Gender Wayang on Piano: How an Expert Solves the Problem

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The findings of the study that I'm discussing today grew out of something I wondered about back when I was an undergraduate in jazz studies. I wondered why some students in the program seemed to make little progress through the years, whereas others quickly surpassed their peers and became accomplished players. Investment of effort seemed to be similar across the students—everyone was practicing a lot. Motivation seemed to be similar—everyone was striving to be a good jazz musician—yet, the net effect of "trying hard" varied noticeably across students.

One of the jazz piano students was a fascinating case in point. When I met him, he had no formal knowledge of music and had never been exposed to jazz. His musical experience consisted of one year of casual piano playing and several years of self-taught folk guitar. His goal at the time was to get into the jazz performance program.

He had never learned to read music, so I gave him a crash course in musical rudiments. In the meantime, he found a jazz piano teacher and took a year of lessons. After that, he auditioned for the program and got in.

Two years into the program, this quiet and unassuming student became a player of some notice, clearly sounding better than much more experienced jazz piano players, and having an essential grasp of jazz improvisation. His success was even more impressive in light of the fact that he was a psychology major and not a full-time music student as were his peers. Also, he didn't seem musically gifted in any way or to be anything but average academically. He just seemed to be "applying" himself in some kind of critical way.

My fascination with this student's success followed me to graduate school at the Centre for Applied Cognitive Science at the University of Toronto. At the CACS, I worked on research projects under Carl Bereiter and Marlene Scardamalia who were heading up investigations into the nature of expertise.

What we knew at that time from previous literature on expertise is that experts are distinguished by their vast stores of domain-related knowledge and they call up this knowledge when problem-solving. Classic studies on chess expertise by de Groot, and later Chase and Simon, showed that if you presented experts with chess figures arranged in game-like fashion, after viewing these configurations for 5 seconds, the experts could hold in memory and reconstruct the positions of up to 20 chess pieces. Amateur players, however, were only able to reconstruct the positions of 4 to 5 chess pieces. Over the course of many years of playing, the masters had confronted thousands of chess patterns, each a great number of times, so when shown chess patterns in an experimental setting, the experts were able to retrieve from memory and reproduce the configurations easily. Pattern recognition studies similar to de Groot's have been carried out in the domain of music with the same results. Sloboda showed that in reading music, musicians "chunk" individual notes into familiar constellations, processing each chunk as a single unit.

Another feature of expertise that we knew from the literature is that these chunks of domain-related knowledge are hierarchically embedded. In a study by Chi, Feltovich and Glaser, a group of PhD physics students and a group of undergraduates who had completed a semester of mechanics were given 24 physics problems to put into categories. Novices were found to group problems according to literal objects and key terms presented in the problems. So, for the novices, problems about inclined planes went into category A, problems involving rotation went into category B, and problems involving springs went into category C. Experts, however, were found to group problems according to the physics laws underlying them. So, for example, they might put into the same group all the problems that had to do with The Law of Conservation of Energy.

These early expert-novice studies indicated several things: (1) that through years of experience within a domain, experts develop superior recognition abilities, (2) that experts are able to understand problems at deeper levels, and (3) that experts are able to generate initial hypotheses that are more accurate than those of novices. But this still didn't explain why that jazz piano student, that kind-of-average guy, became the cream of the crop. The key for me lay in what Bereiter and Scardamalia identify as the central feature of an expert's problem-solving process.

They said that experts engage in “progressive problem solving.” That is, once an expert solves a problem, that problem is reformulated into a more complex problem to be solved. This process is ongoing such that experts are always working at the edge of their competence in constant pursuit of some ideal goal. The expert approach also involves an element of risk (so experts seem willing to risk failure or mockery in order to tackle unexplored areas of a domain.)

Novices, on the other hand, take a “problem reducing” approach. Their end goal is to reduce all problems to the point that they can be handled easily within their existing competence. Once a problem is solved, the novice considers it eliminated.

To explore Bereiter and Scardamalia’s theory, I looked at the specific ways in which experts and novices approach a musical problem that challenged their current knowledge or ability. The first subject that I looked at was a professional pianist who performs internationally and who plays a substantial amount of improvised music. I asked him to choose a piece of music that he planned on learning but hadn’t begun practicing yet. The piece he chose was a transcription of a *gender wayang* that he had been commissioned to perform for national radio.

The concert pianist was asked to go about preparing the piece in his usual manner and to think aloud as he worked his way through the piece. His think-aloud protocol was audio-recorded and later analyzed.

