strategy	1	Sight-read = 14.43 + 7.19 Strategy	.42	.42
Strategy + Practice	2	Sight-read = 6.96 + 6.05 Strategy + .07 Practice	.53	.11

(c)

Play from Memory	Model	Regression equation	Adjusted R^2	R^2 change
Year 1				
Strategy	1	Play from Memory = 24.04 + 27.17 Strategy	.51	.51
Year 2				
Strategy	1	Play from Memory = 62.55 + 21.31 Strategy	.36	.36
Year 3				
Strategy	1	Play from Memory = 75.51 + 21.51 Strategy	.46	.46

Strategy + Practice	2	Play from Memory = 67.22 + 19.44 Strategy + .10 Practice	.49	.03

(d)

Play by Ear	Model	Regression equation	Adjusted R^2	R^2 change
Year 1				
Strategy	1	Play by Ear = 17.35 + 32.36 Strategy	.52	.52
Year 2				
Strategy	1	Play by Ear = 31.66 + 30.56 Strategy	.50	.50
Year 3				
Strategy	1	Play by Ear = 41.15 + 24.86 Strategy	.71	.71

percent in year 2 and 6 percent in year 3 was attributable to the sophistication of the children's strategies for practising their repertoire during their instrumental practice at home.

The regression equations for the other three skills suggest two important trends. First, the adjusted R^2 values are consistently larger, thus indicating more powerful explanations for these three other skills. Second, in contrast to Perform Rehearsed Music, the regression analyses show that Strategy was consistently a more powerful variable for explaining these three skills than was Practice. The lowest amount of variance for Strategy was 11 percent in year 1 for sight-reading, up to a high of 71 percent for playing by ear in year 3. Practice entered the equation for sight-reading across all three years but only explained between 6 percent and 11 percent of the variance. For Play from Memory, Practice entered the equation in year 3, but only explained 3 percent of the variance. Practice did not predict the skill of playing by ear in any of the three years.

Discussion

The aim of this study was to clarify the extent to which the children's learning was sequenced and orderly, and to investigate why some struggled in comparison to others who made rapid progress. The context involved a sample of children of similar ages who were all beginning instruments at the same time in eight different school instrumental programmes.

The first part of the analysis shows that the children's progression was in many ways smooth, with most improving, however gradually, across the initial years of their learning. This result was consistent for all five skills from years 1 to 2, and for all skills except improvising from years 2 to 3. The levelling off on the skill of improvising was not unexpected since the children

were not normally being taught to improvise during their lessons. Nevertheless, many of the children were able to create interesting melodies, with a small number reporting doodling and improvising during their daily practice. In marked contrast, there were also learners who found it difficult to improvise even a simple response for the two tasks of completing a phrase and creating a long extended melody.

It might be expected that children who had previous experience learning another instrument and who therefore had been exposed to more musical training would progress more rapidly on their new instrument as compared with novice learners. However, this was not the case for the skills of performing rehearsed music, sight-reading and improvising. For the aural skills of playing from memory and playing by ear, however, children who where continuing to learn another instrument such as piano in addition to their new school wind instrument, were significantly better at these skills when compared to novice learners. This finding, consistent with other evidence (Elliot and May, 1980; McPherson, 1993), suggests that having lessons on two instruments enhances a student's development on the aspect of learning where the two instruments overlap; that is, aural skill development.

The results also show that by the end of year 3, some of the children had not attained the standard of the average of the sample's year 1 results: around 4 percent on the skill of performing rehearsed music to a high of 20 percent of the children for the skill of improvising. Thus, significant incremental improvement in attainment was evident from one year to the next, but this was accompanied by large within-group differences on each of the five performance skills. Consequently, by the end of the first three years there were extremely wide differences between the children's performance abilities across the five performance skills – a finding that is even more alarming given that some of the poor learners had already ceased instruction before the end of the study.

Importantly, early difficulties in learning to read notation, as evaluated by the children's sight-reading results, and their ear-to-hand coordination skills, as demonstrated by their ability to play by ear, were associated with dropouts. Children who scored in the bottom half of the sample on these two measures in year 1 were more likely to cease instruction. Additional findings show that the children tended to retain their position on all five measures relative to their peers across the three years. In general terms the children who had fallen behind on any of the measures in their first year of learning were those who were typically still struggling on these measures in year 3, or had ceased learning altogether.

