

“SEEING THE BIG PICTURE”: PIANO PRACTICE AS EXPERT PROBLEM SOLVING

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ABSTRACT

Experts in many fields approach a new problem by identifying the general principles involved before starting work on details. Do expert musicians similarly begin work on a new piece with the “big picture” of the piece in mind? To find out, a concert pianist recorded her practice of the third movement, *Presto*, of J.S. Bach’s *Italian Concerto*, commenting as she did so about what she was doing. The comments indicated the main focus of the pianist’s attention. The practice showed both what she was attending to and also effects that were more automatic and less deliberate. Practice was transcribed by counting the frequency of starts, stops, and repetitions in each bar and measuring tempo during the initial sight-reading of the piece. These measures were related by multiple regression to features of the music as reported by the pianist for each bar on three basic dimensions (fingering, technical difficulties, familiar patterns of notes), four interpretative dimensions (phrasing, dynamics, tempo, pedal), three performance dimensions representing features of the music attended to during performance (basic, interpretative, expressive), and location in the formal structure.

An “artistic image” was already evident in effects of structure and performance cues on the initial sight-reading, and on work on technique in sessions 1-6, even though this overall musical picture was rarely mentioned directly. The “big picture” was also evident in practice of performance cues and in comments about memorization and structure in sessions 7-10. Like experts in other fields, the pianist was guided by the “big picture” which in this case consisted of an “artistic image” of how the piece should sound.

1. INTRODUCTION

How do musicians deal with the competing demands on their attention when first learning to play a new piece? On the one hand, decisions about technique cannot be ignored; fingerings must be selected and solutions for technical problems must be found just to play the notes. At the same time, the best solutions to many problems of technique depend on interpretive decisions. So unless the musician begins with a clear idea of the “big picture,” or overall musical shape of the piece, fingerings and other basic motor skills are likely to need relearning once the interpretive decisions have been made. The noted pianist and pedagogue Heinrich Neuhaus suggested that, when an experienced musician begins work on a new piece “*an instantaneous and subconscious process of ‘work at the artistic image’ takes place*” (Neuhaus, 1973, p. 17).

This description suggests that the way that an expert musician goes about learning a new piece may be similar to the way experts in other domains like physics and mathematics approach new problems, first looking at the big picture to understand the basic principles involved. Novices, in contrast, tend to focus on superficial details (Chi, Glaser & Farr, 1988). In addition, Neuhaus’s suggestion that grasp of the artistic image of a piece is “instantaneous” and “unconscious” is reminiscent of the ability of experts in other domains to make decisions intuitively and immediately without having to think them through. For example, chess experts are able to maintain a high level of play while playing “speed” chess with only a few seconds for each move because they can recognize the similarity of the current situation to ones encountered in the past (Chi et al., 1988). It seems likely that the ability of an experienced musician to play musically when first sight-reading through a new piece is the product of similar process. Familiarity with the style, composer, and earlier performances of the same piece would permit snap decisions to be made about technique and interpretation that would then be confirmed later in practice with more time for reflection.

To test these ideas, a concert pianist (the second author) recorded her practice as she learned a new piece, commenting periodically on what she was doing. We compared comments and practice to determine which aspects of the music were the focus of deliberate reflection and problem solving efforts and which were handled more automatically and intuitively. The comments indicated whether the focus was on technique (“*use the first finger for the F*”), interpretation (“*bring out the theme*”), or expression (“*a rousing conclusion*”). Practice, in contrast, might be affected by all three levels at the same time. For example, the pianist might automatically start to articulate a hidden polyphonic theme in the music at the same time as deliberating about what fingering to use. We would expect both decisions to be reflected in the way the passage is practiced, even if only the decision that was the focus of conscious deliberation was mentioned in the pianist’s comments. By comparing activity at the keyboard with the pianist’s comments we were able to distinguish aspects of the music that were handled more automatically and intuitively from those that were dealt with more deliberately.

The focus of the pianist’s conscious, problem solving efforts was determined by content analysis of her comments. The aspects of the music affecting practice were determined by examining where the pianist started and stopped and what was repeated in each practice session. The behavioral record of activity at the keyboard was laid alongside the musical score to see how the complexity of the music affected practice. For example,

when practice consistently starts or stops or repeats at section boundaries, we inferred that the pianist was influenced by the formal structure. The detailed description of the music required for this analysis was provided by the pianist, who reported all the features of the music that she had paid attention to at any point during the learning process by marking them on copies of the score (Chaffin, Imreh & Crawford, 2002, pp. 166-171). Features were reported on 12 separate dimensions. The formal structure was described by the location of section boundaries and switches (places where identical repetitions of a theme begin to diverge). Three basic dimensions require attention simply in order to play the notes (fingering, technical difficulties, and familiar patterns of notes). Four interpretive dimensions provide musical shape to the notes (phrasing, dynamics, tempo, and pedal). Three performance dimensions represent the cues the pianist attends to during performance (basic, interpretive, and expressive performance cues).

