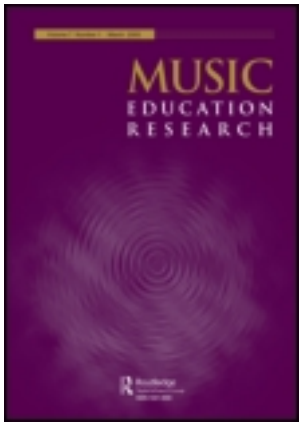

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A Longitudinal Study of Self-regulation in Children's Musical Practice

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ABSTRACT *This study investigates common trends and individual differences in children's practice according to six dimensions of self-regulation. Seven children, aged between 7 and 9 years at the beginning of the study, regularly videotaped their practice over a 3-year period. Behavioural coding addressed the content of practice, the nature of errors and off-task behaviours, and the interaction of family members. Low levels of self-regulatory behaviour, as evidenced in the children's ability to monitor and control their own learning, were found during practice. Learning strategies were confined almost exclusively to playing through pieces once or twice. Most errors were either ignored or corrected by repeating one or two notes. Results show that self-regulatory processes vary widely between students, even from the very early stages of musical development, and help to explain why some learners develop their performance skills quickly while others struggle. Implications for music education and future research are discussed.*

Introduction

Because practice is essential for successful learning on a musical instrument, it is the focus of attention for a number of music psychologists (Ericsson, Krampe & Tesch-Römer, 1993; Slododa, Davidson, Howe & Moore, 1996). One of the most discussed aspects concerns *deliberate practice* (Ericsson *et al*., 1993), a term used to describe goal-oriented, structured and effortful facets of practice in which motivation, resources and attention determine the amount and quality of practice undertaken. Studies show that a major characteristic of expert musicians is the amount of deliberate practice they have undertaken during the many years required to develop their skills to a high level (Ericsson, 1997). Expert musicians exert a great deal more effort and concentration during their practice than less skilled musicians, and are more likely to monitor and control their playing by focusing their attention on what they are practising and how it can be improved.

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From a somewhat different perspective, Sloboda and Davidson (1996) contrast *formal* and *informal* aspects of practice. They found that high-achieving musicians tend to do significantly greater amounts of formal practice, such as scales, pieces and technical exercises, than their less successful peers. High achievers are also likely to report more informal practice, such as playing their favourite pieces by ear, 'messing about', or improvising. Sloboda and Davidson conclude that these informal ways of practising contribute to musical success because the highest achieving students are able to find the right balance between freedom and discipline in their practice. Similarly, in a study designed to explore motivational and self-regulatory components of instrumental performance, McPherson and McCormick (1999) identified three aspects of practice. These were defined as *informal/creative activities* (i.e. playing by ear and improvising for one's own enjoyment); *repertoire* (i.e. learning new pieces and performing older familiar pieces); and *technical work* (i.e. using a warm-up routine; practising scales, arpeggios, and études; and sight-reading music). Results showed that the amount of time students report practising in each of these three areas was significantly related to the quality of their cognitive engagement during practice and also to how much they reported enjoying playing their instrument. Students who undertook higher levels of practice were more likely to rehearse music in their minds and to make critical ongoing judgements concerning the success or otherwise of their efforts. They were also more capable of organising their practice in ways that provided for efficient learning, such as practising the pieces that needed most work and isolating difficult sections of a piece that needed further refinement. These results suggest that students who are more cognitively engaged while practising not only tend to do more practice, but enjoy learning more and are also more efficient in their work.

In the last decade, a body of observational research on expert practising has emerged (Hallam, 1995; Miklaszewski, 1989; Nielsen, 1999). This work has analysed experts' highly developed use of learning strategies. These strategies include (a) the manipulation of the speed of a work and the size of repeated material, depending on its familiarity and complexity; (b) the creation of dependable motor programmes through adherence to consistent technical plans such as fingerings; and (c) the use of musical structure to facilitate memorisation (Chaffin & Imreh, 1997). Other observational research has compared novices with experts to investigate the gradual emergence of such strategies over time (Gruson, 1988; Williamon & Vallentine, 2000).

In contrast to these expertise-oriented perspectives, musical practice can also be studied in terms of the self-regulated processes that students use to become more proficient on their instrument. For many schoolchildren, practice plays a role that is close to homework (Xu & Corno, 1998). Effective practice, like efficient homework, requires self-regulation, which is evident when students are 'metacognitively, motivationally, and behaviorially active participants in their own learning process' (Zimmerman, 1986, p. 308). In this conception, self-regulation is not seen as a fixed characteristic, but rather as a set of context-specific processes that students select from in order to accomplish a task (Zimmerman, 1998). The degree to which these self-regulatory processes are employed by students depends on six dimensions, which appear to be consistent across a range of diverse disciplines such as music, sport and academic learning (Zimmerman, 1994, 1998). Reinterpreted for musical practice, these dimensions incorporate:

1. *Motive*—feeling free to and capable of deciding whether to practise.
2. *Method*—planning and employing suitable strategies when practising.
3. *Time*—consistency of practice and time management.