Such wide individual differences provide indications of how challenging learning an instrument can be for some children, and how this results in the 'survival of the fittest'. Most importantly, these results reinforce the need for researchers to better understand the problems encountered when commencing music instruction, and what teachers can do to help children learn more

efficiently and with less frustration, especially when they are experiencing difficulties or problems.

THE IMPACT OF STRATEGIES VERSUS PRACTICE ON SKILL DEVELOPMENT

The traditional answer to the question 'What does it take to become a fine performer?' is often summarized as follows: 'You seek out the best teacher you can find and then you practice, practice, practice' (Kohut, 1985: 124). This view is consistent with research showing significant correlations between accumulated practice and achievement for both expert (Ericsson et al., 1993; Lehmann and Ericsson, 1997) and younger players (Sloboda and Davidson, 1996; Sloboda et al., 1996; O'Neill, 1997).

While it is true that the children's accumulated practice explained between 9 and 32 percent of the variance in their scores on the Perform Rehearsed Music measure, mental strategies was consistently a more powerful predictor for explaining their ability to sight-read, play from memory and play by ear. These results are not unexpected given that much of the children's home practice would have been concentrated on learning repertoire for the next lesson and it could be reasonably assumed therefore that practice would exert most impact on the skill of performing rehearsed music. However, the results suggest that understanding children's musical progress involves much more than simply examining the relationship between the amount of practice they have accumulated and their achievement on their instrument. Watching the children develop across the three years and analysing their responses provided ample evidence that better players possessed more sophisticated strategies for playing their instrument very early in their development and that these players were the ones who went on to achieve at the highest level. Importantly, these were the players who knew when and how to apply their strategies (especially when asked to complete the more challenging musical tasks), possessed the general understanding that their performance was tied to the quality of their effort (particularly effort expended in employing appropriate strategies to complete individual tasks), and were able to coordinate these actions to control their own playing. In this sense the high achievers on the Sight-read, Play from Memory and Play by Ear measures were those children who were in the beginning stages of developing their abilities to image, monitor and control their playing in the manner suggested by Ericsson et al. (1993) and the *deliberate practice* literature.

The low amount of variance attributable to strategy use for the skill of performing rehearsed music suggests that the children's home practice varied greatly across the sample and that the strategies chosen for analysis were not sufficient to explain how quickly the children developed. A problem with studying such young, inexperienced players is that proper practice habits take years to develop. This has been confirmed in videotape analyses of the same children's home practice (McPherson and Renwick, 2001) where over 90

percent of practice time was spent simply playing through a piece from beginning to end, without adopting a specific strategy to improve the performance. Barry and Hallam (2002) suggest that this is because beginners are not always aware of where they are going wrong, and have not developed appropriate internal aural schemata to identify and correct their own mistakes.

IMPLICATIONS FOR TEACHING AND LEARNING

Despite the importance for children to develop an armoury of task-appropriate strategies to aid their performance, evidence suggests that school teachers do not sufficiently emphasize this in their teaching, particularly during the early years of schooling. For example, Moely et al. (1992) found that elementary teachers (kindergarten to grade 6) spend little of their time dealing with cognitive processes and encouraging metacognition. On average, the teachers they studied allocated 9.5 percent of their instructional time to helping children deal cognitively with a task, with specific strategy instruction only occurring around 2.8 percent of the time when the teachers were observed. Of particular interest to the study reported here was the finding that teachers of grades 2 and 3 typically made more strategy suggestions than teachers of lower grades. This is because from around grade 2, children are 'unlikely to generate effective strategies in all but very simple learning situations and are relatively unsophisticated in their views of memory processes, but are also very amenable to training in memory strategy use' (Moely et al., 1992: 660). Moely et al. (1992) conclude that when teachers spend time on strategy instruction, their students' skills improve, a finding that is especially evident for low and moderately achieving learners. They also cite evidence showing that school classroom teachers generally tend to use metacognitive suggestions more on the basis of their own personal beliefs or attitudes about what their pupils will need to process information, rather than by reacting to their pupils' performance errors. Moreover, they suggest that classroom teachers rarely provide demonstrations of how to use a strategy, perhaps because they assume that their pupils will learn strategies merely on the basis of verbal instruction. Their studies have found very little evidence that school teachers systematically question their pupils about the cognitive processes they employ, model appropriate cognitive processes, praise their students for using a strategy, or give hints about useful strategies which the students can apply to master specific learning tasks. Teachers also tend to spend little of their time instructing students in the generalization of a strategy.