One of the most interesting findings from the transcript of the expert’s thought process is the degree to which he found the task problematic. In addition, five other features of his approach emerged:

1. He perceived the task as a novel problem, for which he felt novel solutions/methods needed to be developed.

2. He structured his practice around generating problems and then trying to find solutions.

3. His viewed the task as a novel problem that entailed the partial negation of former similar-looking knowledge.

4. He was highly aware of his learning process.

5. He self-monitored and self-evaluated in an ongoing way.

To illustrate the features of the expert’s approach, I’d like to read some excerpts from the transcribed protocol. As I read, see if you can identify the features of the expert approach I just described:

> the first section I see is [marked] “free”. I have some feeling...from listening to this music before, it’s sort of like Indian alapana but it has definite notation which means it’s free but within some kind of *pause* well, I don’t know yet.
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> So, what are the patterns? . . . Parallel. [I’m] trying to see what the system is. When voices move together, how do they move together?
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> I’m just trying to study the best kind of sensation—to have the sensation localized in this knuckle, keep the fingers flat, or have the fingers more like mallets, or have it more like a harpsichord.
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> There are these three similar sections...just trying to decide whether to finger them similarly even though they have slightly different requirements . . . and, I’m trying to decide whether to use what I’ve used there, here, even though the notation is a little different or treat them different because they look different.
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> I can’t repeat the sensation in my hand because the muscles and tendons—everything needs to be in a different place so that feeling that I have of mallets here is fine because the short fingers are playing white notes and the long fingers are playing black notes . . . when I’m playing the opposite kind of pattern, to play long fingers means terrible leverage and also the key is very skinny . . . so I’m looking for how I can get the same sensation.
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> I’m having to think of [the patterns] as chords rather than four voices . . . E chord, F#, C#sus4 chord, which is one of the problems even transcribing music from another culture is—you superimpose your own . . . conceptual emotional grids. However, if you’re aware of it, it’s a little less damaging.

> It sounds too Dixieland-ish...it's got to have something dignified in it...I really want to swing it . . . that's interesting, that kind of cultural cross-over . . .
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> Looking for the tempo. Worrying about being boring in the slow parts. Not because the Balinese write boring music but because the sound of the instrument is more compelling than the piano. Besides, the fact that it's 3 or 4 instruments, plus a puppeteer and puppets and a story, sound effects. So it's going to be problematic to make this work as a concert piece . . . and part of it is going to be tempo.
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> If you're going to divide your attention between any two thoughts or two hands . . . it needs to . . . have it's ground somewhere and usually the ground is in the unchanging element. But . . . they're both unchanging elements—that's the problem.
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> . . . I see that I would now like to read Colin McPhee's book on music in Bali . . . I'll certainly want to listen to more tapes of wayang music.
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> Besides fingering, you need to choreograph the lateral and vertical movement of the wrist at the very least. I mean this piece doesn't involve arm movement the way you know, Romantic virtuoso piano music would. But it's not just finger music like harpsichord music. There is a lot of stuff where you have to use your wrists, so the thing is to choreograph the balance.
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> I've played all kinds of stuff but [this] is just tricky and there's something in me reluctant to let something go because—I could just really build up a phobia about it, which I'm close to doing already.

The expert's protocol illustrates that he is focused on the main problem of learning the complex rhythmic patterns in the piece. He seems to have set himself the goal of playing the rhythms so that they sound like layers of separate instruments. In pursuing this goal, the expert is recognizing the need to develop a technique distinct from techniques used for playing other styles of music. He works on developing a "mallet" technique, whereby he uses his fingers like "tiny sticks" in imitation of mallets used in a gamelan.

An interesting feature of the expert's approach is his awareness of the effects of prior knowledge and how he is cautious of them, as in the case when he was playing the patterns and caught himself lapsing into swing. Another interesting feature is the abundance of meta-statements or statements about the learning process that the expert makes.

In the next phase of the study, I looked at two piano performance majors from the University of Toronto. These undergraduates had no knowledge of Balinese music outside of an introductory unit in their first year. An audio recording of *gender wayang* music belonging to the expert was copied and given to the students to listen to two days before the interview as a way of giving them a basis for the type of performance they might aim for when learning the piece. At the start of the interview, each student was also given a short written description of the *gender wayang* that they were asked to study. Their instructions were to go about preparing the piece as though they were going to perform it for radio and to think out loud while they went about the task.

It would be tempting to hypothesize that the two undergraduate students' approaches would look similar to each other and that they would be distinctly inferior to that of the expert. However, what actually emerged was that one of the students, in spite of his relative lack of experience, greatly resembled the expert's "progressive problem-solving approach" and the other student clearly exhibited many of the features of "problem-reducing." In spite of being considered an accomplished and talented young performer, the "problem-reducing" student's rendition of the piece was not rated highly, as we'll later see.

Here are some protocol excerpts from the student who exhibited expert problem-solving strategies. As I read, contemplate the parallels between this first student's approach and that of the expert.

> The rhythm seems complicated in this first stage so I suppose I'd have to figure out how to count it, except that it says "free," so the question is: how free? . . . I'm going to count up and see exactly how many of these notes I'm supposed to be playing . . . although that could be a Western preoccupation.