4. *Performance outcomes*—monitoring, evaluating and controlling performance.
5. *Physical environment*—structuring the practice environment (e.g. away from distractions).
6. *Social factors*—actively seeking information that might assist (e.g. from another family member, teacher, practice diary or method book).

We consider this self-regulatory perspective to be particularly attractive. Not only does it enable us to clarify key processes involved in efficient musical practice and to compare these with other disciplines, but it may lead to a more complete understanding of musical learning with implications for optimising practice. Consequently, it is in this perspective that the present study is grounded.

Background to the Study

So far, most research has concentrated on defining the processes that lead to expert performance, often through the use of retrospective accounts and studies in which performers are asked to prepare assigned pieces for a formal performance. Relatively little research has studied practice in naturalistic settings, free of restrictions imposed by researchers. Another gap in the existing literature concerns the very beginning stages of learning an instrument and particularly what young children actually do when practising their instrument at home. To expand knowledge in this area, we analysed videotapes of children's home practice using a procedure that attempted to make our observations as 'normal' and therefore as ecologically valid as possible. Data we obtained from the analyses of these videos were used to supplement information obtained from regular, detailed interviews with a larger sample of 157 children in eight primary schools who started learning their instrument in school in grades 3 or 4. Data were also gained from interviews with their mothers, classroom teachers and instrumental teachers. Our purpose was to synthesise findings from the larger sample of interview data with new information obtained from analysing children's videotaped practice, in a way that would shed light on the self-regulatory processes outlined earlier.

Procedure

At the beginning of the study all the 157 children and their parents were invited to participate in the videotaping of practice, and 27 families agreed. Before the taping commenced, the parents and children were interviewed in order to explain the purpose of the study. This preliminary briefing stressed the need to ensure that the home practice sessions should be as normal as possible, and representative of how each child generally practised his or her instrument. After viewing all videotapes, seven children (three females and four males) between the ages of 7 and 9 were selected for the analysis reported here. The rest were excluded because they were irregular with videotaping of practice or because the child's behaviour appeared to be unduly influenced by the recording situation. Two were complete novices, three had learnt another instrument (either piano or violin), which they stopped playing before joining the school instrumental programme, and two were continuing to play piano while beginning their new band instrument. The sample consisted of two trumpets, two clarinets, and one flute, saxophone and cornet. In this article, each participant is referred to by their instrument and gender (e.g. the female clarinettist is labelled 'Female Clarinet').

Two practice sessions were selected for analysis for each of the seven children participating in year 1, and these were compared with two sessions for each of the five children who continued through to year 3. They were coded using the software package, *The Observer* (Noldus, Trienes, Hendriksen, Jansen & Jansen, 2000), which allows the researcher to play the videotape at various speeds through a computer interface, and to use various 'channels' to code behaviour. This process provides highly rigorous data that can be revisited by repeatedly viewing the videotape, although this rigor comes at a high cost in terms of research time: a 10-minute practice session can take up to 5 hours to code.

Results and Discussion

Results for the analyses can be discussed according to the six self-regulatory processes as defined by Zimmerman (1994, 1998; see also McPherson & Zimmerman, in press).

Motive

To understand this dimension of self-regulation, it is necessary to examine the degree to which the children feel free to and capable of deciding whether or not to practise. Results from interviews before the children commenced lessons (McPherson, 2000) show that they were able to differentiate between their interest in learning a musical instrument; the importance to them of being good at music; whether they thought their learning would be useful to their short- and long-term goals; and also the cost of their participation in terms of the effort needed to continue improving. Before joining the instrumental programmes, the children were asked how long they expected to continue learning their instrument. These initial motives and expectations for learning, coupled with how much practice they undertook, provided a powerful predictor of their subsequent achievement 9 months later (McPherson, 2000). Children who made the least progress tended to express more extrinsic reasons for learning, such as being part of the school band because their friends were also involved. In contrast, children who made rapid progress were more likely to express intrinsic reasons, such as always having liked music or wanting to play particular pieces for their own personal enjoyment.

A case study of one of the children involved in the present study (Renwick & McPherson, 2000) also revealed a strong effect of intrinsic interest in a particular repertoire on the degree of her self-regulation. When practising repertoire that she selected and wanted to learn herself, this young learner displayed a higher level of cognitive engagement and was markedly more efficient and persistent with her efforts. This finding suggests that young music learners who are motivated by a personal rather than an externally driven desire to learn, will be more likely to engage in the types of self-regulatory behaviour that enhance their achievement.

