

# CHERISHING THE ERROR: CLASHING SCHEMAS AND COGNITIVE BIAS IN PIANO PERFORMANCE

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## ABSTRACT

Common errors in initial piano studies sometimes appear to stem from schema miscues. That is, rather than arising from any obvious physiological or motoric challenge, the error suggests a subconscious interpretation of an overt or subtle ambiguity. These miscues typically implicate a cognitive bias, often an anchoring heuristic. We polled numerous professional piano teachers, gathering examples of commonly recurring errors amongst their students, as well as descriptions of how they approached these errors in their teaching. We present examples of their responses along with our analysis of these occurrences. We propose a seemingly rarely taken approach of addressing these situations not as ‘errors’ but as ambiguities to be appreciated by the student, hence ‘cherishing the error.’ Finally, we consider evidence of cognitive biases in interpretive decisions of professional performers.

## 1. INTRODUCTION

Schemas optimize mental processing and are essential to expectation formulation. Occasionally, however, schema selection might impede appropriate, and even vital, interpretations. They may “prevent us from seeing what would otherwise be obvious” (Sweller, 2011). Such ‘miscues’ are prone to cognitive biases that may result in particular judgments about an ambiguous context through an auditory analog of the focusing effect, or due to an anchoring heuristic (Vass, 2014).

In this paper, we consider instances of apparent schema miscues in piano performance and consider the ensuing cognitive biases in terms of resulting behavioral heuristics. We consider instances in which schema miscues might affect both learning and recall, particularly by children. We propose that appreciating the underlying ambiguity of the miscue (i.e., ‘cherishing the error’) might afford a valuable teaching opportunity, not only about music, but also about cognitive bias in decision making.

## 2. CASE STUDIES

Consider the opening measures of the Musette in D from *Clavierbüchlein der Anna Magdalena Bach* (BWV Anh 126), a canonical pedagogical piece in the piano repertoire. Results from our survey of piano teachers consistently emphasized the tendency for students to accentuate the octave As in measures 3 and 4 (as shown in Figure 1), effectively turning the two sixteenth notes in measure 3 into an upbeat. This engenders a metric shift by a single eighth note. The student typically continues the shifted meter, accenting the second eighth note of measure 4.

The durational accent on the A (second eighth note in measure 3), the ascending line to that A, the descending conjunct tetrachord that follows, and the registral return to the A on the second eighth note of measure 4 all articulate multiple schemas that collaborate to create this abrupt metric shift – particularly remarkable given the fact that the meter has just been so strongly established in the preceding measures.



**Figure 1.** Measures 1-4 of the Musette in D from *Clavierbüchlein der Anna Magdalena Bach* (BWV Anh 126). The two sixteenth notes in measure 3 are often played as upbeats to the descending conjunct tetrachord that follows.

Piano teachers we interviewed consistently report this ‘error’, and describe methods of ‘correction’ that primarily comprise added visual cues (as in Figure 2). This is one example of numerous amassed anecdotal responses relating instances in particular works in the standard piano pedagogy repertoire in which student performance errors seem to result from a musical schema contradictory to the notated score.

In our study, we isolated instances in which such ‘miscues’ were reported as commonly occurring amongst a broad population of students by a wide variety of music teachers. While typically the teacher will simply attempt to correct the ‘error’, we suggest that such schema miscues often pose creative teaching opportunities to discuss the ambiguity and elucidate the cognitive bias that fosters an ‘interpretation’, rather than merely flagging the performance as ‘erroneous’.

Experientially acquired schemas are key in context creation. Competing schemas in music can include visual assumptions. For example, the spatial schema (Tversky, 2001) of the space between delimiting bar-lines represents an accentually initiated metrical unit. Students are taught early on to ‘count beats of the measure.’ In Figure 1, these visually premised, metrical expectations do not correspond with the auditory schema driving the student’s performance.

Instances such as these are remarkable in that the schematic expectation is often so firmly felt that the spatial schemas in the score—including bar lines, beaming and slurring—as well as teacher’s annotations—such as arrows, circles, exclamation marks, and other devices—are not enough to override students’ schematic musical expectations.