The idea behind the basic and interpretive dimensions will be familiar to anyone who has played a musical instrument. The performance dimensions, on the other hand require more explanation. Implementation of decisions about basic and interpretive dimensions becomes automatic with practice, allowing the pianist to decide which features to pay attention to while performing. With practice, attention to these features becomes automatic so that they come effortlessly to mind as the piece unfolds, becoming performance cues. These cues provide a means of consciously anticipating and directing the highly practiced, automatic movements of hands and fingers. Basic and interpretive performance cues are subsets of the basic and interpretive features, i.e., those features selected for attention during performance, while expressive performance cues represent the musical turning points -- the changing emotions -- that the performer wants to draw to the audience's attention. Expressive cues are a distillation of the musical effects of all of the other dimensions, representing the ebb and flow of feeling produced by the musical structure.

The development of an artistic image should be reflected in effects on practice of the formal structure, the performance dimensions that represent the pianist's ideas of how the work should be performed, and the interpretive dimensions that provide musical shape to the notes. Work on technique should be reflected in effects of the basic dimensions (fingering, technical difficulties, and familiar patterns of notes). If Neuhaus (1973) is correct and the development of the artistic image is "*instantaneous and subconscious*," then we would expect to find it affecting practice early in the learning process without being explicitly mentioned in the comments. This would suggest that the development of the artistic image was the product of the kind of rapid, intuitive decision making that is characteristic of other kinds of experts when they perform under time pressure (Chi et al., 1988). On the other hand, if achieving an artistic image for the piece required deliberate effort, then we would expect to find comments about those efforts in addition to effects on practice. For example, the pianist might talk about the differences between the different sections, or describe the musical feelings that she was trying to achieve.

2. METHOD

The Pianist. Gabriela Imreh was trained as a concert pianist in Romania. During the ten-month period covered by this study, she gave about 30 concerts involving two recital programs and five concerti with orchestra, in addition to preparing the program which included the piece selected for study.

The Music. The third movement, *Presto*, of the *Italian Concerto* by J.S. Bach was learned for the professional recording of an all-Bach CD. The pianist had played Bach throughout her career, and had taught the *Italian Concerto* to a student three years earlier, but had not played the piece herself. The *Presto* is of moderate difficulty, is scored in 210 bars, is notated in 2/4 time, and lasts for 3-4 minutes.

Procedure. The pianist videotaped her practice from the first time she sat down at the piano until she performed the piece without the score at the recording session. Practice was transcribed by recording the bar on which each practice segment started and stopped and classified as *runs* (the playing of longer passages) or *work* (the repetition of the same short passage). Amount of practice was measured by counting the number of starts, stops, and repetitions of each bar separately for runs and work, giving a total of six dependent measures for each bar. Tempo during the initial sight-reading of the piece was measured as interbar-intervals (IBIs) with a mean accuracy of 15 msec. Tempo and the six measures of amount of practice served as dependent variables in multiple regression analyses in which predictor variables were measures of musical complexity and structure. Bars (N=210) were the unit of analysis.

The pianist marked the features of the music she had attended to during practice and performance on copies of the score separately for each of the ten basic, interpretive, and performance dimensions and for section boundaries and switches (places where two identical themes first separate). Musical complexity was measured for each bar by counting the number of features or cues reported. Location of a bar in the formal structure was represented by two dummy variables representing the first and last bar in each section, serial position in a section, and number of switches reported for each bar. For the analysis of IBIs, theme (A,B,C, or D) was included as an additional predictor by coding the bars of each theme with a dummy variable reflecting the rank ordering of the mean IBI for the different themes in the final performance recorded on the CD. Number of notes in a bar was also a predictor in all analyses.

The pianist commented on what she was doing as she practiced. Comments were classified as concerned with basic technique (fingering, technical difficulties, and familiar patterns), interpretation (phrasing, dynamics, tempo, use of pedal), performance (memory, attention, musical structure, and use of the score), or metacognitive issues (e.g., self-evaluation, plans, strategies) ($Kappa = .78$).