Method

The method dimension focuses on *how* the children practised, in terms of the types of strategies they adopt. Statistics generated by *The Observer* revealed that almost all of the children's practice consisted of simply playing the piece through without any other strategy being used (see Table 1—year 1: 94.1%; year 3: 95.3%). However, as shown in Table 1, differences between players can be observed. Four of the players accompanied their playing with body-movements, mostly foot-tapping, in year 1, but only

TABLE 1. Percentage of practice time spent using various strategies

	Year 1						Year 3					
Participant	Playing only	Moving	Counting	Thinking	Singing	Fingering	Playing only	Moving	Counting	Thinking	Singing	Fingering
Female Flute	94.0	6.0	0.0	0.0	0.0	0.0	99.8	0.0	0.0	0.2	0.0	0.0
Male Trumpet 1	93.4	0.0	2.8	3.0	0.8	0.0	85.3	8.9	0.0	2.8	3.2	0.0
Male Trumpet 2	99.1	0.0	0.9	0.0	0.0	0.0	97.9	0.0	0.0	2.1	0.0	0.0
Female Clarinet	99.2	0.0	0.0	0.8	0.0	0.0	94.8	0.0	0.0	3.2	0.8	1.2
Male Saxophone	91.1	7.9	0.0	1.0	0.0	0.0	99.0	0.0	0.0	1.0	0.0	0.0
Male Clarinet	91.0	1.6	7.1	0.3	0.0	0.0	—	—	—	—	—	—
Female Cornet	90.8	9.1	0.1	0.0	0.0	0.0	—	—	—	—	—	—
Mean	**94.1**	**3.5**	**1.6**	**0.7**	**0.1**	**0.0**	**95.3**	**1.8**	**0.0**	**1.8**	**0.8**	**0.3**

Percentages were analysed according to the amount of time spent practising, as measured from the first to last note of each practice session.

TABLE 2. Time spent practising by run-through

	Run-through					
	Year 1			Year 3		
Participant	First	Second	Third–fifth	First	Second	Third–fifth
Female Flute	100.0	0.0	0.0	100.0	0.0	0.0
Male Trumpet 1	73.5	10.3	16.2	83.4	16.6	0.0
Male Trumpet 2	100.0	0.0	0.0	88.6	11.4	0.0
Female Clarinet	100.0	0.0	0.0	96.3	2.4	1.3
Male Saxophone	91.3	8.7	0.0	91.1	7.6	1.3
Male Clarinet	88.2	10.9	0.9	—	—	—
Female Cornet	77.1	22.9	0.0	—	—	—
Mean	**90.0**	**7.5**	**2.5**	**91.9**	**7.6**	**0.5**

A run-through was defined as the number of times the participant played the item in the present practice session all the way to the end (e.g. Second indicates that the participant has already reached the end of the item and this is the second run-through).

one of the players employed this strategy in year 3. Four of the children, notably the Male Clarinet, spent time introducing a piece by counting the beat aloud, but this behaviour had disappeared by year 3. Other strategies such as thinking (i.e. silent inspection of the music), singing and silent fingering each accounted for an average of less than 2% of the total time in both years. No evidence of chanting or using a metronome was observed.

Interviews with the instrumental music teachers revealed that the standard advice about practice given to the students was to work for 15–20 minutes, 5 days per week, and that this should consist of repeating pieces and exercises until a degree of fluency is reached. Contrary to this advice, the vast majority (year 1: 90%; year 3: 91.9%) of their playing time was spent playing through a piece or exercise only once (see Table 2). Although the children would occasionally stop and repeat a small section after an error, as soon as they finally reached the end of the piece they seemed content to move on to another task. This trend was relatively stable across the 3 years. As a result, there was virtually no evidence of the deliberate practice strategies that are typical of expert musicians.

We speculate that this finding helps to explain one aspect of why beginning instrumentalists practise less than at later stages in their development (McPherson, 1993). Because they have not assimilated the types of strategies that lead to more effective self-evaluation and monitoring of their own progress (Hallam, 1997, 2001; Pitts, Davidson & McPherson, 2000), they simply 'run out of pieces' to work on. Most importantly, however, our results provide evidence that young players take years to assimilate the types of strategies that lead to effective self-regulation of their own progress.