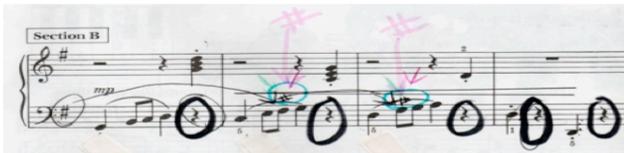
## 2.1 Miscues and Cognitive Biases

We culled examples of piano performances by children with notable schema miscues. These were collected from a sampling of experienced piano teachers who, collectively, have taught more than 2,000 students over the past 50 years. In interviews with these teachers, we tried to follow the process of their attempted ‘correction’ of the ‘error’. We noted cases in which behavioral anchoring heuristics are at play in the student’s interpretation and execution of the excerpt, and discussed the teaching method of addressing these moments.

In all of the examples collected, the students’ schematic expectations conflict with the notated music. In some cases the inherent ambiguity between what is notated and the schema that is seemingly invoked seems to be intentional on the part of the composer, while in other cases, the ambiguity seems to be subtler, if not entirely unintentional. The child often finds it difficult to rectify the ‘erroneous’ interpretation as the schema miscue creates a behavioral bias, most often an anchoring heuristic (Tversky & Kahneman, 1974).

Figure 2 presents a marked score from one of the participating piano teachers. The work, Olympics Parade by James Bastien, is a commonly used pedagogical piece for children. The ‘error’ apparently results from the student internally hearing the opening measure as a dominant preparation to a major chord in Measure 2 and, understandably, plays without regard to the notated key signature.

The level of frustration on the part of one teacher in trying to correct the child’s persistent erroneous F-natural is evident in the penciled corrections in Figure 2. As the teacher describes, the ‘error’ often persists even after the key signature is circled and the accidentals marked in multiple colors on the score.



**Figure 2.** A teacher’s notated corrections in a reportedly common performance error in Olympics Parade, a pedagogical piano work by James Bastien. The student has interpreted the tonic G-Major chord in measure 1 as the dominant of C Major, resulting in F-natural (rather than F-sharp) being played in measure 2.

A similar error, again a mishearing of the incipient tonic as a dominant, is evident in the commonly recurring error near the opening of the Minuet in G from *Clavierbüchlein der Anna Magdalena Bach* (BWV Anh 114), shown in Figure 3.

As in the previous example, many students seem to hear the opening as a dominant upbeat heading toward the perceived structural accent of measure three. The (mis-)interpretation of the opening measure as a dominant rather than a tonic appears firmly anchored, overriding the plainly visual cue of the key signature. Again, disregarding the key signature, students anchor the piece in the key of C Major rather than G Major. While erroneous, this

interpretation is not irrational. The prolongation of the incipient harmony through the second measure reinforces the interpretation of a dominant preparation. Simply referring the student to the key signature constitutes a ‘correction’, but does not recognize the musical rationale behind the error. Thus, in our study we choose to designate instances such as these as ‘miscues’ rather than ‘mistakes’. The miscue has validity, although it is based upon a false assumption resulting from anchoring to the strength of what they are hearing and seeing in that very first measure.<sup>1</sup>



**Figure 3.** Measures 1-4 of *Minuet in G Major* (JS Bach/C. Petzold, *Minuet, Clavierbüchlein der Anna Magdalena Bach*, BWV Anh 114). The piece as notated (left) and as performed (right).

Heuristic behaviors come into play in economic situations either because people have been given an errant starting point, or because they lack the time needed to reach a fully informed decision. This is similar to how a musical performer might improvise his way through sheet music because it sounds right even though it might not be true to the composition. In music this is called ‘faking it’; in economics it is a cognitive bias that is based on a gut instinct. But in both cases, those choices are not random. In music, performers are given general performance guidelines through knowledge of beat and key signatures. In economics, something is also anchoring your decision—either someone is giving you a starting number or you are surmising it from suggestion.

One such guiding behavior is the Anchoring Heuristic, first written about by Amos Tversky and Daniel Kahneman in their seminal 1974 work, *Judgment under Uncertainty: Heuristics and Biases*, and this principle comes into play in both musical miscues and economic cognitive biases. They state:

*In many situations, people make estimates by starting from an initial value that is adjusted to yield the final answer. The initial value, or starting point, may be suggested by the formulation of the problem, or it may be the result of a partial computation. In either case, adjustments are typically insufficient. That is, different starting points yield different estimates, which are biased toward the initial values. We call this phenomenon anchoring.*

<sup>1</sup> The authors would like to add that the children correctly play F-sharps in other places within the composition, so this is not a result of physiological constraints or motor coordination in an attempt to play the black key. And again, this is an error that is repeated over decades by numerous students with different teachers.