I was just noticing that it might help me to look at it in terms of the language I already understand—look at the vertical aggregates of these things . . . like explain those two as C# minor

Okay, I more or less know what's going on there. So I'd start that really soft. From the tape it seems it's one of those jingly things . . .

Okay, I seem to be going off the rails here. I was just going to try to huck my way through and see how the full crescendo is going to look . . .

That seems to be actually something important that I've neglected...I'm just treating this as a noodling thing but it is in fact a rhythmic entity it seems . . . which is important.

It becomes obvious that certain rhythmic cells are really fundamental . . . to the whole piece; they recur so often and some of them are really quite elaborate...so that would be something that I'd like to work over and over on, just to make sure.

[I'd need to] figure out for sure something with the block because it seems to be an articulation device . . . I could choose a pitch . . . no, that wouldn't sound any good . . . there's something about a pitch that [isn't] quite right.

One thing I'd do is I'd make sure I didn't do any little Western rubatos in there; I think one snuck in at the end.

You see, I'm always a little mystified when I come to sections like this because I wonder . . . in the actual orchestra, what is actually prescribed to the instruments? . . . [do] they have maybe three pitches and they have a basic rhythmic parameter and they do what they want?

There is [some]one in this school who knows something about Balinese gamelan and if I could—there's just a basic question—what are the players actually doing? Do they just have four gongs and they hit them however they want? I mean obviously the whole orchestra does the same thing; stops and starts . . . so there are some parameters that they're following . . .

There could be conventional groupings and orders that you strike the thing in, I don't know. Like a raag of India, there might be something like that . . .

Now I'd like to read excerpts from the 2nd student's protocol. And again, as I read, see if you can identify what about this student's protocol is typical of a problem-reducing approach.

There's no time signature written on the score, so what does that mean? I guess it means I can do whatever I want.

I'm just approaching this very basically; just like what's written there. That's all I can do because I just have absolutely no knowledge of anything that this music's about.

. . . this for me sounds like the closest thing to French Impressionist music . . . so from what I know about that, that's how I would approach it.

All I need to do is give [the piece] the structure it doesn't have.

He writes "free" so . . . if he wants me to be "free" and I'm left with all these liberties, then basically I'm just not going to get fucked up by them and just do whatever I want.

I'm just going to do something that works. So in this introduction I'm going to try to create this really mysterious acid trip mood or something. I mean, that's how I have to approach this kind [of thing] . . .

He writes all of these really contrasting things so I'll just go and make all of these really big contrasts.

> So are you ready to hear it from the beginning . . . until page two? I'm gonna take a lot more time in my opening . . . I'm going to make it sound very soloistic.
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> I have done quite a bit of modern, very 20th century music and I find that the only way to keep your audience interested is you have to prepare a whole show . . . [otherwise] my audience would fall asleep because it's just inaccessible music . . . the structure is so chaotic . . . it's not Western structure.
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> Yeah well, I think I could [perform] this now . . .

These protocol excerpts illustrate the differences in the students' approaches and seem to illustrate that the learning processes of the expert and the first student are strikingly parallel, whereas the two novices (the two students) were quite opposite in their approaches.

In the last phase of this study audio recordings of the students' performances were given to an ethnomusicologist for evaluation. The ethnomusicologist was asked to disregard differences in the students' technique and to comment only on each student's rendition of the piece. To conclude, I'd like to read the ethnomusicologist's report. Here's what he said about Student #1, who assumed the progressive problem-solving approach similar to the expert's:

> I feel that student #1 conveyed more accurate knowledge of Balinese performance style [and] seemed to have more a grasp of the rhythmic sense primarily. The articulation of [student] #1 was more percussive and tended to sound more like the instruments that are used primarily in the gamelan orchestra. It had more attack and the spacing of the notes seemed more like that of a gamelan. [Student #1] also had more of the angular phrasing concept of Indonesian music rather than the more fluid phrasing of a Western symphony orchestra.
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> Student #2 tended to play the rhythms very legato, more in the manner of a performer of Western music . . . I got the sense when listening to [student #2] that it was a Western piano player who encountered some Balinese music and was playing it the way [he] thought it should be interpreted vis-à-vis Western standards. [He] tended to run the notes together, more like a Western string player would.
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> I must say it's very difficult to make an extensive critique from such a short amount of music and also in such an unusual situation, but wrapping it up, I would just say that [student #2] didn't give me a sense that I was listening to anything other than Western music and [student #1] gave the sense that the player was attempting to convey a Balinese style. Consequently, my decision is to prefer the style of [student #1].

What these results suggest is that a progressive problem-solving approach may well be at the heart of how experts become experts. They also suggest that the acquisition of expertise may be both learnable and predictable. Most fascinating of all, the results suggest a rationale for how that unassuming beginner piano player that I knew so many years ago managed to turn himself into an outstanding jazz improviser in spite of the odds against him.

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