Time

How children plan and manage their time has important implications for how efficient their practice will be. In year 1, 72.9% of the students' observed videotaped practice was spent playing their instrument. This percentage rose to 84.1% by year 3, suggesting that these five participants were beginning to spend their time more efficiently. As shown in

Table 3 the vast majority of this playing time was spent on repertoire (year 1: 84.5%; year 3: 92.6%) with approximately equal time spent on ensemble parts and solo pieces. Technical work (scales and arpeggios) took up the remainder of playing time (year 1: 15.2%; year 3: 7.4%), while the presence of informal practice (playing by ear, improvising, and playing from memory) was negligible. This pedagogically unbalanced 'diet' (McPherson, 1998) is surprising, and reveals that the informal practice found by Sloboda *et al*. (1996) in more experienced young musicians had not yet emerged in this group of beginners.

The remainder of the children's practice time was spent on non-playing activities (year 1: 27.1%; year 3: 15.9%). These activities show an interesting pattern of change with skill acquisition. Time spent looking for printed music to play rose from 44.7% of non-practising time in year 1 to 75.8% in year 3. Time spent talking or being spoken to fell from 32.4% in year 1 to only 7.7% in year 3, mostly as a factor of the reduced presence of other people in the room in the later sessions. Between year 1 and year 3, day-dreaming fell from 4.1% to 2.6% of non-playing time, responding to distractions fell from 3.8% to 1.7% and outward expressions of frustration fell from 3.0% to 0.9%. Time spent resting between pieces rose from 2.5% of non-practising time in year 1 to 5.6% in year 3, possibly as a factor of the longer and more demanding pieces played at this stage.

Table 3 also reveals marked differences between individuals. For example, in year 1, the least efficient learner (Male Clarinet) spent only 56.6% of his time actually playing, while the most efficient learner (Male Saxophone) spent 82.3% of his time practising. Research in academic subjects shows that many children actively avoid studying or use less time than allocated (Zimmerman & Weinstein, 1994). This was also true in our analysis of the children's practice. With the Male Clarinet, 21.5% of his total session time was spent talking with his mother about his practice tasks in a highly diffused manner, where the child's repeated errors became the primary focus and a source of considerable frustration. With some children, there was a high level of reference to the time, with frequent behaviours such as calling out to a parent to ask if they were 'allowed to stop yet.' For our sample it appears that a minimum time limit for practice was often enforced, yet the efficient use of that time was not.

By year 3, all five remaining subjects were spending more than 75% of their sessions actually playing, although some tended to display more instances of avoidance strategies such as talking with another family member, fiddling with their instrument and day-dreaming, compared to their peers. This was particularly evident in the results for our Male Trumpet 1, who spent less time playing than his peers, and also a larger proportion of his actual practice sessions fiddling with his instrument, day-dreaming, being distracted, and expressing frustration.

These results reinforce how subtle differences in students' practice habits can impact on their progress and ability to self-regulate, especially during the beginning stages of musical development. For example, examination of the students' results on the Watkins–Farnum Performance Scale (Watkins & Farnum, 1954), a standardised measure of performance achievement, shows that the Male Trumpet 1 made the least progress on his instrument when tested at the end of year 3. As an indication of the enormous difference that emerged between players, this young learner had reached the standard of playing which many of his peers had reached by the end year 1.

TABLE 3. Contents of practice expressed as a percentage of time spent practising or time spent not practising

	Year 1								Year 3					
Contents of practice	**Mean**	FClr	FCor	FFlt	MClr	MSax	MTr1	MTr2	**Mean**	FClr	FFlt	MSax	MTr1	MTr2
Total time practising[a]	**72.9**	79.9	74.3	72.8	56.6	82.3	71.9	72.7	**84.1**	85.1	90.0	87.7	75.9	82.0
Repertoire[b]	**84.5**	81.6	84.6	50.4	88.0	95.4	98.0	93.2	**92.6**	91.6	94.9	93.6	100.0	83.0
Technical work[b]	**15.2**	18.4	15.4	49.6	9.4	4.6	2.0	6.8	**7.4**	8.4	5.1	6.4	0.0	17.0
Informal practice[b]	**0.3**	0.0	0.0	0.0	2.7	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0	0.0
Total time not practising[c]	**27.1**	20.1	25.7	27.2	43.4	17.7	28.1	27.4	**15.9**	14.9	10.0	12.3	24.1	18.0
Find exercise[d]	**44.7**	36.3	52.4	94.4	16.1	81.8	18.8	41.9	**75.8**	94.2	95.5	82.4	54.7	73.1
Talk[d]	**32.4**	63.7	40.4	2.9	49.5	1.7	14.3	42.4	**7.7**	0.0	0.1	0.0	20.6	6.3
Fiddle with instrument[d]	**9.6**	0.0	2.1	0.0	3.1	0.0	57.1	1.1	**5.8**	0.0	2.6	4.5	8.6	9.6
Resting[d]	**2.5**	0.0	1.4	2.7	4.8	0.0	1.2	4.5	**5.6**	5.8	0.0	13.0	0.0	11.0
Day-dreaming[d]	**4.1**	0.0	0.0	0.0	12.9	0.0	2.8	4.8	**2.6**	0.0	1.9	0.0	7.7	0.0
Distracted[d]	**3.8**	0.0	0.0	0.0	6.2	16.5	5.8	0.0	**1.7**	0.0	0.0	0.0	5.5	0.0
Frustration[d]	**3.0**	0.0	3.8	0.0	7.5	0.0	0.0	5.2	**0.9**	0.0	0.0	0.0	3.0	0.0