Unfortunately, evidence suggests that these problems also apply to music where instrumental lessons tend to be dominated by teacher statement-oriented behaviour in which interactions consist largely of statements by the teacher about how a task should be accomplished with very few questions asked of the student (Hepler, 1986; Werts, 1992). For example, a recent investigation by Rostvall and West (2003) shows that their sample of instrumental

teachers tended to talk to their students in short utterances related to the previous or upcoming action about how the music should be performed in preference to performing and demonstrating it to them. In doing so, these teachers provided their students with 'few opportunities to listen and form mental representations of the melodies they were going to learn' (p. 218). A variety of evidence in both individual and group lessons shows that this type of direct instruction results in a decrease in student attentiveness at all age levels (Kostka, 1984; Spralding, 1985; Witt, 1986; Price, 1989).

Given this evidence, music teachers should be encouraged to recognize the importance of reacting perceptively to performance errors by analysing why they might occur and trying to understand what the student is thinking about mentally, especially when introducing a new skill. The results of this study suggest that asking pupils to reflect on what they are doing, how they are doing it, and to consider alternative approaches to performing would go a long way to improving music instruction, by helping children who find their learning frustrating and difficult and who typically fall behind or do not survive the first few years of learning.

DEFINING FUTURE RESEARCH

The low amount of variance explained in the regression equations, especially during the first year on the visual skills of performing rehearsed music and sight-reading, demonstrates that there is still a great deal more to explore in future research. In particular, further systematic studies need to be devised to more clearly and precisely understand the strategies used by children. Providing a more detailed listing of strategies would undoubtedly help determine more precisely how task appropriate strategies may or may not develop, plus provide better clues for how teachers can help children employ musically appropriate strategies as they learn their instrument. Another need is to examine the quality of the children's practice as it relates to the strategies they employ while practising, and to compare these with their achievement both short-term while they are learning pieces, and long-term in order to more fully understand their ongoing development. A related concern however, would be to investigate more carefully the validity of self-reports of strategy use, by comparing these with observational data and other types of protocols such as thinking aloud after completing structured tasks.

The need for, and importance of, explicit, teacher-led instruction in mental strategies is a clear finding of the academic literature on strategy use (Rosenshine, 1997). And consistent with this literature is the need to explore further the types of teaching techniques that teachers can employ to prompt children to use task-appropriate strategies when performing music, and especially the types of instructional procedures that are most efficient to help young children progress to a higher level of functioning. We need to know much more about how music teachers can encourage their students to think and reflect on their learning, what types of learning situations might be most

appropriate, and how encouraging more appropriate metacognition and reflection might impact on skill acquisition. If music learning is different from other school-based subjects, then clarifying the types of task-related strategies that enhance learning should also become a focus of future research in music education.

While a great deal of research has been undertaken to map out how skills develop, an equal and perhaps even more important challenge is to understand the mechanisms that initiate progression. For future research this implies devising studies that concentrate on the processes involved in developing skills rather than on their outcomes. The results of this study suggest that understanding how students think about and react to various musical challenges is just as important as seeing and hearing them demonstrate their ability through performance. This agenda is especially important if research is ever to be able to inform teaching. Understanding what is going on in children's minds as they perform enlightens our understanding of what they are able to do and why their progress might be smooth or rocky.

Many strategies utilized in music are domain-specific and are quite different in nature to the types of strategies children employ in other domains of their school learning such as reading and mathematics. Further clarification of these music-specific strategies would undoubtedly have implications for the ways in which music educators define the constructs 'musicianship' and 'musical ability'.