3. RESULTS & DISCUSSION

Stages of the learning process. The preparation of the *Presto* took place in 57 sessions totaling 33.5 hours over 39 weeks. Practice sessions were grouped into three main periods separated by intervals of up to three months during which the piece was

not played. The present report focuses on the first period which consisted of 12 sessions totaling nearly 12 hours over 5 weeks (see Chaffin & Imreh, 2002 and Chaffin et al., 2002 for the later periods). Session 1 began with a slow sight-reading of the entire the concerto before the pianist started working systematically through the *Presto* a few sections at a time, deciding fingerings and establishing motor memory. This stage was completed by session 6 and, after a three-day break, the new goal in session 7 was to play fluently through the whole piece. This was first achieved at the end of session 8 with five fluent performances, one “*mostly from memory*”. Sessions 9 and 10 were devoted to developing interpretation, sessions 11 and 12 to “*just running through ... and fix[ing] whatever goes wrong.*” At the end of session 12 the pianist played through the piece twice from memory before setting the *Presto* aside for three months.

Inter-bar intervals (IBI) during sight-reading. The initial sight-reading through the piece was done at less than half-tempo with many fluctuations and hesitations, but without ever coming to a complete stop or repeating anything. The pianist reported in a later interview that her goal was not fluent performance but to locate the main themes and look for ways to make each return

of a theme distinctive, identify problem spots for performance, and evaluate fingerings. The regression analysis summarized in column 1 of Table 1 supports this account by showing that the tempo slowed at section boundaries as the pianist looked ahead at the next section (Begin and End section) at basic cues where technique would later need attention during performance (Basic cues), and at bars where fingering decisions were later reported (Fingering). These effects indicate that the pianist was looking at “the big picture”. There was also evidence that the pianist had already formed at least the outline of an “artistic image”. The effect of Theme indicated that the different themes were played at different tempi in the same way as in the final performance 10 months later. The effects of Dynamics and Pedal, which also appeared in the final performance, also point to the conclusion that the pianist had already formed an “artistic image” of how the piece should sound. Like experts in other fields, the pianist began with a deep understanding of the task (Chi et al., 1988). Although obliged to pay some attention to technique (the effects of Fingering and Familiar Patterns), the pianist was also looking at the big picture (the effects of Musical Structure and Performance Cues).

| Predictor variable | Tempo during initial sight reading | Number of effects on repetitions/starts/stops for runs & work | | | |
|--------------------------------|------------------------------------|---|-----------------|-----------------|----------------|
| | | Sessions 1-6 | Sessions 7-8 | Sessions 9-10 | Sessions 11-12 |
| Musical Structure | | | | | |
| Theme | .30*** | x | x | x | x |
| Begin section | .17* | 3 | . | . | 2 |
| End section | . | . | . | . | . |
| Serial position | . | . | 2 | 2 | . |
| Switch | . | 6 | 2 | 2 | . |
| Performance Cues | | | | | |
| Basic cues | .21** | 1 | 4 | 1 | 2 |
| Interpretive cues | . | . | 2 | 2 | . |
| Expressive cues | . | . | 1 | 1 | . |
| Basic Dimensions | | | | | |
| Fingering | .22*** | 2 | 2 | . | 1 |
| Technical difficulties | . | 3 | 2 | 3 | 3 |
| Familiar patterns | . | 2 | . | . | . |
| Interpretive Dimensions | | | | | |
| Phrasing | . | 1 | . | . | . |
| Dynamics | -.13* | 1 | . | 2 | . |
| Tempo | . | . | . | . | . |
| Pedal | -.23* | . | . | 1 | . |
| Number of Notes | | | | | |
| R ² | .41** | .14*** - .25*** | .17*** - .29*** | .10*** - .30*** | .05 - .24*** |

Table 1. Significant effects of musical structure, performance cues, and basic and interpretive dimensions showing standardized regression coefficients for tempo during initial sight reading and number of significant effects ($p < .05$) on six dependent measures of practice in sessions 1-12 (starts, stops, repetitions for runs and work). ‘x’ indicates predictor variable excluded; R² for repetitions/starts/stops indicate the range of values obtained; * $p < .05$, ** $p < .01$, *** $p < .001$.

Comments and practice in sessions 1-12. The percentage of comments about basic, interpretive, and performance issues is shown in Figure 1. Basic issues predominated in sessions 1-6 (49 of 145 comments), performance issues in sessions 7-8 (8 of 28 comments), interpretation in sessions 9-10 (14 of 41 comments), and performance again in sessions 11-12 (10 of 20 comments).