[a] Time spent on repertoire, technical work, or informal practice from the first note played to the last note played in the session.
[b] As a percentage of total time spent practising.
[c] Time *not* spent on repertoire, technical work, or informal practice from the first note played to the last note played.
[d] As a percentage of total time spent not practising.
FCr, Female clarinet; FCor, Female cornet; FFlt, Female flute; MClr, Male clarinet; MSax, Male Saxophone; MTr1, Male trumpet 1; MTr2, Male trumpet 2.

Performance Outcomes

A typical self-regulated approach to practice involves an ability to react by modifying and adapting one's playing based on the feedback obtained when performing. We chose to assess this type of performance outcome by analysing the nature of the children's errors (cf. Palmer & Drake, 1997; Drake & Palmer, 2000).

Our seven children fell into three clear groups concerning prior learning, and these corresponded clearly to their ability to monitor their playing. The Female Flute and Male Saxophone had previously learned piano, and were continuing on this instrument as well as learning their new band instrument. They made an average of 2.6 errors per minute in year 1 (see Table 4). The Female Cornet, Male Clarinet and Female Clarinet had learned either piano or violin but ceased playing this instrument before taking up their new band instrument. In year 1 these children made an average of 7.3 errors per minute. The two trumpeters, who had not previously learned an instrument, made too many errors to count, and were eliminated from the analysis shown in Table 4 because their pitching was too inaccurate. Using aural analysis alone meant that only the clearer pitching of the beginner woodwind instruments and the cornet could be reliably assessed. The analysis shown in Table 4 therefore only includes children with prior experience in learning another instrument, and for whom reading had become to a certain extent automatised. As the results show, many of the pitch errors made by the children in the first year of learning were ignored, which points to a general inability of these young learner to correct their performances based on the feedback they received while playing.

It is interesting to compare the total errors per minute and the ignored errors per minute for the two participants with the highest (Female Cornet) and lowest (Male Saxophone) error rates in year 1 (see Table 4). While our Female Cornet player made many more errors than our Male Saxophone, she also ignored a far higher proportion of these errors. Our Male Saxophone's regulation of his own accuracy was remarkable in year 1 and also when we analysed his practice in year 3. Most notably, his rate of improvement was very high on the second run-through of a piece: in year 1 his error rate fell from 1.4 per min on the first run-through to 0.6 per min on the second run-through, suggesting that he possessed an outstanding ability to retain a mental representation of his performance between run-throughs, and to use this as a basis for learning from his errors. In year 3, the same phenomenon prevailed with our Male Saxophone player. Although the frequency of his errors had risen (year 1: 1.4/min; year 3: 6.7/min) because of a steep increase in the difficulty of the repertoire he was playing, the error rate on the second run-through of his practice was only 34% of that on the first. This is in sharp contrast with our Female Cornet in year 1 and Female Clarinet in year 3, who actually made more frequent errors on their second run-throughs.

In some cases (especially with the Female Cornet, the participant who ignored the most errors), a number of ignored errors may have been 'honest mistakes', in the sense that the children may have believed what they were playing was correct. The most common ignored error was a failure to observe the key signature, and the children may have believed that the wrong-sounding note must be correct, because they were using what they thought was the correct fingering. An analogous situation is in faulty text comprehension, where children fail to recognise contradictory ideas because they believe printed material must be correct (Hacker, 1998).