RECONCEPTUALIZING MUSICAL LEARNING

The issues and concerns raised in the discussion above become even more apparent when one considers the traditional view of musical progress and achievement, at least in many western countries where a young musician's ability is often gauged by his or her ability to play and reproduce repertoire from notation. This narrow view of instrumental skills has been criticized across many decades (Mainwaring, 1941, 1947, 1951b, 1951c; McPherson, 1995a) even though it still pervades music teaching in many countries throughout the world. As I have argued elsewhere (McPherson, 1995b; McPherson and Gabrielsson, 2002), notational skills should never be taught in isolation from perception, and stressing the reading of notation, with few opportunities for children to perform in other ways, restrict the types of strategies young learners acquire, and consequently their ability to function effectively as musicians.

The results highlighted above also speak to the importance of providing children with quality early experiences in music, so that they establish not only proper playing habits, but develop their capacity to think musically. In this regard it is especially important for teachers to include activities that teach children how to coordinate their eyes, ears and hands, so that they develop their capacity to 'think in sound'. A principle, stressed by Mainwaring (1951b, 1951c) more than 50 years ago, involves the important

distinction between seeing notation, and responding mechanically to produce the notated sound (i.e. working from symbol to action to sound), in contrast to seeing the musical notation, and being able to hear the notation inwardly before reproducing it on an instrument (i.e. working from symbol to sound to action). The former method Mainwaring (1951a, 1951b, 1951c) believed to be typical of most instrumental teaching practice. However, it was the latter that he advocated as the most efficient and effective means for developing a young player's overall musicianship.

This ability to 'think in sound' is typical of many musically gifted children who, soon after commencing an instrument, will often delight in picking out tunes by ear, improvising and transposing pieces just for fun (Winner and Martino, 2000). By undertaking activities of this type these children learn to represent music in multiple ways, so that they are able to move beyond technical and analytic skills to developing their sensitivity to the expressive properties of music (Bamberger, 1986; Winner and Martino, 2000).

All of the above highlights the need for teachers to make strategy instruction a consistent and ongoing part of their teaching. The following are examples of some teaching strategies that would encourage children to monitor, control, and reflect on their own progress, as ways of improving strategy development:

- Asking students to explain how they are doing a task, what they are feeling, and whether they feel competent enough to do it on their own (e.g. questions such as 'Can you explain to me what you are doing' and 'Can you teach me how to do this?').
- Providing information about the child's performance which encourages them to reflect on whether the way they are approaching the task is the most appropriate or best method (e.g. 'Is what you are doing working? Why not?').
- Providing content-specific information on how to do a task, rather than telling the student what to do (e.g. 'In order to do this, you will need to. . .').

Conclusions

The findings of this study extend previous research on skill acquisition by proposing that conceptions based on the amount of practice undertaken or that focus exclusively on children's ability to reproduce rehearsed music from notation are inadequate to understanding their overall development. It is proposed that a more coherent explanation of learning to perform on an instrument comes from understanding what children are thinking as they process music visually and aurally, and that the sophistication of their mental strategies provides an important means of understanding why some progress effortlessly in contrast to others who struggle and fail.

The most important finding is that those children who applied musically

appropriate mental strategies very early in their learning were more likely to succeed in comparison with their peers. A major concern for all who are interested in effective learning therefore, is the number of children who failed to apply musically appropriate strategies in the early months of their learning, and whose learning was seriously affected, to the extent that they fell far behind in their learning compared to their more successful peers or even ceased learning altogether. Again, these results lead to the proposition that there is much more to the making of a musician, and to explaining musical development, than just hearing how well a child can reproduce music from notation that has been rehearsed over multiple practice sessions.

Finally, the major implications arising from the study are that improvements in instruction which help children struggling with their learning, can be attained by placing more emphasis in music on teaching (a) what are appropriate musical strategies, (b) how musical strategies can be used, (c) where and in what situations certain types of musical strategies are best employed, and (d) why each type of musical strategy aids one's performance. Very little research is currently available that helps clarify how this might best be achieved and so a high priority for future research should be to focus more attention on this area of musical thinking and learning.

ACKNOWLEDGEMENT

The author is grateful to James Renwick and Emery Schubert who each provided very helpful suggestions and insightful comments on an earlier version of this article. This research was supported by a large Australian Research Council grant (No. A79700682).

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