Table 1 (columns 2-5) summarizes the results of the six regression analyses performed for each set of sessions by reporting the number of significant effects obtained. This measure gives a rough index of the impact of each predictor on practice (for a more complete report see Chaffin, Imreh, Lemieux & Chen, in press). The number of significant effects for each group of

variables changed across practice sessions. In sessions 1-6, the majority of significant effects were for musical structure and basic dimensions, while performance cues and interpretive dimensions had very few effects. In sessions 7-8, in contrast, performance cues produced the largest number of effects, while effects of structure and basic dimensions were less numerous and there were no effects for interpretive dimensions. In sessions 9-10, effects of two interpretive dimensions reappeared, while in sessions 11-12 performance cues and basic dimensions again accounted for the majority of effects as they had in sessions 1-6.

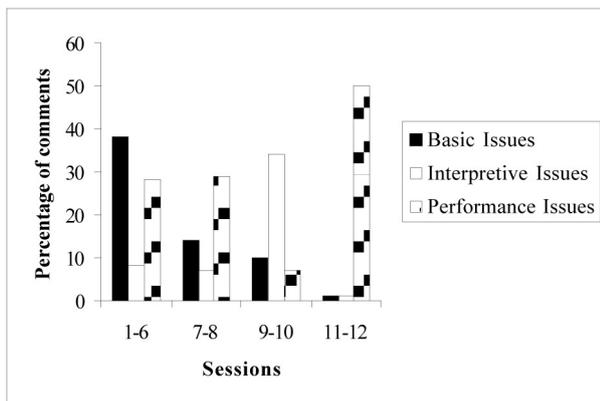


Figure 1: Percentage of pianist's comments about basic, interpretive, and performance issues during the first 12 sessions. (Metacognitive comments are excluded).

There were striking correspondences between comments and practice; also interesting discrepancies. In sessions 1-6, when basic dimensions were the predominant topic of comment, all three basic dimensions also had multiple effects on practice, suggesting that technique was the focus of deliberate problem solving efforts. In contrast, structure had multiple effects on practice but was mentioned much less frequently, suggesting that its effects were more automatic and intuitive. In sessions 7-8, as the piece was performed fluently for the first time, practice and comments were in agreement in pointing to performance as the main focus of attention with effects on practice of all three performance dimensions. In sessions 9-10, both comments and practice point to interpretation as the main focus of attention, with three interpretive effects for practice (compared to none in sessions 7-8) and comments about interpretation predominating. Finally, when the pianist was "just running through the concerto" in sessions 11-12, performance became the main topic of comment at the same time that performance and basic dimensions were again responsible for most of the effects on practice. The main focus of attention was performance, while "fix[ing] whatever goes wrong" occurred more automatically, affecting the practice of basic dimensions but not attracting any comments.

4. CONCLUSIONS

The pianist approached the learning of the *Presto* with an "artistic image" of the piece already in mind (Neuhaus, 1973). In her initial sight-reading, she played the four main themes at different tempi in the same way as in the finished performance 10 months later. In this respect, the pianist behaved like experts in other

fields who approach a new task by looking for the underlying principles involved (Chi et al., 1988). In the present case, the pianist used the initial sight-reading to gain an overview of the musical shape of the piece, identify problems, and evaluate the work of the editor. Besides giving each of the four main themes a distinctive tempo, the pianist also slowed down at section boundaries to look ahead at the next section, at basic performance cues to examine difficulties that would emerge when the piece was later performed up to tempo, and at places where fingering decisions would later be made. The latter two effects reflect an anticipation of decisions that would be confirmed later after testing during practice. This ability to make snap judgments that anticipate later decision making is another characteristic of expert problem solving (Chi et al., 1988).

The pianist's ability to anticipate was not, however, absolute. Her musical image developed with practice. The expressive and interpretive turning points of the piece (expressive and interpretive performance cues) were not practiced until fluent performance developed in sessions 7-8, and additional interpretive nuances were added in sessions 9-10.

The musician's comments and activity at the keyboard provided separate and complementary sources of information. Comments reflected the problem solving goals that were foremost in the pianist's mind while practice reflected both these and additional influences that affected practice more automatically and intuitively. In sessions 1-6, technique was the focus of deliberate problem solving and this was reflected both in the practice of basic dimensions and in the comments. Musical structure, in contrast, was not the focus of attention and affected practice without being mentioned in the comments. Similarly, in sessions 7-8 and 9-10, practice of expressive and interpretive cues showed that the pianist had identified these critical landmarks, even though they were not directly mentioned in her comments. The comments indicated that the pianist's main concerns were with fluency and memorization; the practice showed how these goals were achieved – through practice of performance cues. Thus, by looking at both comments and practice together we were able to achieve a deeper understanding than would have been possible with either source of information alone.

5. REFERENCES

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