Based on the above results, we believe that teachers should use a variety of techniques during their lessons to encourage students to reflect on the accuracy of their performances. For example, after completing a performance, students could be asked to

TABLE 4. Distribution of errors per minute, year 1, according to first instrument status

	Continuing first instrument?					
	No			Yes		
Error category	Female Cornet	Male Clarinet	Female Clarinet	Female Flute	Male Saxophone	**Mean**
Total errors per minute	11.0	5.5	5.5	3.8	1.4	**5.4**
Ignored errors per minute	7.7	2.4	0.9	0.3	0.3	**2.3**
Repeat 1–2 notes after finger error	0.7	0.3	1.3	2.2	0.4	**1.0**
Repeat 1–2 correct notes	0.6	0.4	2.2	0.6	0.1	**0.8**
Repeat >2 notes after finger error	0.5	1.2	0.7	0.3	0.1	**0.6**
Repeat >2 correct notes	0.4	1.1	0.4	0.2	0.1	**0.4**
Correct sound production error	1.1	0.0	0.1	0.2	0.4	**0.4**

comment on how and in what ways they believe that their playing was correct or wrong according to the printed notation. Armed with this information, a teacher can devise strategies for making the identification of performance errors more explicit by:

- demonstrating to the student how they played, as compared to how the piece should sound;
- teaching them mental scripts to use before they commence playing, such as consciously searching for and thinking about the time- and key-signatures;
- silently singing the melody of the opening phrase before playing to establish an appropriate tempo and interpretation; and
- scanning the music to identify and rehearse separately possible obstacles (see further, McPherson, 1994).

Another technique would be to ask students, periodically, to demonstrate how they would practise those sections of a piece which they or their teacher believe would be difficult to master. Diagnosing not only where errors occur, but also how and why students ignore problems or are unable to improve an inadequate performance, will place teachers in a better position to tailor their teaching in ways that will help improve individual students' home practice habits.

In addition, careful viewings of the videotapes of the two trumpet players, who had never learned an instrument before, demonstrated that these children had enormous difficulty coordinating and monitoring their own playing. Such large differences in these children's ability to self-regulate the accuracy of their playing can partly be explained by considering the enormous demands placed on working memory for children learning to simultaneously read notation, manipulate the keys or valves on their instrument, and adjust their embouchure according to aural feedback. The tradition from which these students come places great importance on learning to read notation from the first lesson, and for many of them, there is insufficient opportunity to learn to associate their nascent aural schemata with the notation. Our conclusion, based on repeated observation of these two learners and other practice videos we collected of beginners with no previous instrumental experience, shows that they would sometimes play new unfamiliar repertoire so slowly and hesitantly that they were no longer able to perceive the music they were rehearsing as a complete phrase or melody. In such situations they appeared deaf to the sound of what they were trying to play, because a majority of their cognitive resources were devoted to decoding the notation at the expense of them being able to listen to what they were trying to play. These results are in stark contrast to the most accurate students in our study, who were relieved of this high cognitive load because they had learned how to read music on another instrument before starting in the school instrumental programme.

Table 5 shows the longitudinal changes for the three children (Female Clarinet, Female Flute and Male Saxophone) whose year 3 errors were coded. After the 2-year interval, the error rate had increased by 218% (i.e. average 3.6 errors per minute to 7.8 per minute), presumably because of the increased difficulty of the material. By year 3 their error profiles had changed in a somewhat unclear way. As would be expected from previous research (Gruson, 1988; Hallam, 2001), there was now a trend to repeat more than two notes after an error instead of one or two. Surprisingly, however, these three children were more likely to ignore errors and less likely to repeat music unless in response to an error. We speculate from these findings that these changes may be partly explained by the large shift in instructional style that these children experienced, with the group-centred method-book approach of year 1 shifting to a much more difficult

TABLE 5. Longitudinal change in error categories for years 1 and 3

	Year 1				Year 3			
	Female Flute	Female Clarinet	Male Saxophone	**Mean**	Female Flute	Female Clarinet	Male Saxophone	**Mean**
Total errors per minute	3.8	5.5	1.4	**3.6**	6.7	7.7	9.0	**7.8**
Total ignored errors per minute	0.3	0.9	0.3	**0.5**	3.9	2.3	2.5	**2.9**
Percentage of errors by category								
Repeat 1–2 notes after finger error	58.3	23.4	27.3	**36.3**	24.0	17.2	35.7	**25.6**
Repeat 1–2 correct notes	16.7	39.4	9.1	**21.7**	11.0	9.2	5.4	**8.6**
Repeat >2 notes after finger error	8.3	12.8	9.1	**10.1**	5.0	22.9	28.7	**18.9**
Repeat >2 correct notes	4.2	6.4	9.1	**6.5**	1.0	9.7	0.8	**3.8**
Correct sound production error	4.2	2.1	27.3	**11.2**	1.0	11.0	1.5	**4.5**
Ignore finger error	8.3	15.9	18.1	**14.2**	40.0	26.9	27.9	**31.6**
Ignore sound production error	0.0	0.0	0.0	**0.0**	18.0	3.1	0.0	**7.0**

individual-centred approached aimed at the preparation of solo repertoire for formal music examinations in year 3.