These anchoring situations can occur when “a starting point is given to a subject,” or “when the subject bases his estimate on the result of an incomplete computation” (Tversky & Kahneman, 1974, p.1128). An example of the former: A used-car salesman spots a buyer and tries to sell her a car for \$1,000, knowing full well that its worth is only \$500. The dealer has anchored the buyer with that \$1,000 price, forcing her to negotiate down from that point, this despite the fact that the dealer could have started at any number. Now, suppose the buyer negotiates the dealer down to \$750 for the car. She leaves the lot feeling content in her conviction that she has purchased at a good price, based upon its reduction from the starting price that was given.

In both musical performance errors and economic cognitive biases, these heuristics are not limited to the young or inexperienced. As Tversky and Kahneman (1974, p.1130) point out, “The reliance on heuristics and the prevalence of biases are not restricted to laymen. Experienced researchers are also prone to the same biases when they think intuitively.”

In a casual study, we asked the very piano teachers who corrected the ‘error’ in Figure 1 to vocalize the melody. In many instances, the teachers fell trap to the same ‘error’ they had been correcting in their students for decades: While they consistently corrected the error in pedagogical situations, they themselves performed it when asked to sing or hum the passage. Furthermore, some insisted they had reproduced the section correctly, not realizing their error until we pointed it out to them.

Beyond pedagogy, a survey of recorded performances—both by professional and amateur musicians—reveals the inherent ambiguity, with many, if not most (including Eugene Ormandy’s performance of an orchestral arrangement with the Philadelphia Orchestra<sup>2</sup>), performing what most piano teachers earmark as ‘erroneous’.

### 3. DISCUSSION

Labeling a given interpretation of a musical ambiguity as ‘right’ or ‘wrong’, with preference given to visual versus musical schema, may have pedagogical rationale in terms of imparting literacy. However, the remarkable fact is that in instances such as that of the *Musette*, the intuitive interpretation of the child—based upon schematic expectations (and, due to the anchoring effect, difficult to be dissuaded of) is retained in both the intuitions of the teacher (when ‘caught off guard’), as well as the conscious performance decisions of mature artists. There is potential for a valuable, profound teaching moment in recognizing the ambiguity.

Beyond piano pedagogy, placing heavy emphasis on the first piece of information we encounter can affect our subsequent decisions—for better or worse—and heuristics cross over into many domains of our lives. Whether learning the piano or shopping for a used car, the mechanisms behind the underlying heuristics are essentially the same.

The argument in favor of one tonal or metric interpretation over another constitutes a rich but often avoided aspect of piano pedagogy and music education. As we proceed with behavioral studies of schema miscues and cognitive biases, we seek to further understand how age affects interpretation. Is it possible (and desirable) to develop an instructional curriculum that develops an appreciation of the process of making interpretive choices from early on, rather than presuming that maturity, skill, and sophistication are prerequisites for such choices?

Some methodologies (the Suzuki method, for example) inherently avoid recognizing ambiguity; other approaches favor notation over intuition. Most methods advocate mimicry. The potential pedagogical rewards of ‘cherishing the error’ not only fosters deeper appreciation of music but also could teach children to recognize and navigate the judgmental complexities imposed by cognitive biases.

### 4. SUMMARY

By examining musical performance errors from an economic heuristic perspective, we show that these might not be errors at all but creative, intuitive judgment calls or ‘miscues’ based upon firm principles. Therefore, it may be more useful for educators to discuss with their students the anchoring behind a miscue rather than simply labeling and squelching the ‘error’. Understanding the underlying mechanism behind these miscues and reconciling the ambiguity can foster creativity and constitute a more insightful and lasting pedagogical experience.

### 5. REFERENCES

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<sup>2</sup><https://itunes.apple.com/us/album/baroque-masterpieces-pachelbel/id173975441>, Track 5