The large individual differences in the proportion of ignored errors suggest that the practising tasks were far from being ideally tailored to the capabilities of each child. The simple tunes set in year 1 were well below the level of challenge for the Male Saxophone and Female Flute, given their experience with notation from their prior and current piano lessons. Despite receiving individual tuition, these children were required to practise music that was below their level of challenge. However, by year 3, these two higher-achieving children had been allowed to increase considerably the difficulty of their tasks, which, in the case of the Male Saxophone, was typical of students learning for 5–6 years. Accordingly, the error rate had increased considerably by year 3 (178% for Female Flute and 628% for Male Saxophone).

At the other end of the spectrum, our two trumpeters were extremely inaccurate in Years 1 and 3—often showing no sign of noticing their errors. Most of their errors were due to mispitching to the wrong note on the harmonic series, which suggests that they were unable to verify the accuracy of their playing beyond checking that they were using the correct fingerings. By year 3, the rate of progress enforced by band membership resulted in these boys struggling to practise music that was beyond their ability, leading to obvious frustration and frequent examples of giving up on a piece before it had been completed. These observations can be considered in terms of *flow theory* (Csikszentmihalyi, 1991), which stresses the importance to motivation of the balancing of skill and challenge in learning situations. In music, O'Neill (1997) suggests that teachers need to provide tasks that are difficult enough to be challenging, but not so difficult that they will cause frustration, so that 'children will value learning goals and respond by mastery behaviour' (p. 66). In terms of our two novice trumpeters this was clearly not the case, either in year 1 or year 3.

Another pervasive feature of the error analysis was the variable quality of rhythmic accuracy, which was so poor that we decided not to code rhythmic errors. For much of the observed practice in year 1, our beginners' approach was solely based on decoding the pitch symbols in the notation and finding the matching fingerings: very little attention was given to rhythm, and no strategies were used to address it beyond the children counting themselves in. For most of the participants, it seems that only prior familiarity with tunes such as *Old Macdonald* or the aural memory of their teacher's rendition guided their rhythmic accuracy. The large disparity between rhythmic and pitch accuracy confirms previous research with more advanced instrumentalists. McPherson (1994), for example, reports that intermediate and advanced level students make three times more rhythmic errors than pitch errors, and explains this finding by suggesting that correct performance of a rhythm demands comprehension of the notation. In contrast, players who are able to link pitches notated in a score with their correct fingerings can perform correctly even though they are not able to hear the notated pitches in their mind. In addition, Barry (1992) found that novices made no improvement in rhythmic accuracy or in 'musicality' during free practice, although their playing improved considerably during supervised, structured practice. The one instance in the present study where extended parental 'teaching' was observed was with the Male Clarinet, where there was a far greater emphasis on rhythmic accuracy.

Physical Environment

Self-regulated learners are aware that their physical environment should be conducive to efficient learning. There was a wide range of locations chosen by the children for practice, ranging from the privacy of a bedroom to a shared family space. Some children would appear in different rooms in different sessions, suggesting that they were choosing a quiet space according to the family situation on the day. This appeared to give the children access to help from other family members when they needed it, but also meant that some needed to spend some of their practice time coping with distractions from siblings, pets or a television in the next room. Data obtained from both the videotaped practice sessions and child/mother interviews shows that the physical environment was mostly well-equipped with a music stand and an appropriate chair (only one child stood while practising). However, differences between children were noticeable in the videotapes of the 27 children whose practice we observed. One child practised (in his pyjamas) while sitting cross-legged on his pillow with the bell of his trumpet resting on the bed. Another trumpeter undertook most of his practice either squatting on the floor or laying back on a lounge chair. The poor posture of these young learners could be contrasted with some of their peers, who were more capable of holding their instrument correctly while sitting or standing with a straight back and suitable playing position. Our analysis of the videotapes across the 3 years demonstrates that the way young learners structure their physical environment does exert a powerful influence on how quickly they will develop skill on their instrument.

Social Factors

When faced with difficulties, self-regulated learners actively seek help from knowledgeable others. The observation of family involvement reveals a rich pattern (see Table 6) with a noticeable decline in the participation of parents between the first and third years of learning. In year 1, one or both parents were present in the room for 65.2% of the observed time. (This level of participation may have been affected by the role some parents took in being a camera-operator.) This time spent in the practice room further broke down into four parental behaviours: 9.3% involved a parent teaching the child (i.e. taking a very active instructive role). Another 10.4% of parental involvement was classified as *guiding* (e.g. 'What piece are you going to do first?'). Except for a small amount of time where a parent was distracting the child, the remainder of the time (79.6%) was spent listening less actively again. A large amount of maternal involvement with some of the children consisted of bolstering motivation and delivering praise. Discussion between parent and child about appropriate practising strategies was found in only one participant (Male Clarinet), and this was highly argumentative—certainly falling outside of the parental involvement that might be called *autonomy-supportive* (Grolnick, Kurowski & Gurland, 1999). Nevertheless, by the third year of the study, a higher level of autonomy was observed, with parents present in only 23.4% of the time, and now almost exclusively in a half-listening but supportive capacity.

In year 1, five of the seven children showed high usage of a practice diary in which the teacher had written down set tasks. The two trumpeters, who showed poor monitoring of their errors, were not observed referring to a diary at all. By year 3, only two children continued to refer to their diary, but this in no way would imply that the other three children were capable of remembering what had been assigned by their teacher.

TABLE 6. Parental behaviours as a percentage of total session time

	Year 1								Year 3					
Contents of practice	**Mean**	FClr	FCor	FFlt	MClr	MSax	MTr1	MTr2	**Mean**	FClr	FFlt	MSax	MTr1	MTr2
Parent present	**65.2**	100.0	100.0	28.4	40.0	100.0	50.0	37.9	**23.4**	0.0	50.0	0.0	16.9	50.0
Parent teaching when present	**9.3**	0.0	2.1	0.0	62.6	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0	0.0
Parent guiding when present	**10.4**	27.0	11.6	0.0	2.8	3.2	0.0	28.4	**3.1**	0.0	0.0	0.0	12.7	3.0
Parent listening when present	**79.6**	73.0	85.9	97.3	34.2	96.1	99.4	71.6	**53.5**	0.0	100.0	0.0	70.6	97.0
Parent distracting when present	**0.7**	0.0	0.4	2.7	0.4	0.7	0.6	0.0	**3.3**	0.0	0.0	0.0	16.7	0.0

FCr, Female clarinet; FCor, Female cornet; FFlt, Female flute; MClr, Male clarinet; MSax, Male Saxophone; MTr1, Male trumpet 1; MTr2, Male trumpet 2.

Conclusions

Zimmerman (1998) concludes that the self-regulatory processes identified here are distinguishing characteristics of experts but that they can also be found, to a greater or lesser extent, in the early stages of learning. It can therefore be speculated that musicians who display these characteristics early in their development will be more likely to practise harder and more efficiently, express more confidence about their own capacity to learn, and be more likely to achieve at a higher level. Early results from our interview and videotape research show that the practice habits of the children we studied varied considerably and that there were important differences between them on each of the six self-regulatory processes, even from the very earliest practice sessions. Not only did our sample undertake different amounts of practice during the 3 years they were studied, but there were also large individual differences in the quality of their practice, in terms of the time they actually devote to playing, correcting problems and actively seeking to improve their performance, even from the first weeks of learning.

Our results lead us to conclude that a majority of our learners possessed the *will* to learn their instrument, but not necessarily the level of *skill* required to ensure efficient and effective practice. By this we mean that the young learners were typically excited about learning their instrument and came to their learning as optimistic, keen participants. However, while their instrumental teachers were making them aware of *what* to practise, many had very little idea of *how* to practise. An important implication therefore is that teachers should spend time during their lessons demonstrating and modelling specific strategies that their students can try when practising, such as how to correct or prevent certain types of performance errors. However, such strategies will be ineffective unless the learners also develop their capacity to monitor and control their own learning. Consequently, teachers should also devise strategies whereby learners can be encouraged to reflect on the adequacy of their own practice habits, and especially on how they might invent better ways (such as self-reflective comments in their diaries) that will help them practise more efficiently. Our preliminary findings suggest that the skills of knowing how to self-monitor, set goals and use appropriate strategies take time to develop in most young children. Helping beginning instrumentalists to reflect on their own progress and ability to employ self-regulatory processes may go some way to improving instrumental instruction, especially for children who do not pick up these skills informally.

The results of this study, combined with the extensive body of evidence found in academic learning, suggest that the six self-regulatory processes are used to greater or lesser degrees in young musicians. Most importantly, our results indicate that these differences emerge from the very first practice session and that they account for a large part of a student's subsequent progress. Further research currently being undertaken with a larger sample of music students over a wider age range will shed further light on how such processes develop into adolescence. Specifically, our research with beginners is attempting to clarify the extent to which higher- and lower-achieving learners differ in their practice behaviour. However, on the available evidence, it seems clear that every time a young musician self-initiates practice, consciously plans what to practise, chooses to correct their performance, structures their learning environment or actively seeks information from knowledgeable others, they come one step closer to refining the self-regulatory processes that will eventually become automatised. For researchers, the challenge involves expanding and clarifying these issues in a way that will provide useful information that teachers can use to cater for the wide range of student abilities that they encounter in their everyday teaching.

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