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Quantitative Listening: Temporal Proportion in Recordings of Mozart's Piano Sonatas

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Abstract: There is much evidence to suggest that the golden mean (the ratio of approximately 1:1.618) can be observed in the spatial proportions of much classical architecture and painting. Subsequent research has posited that the ratio may also have been used in the temporal proportions of pieces of music by a range of composers. Several writers have suggested that Mozart used the golden mean in the sonata form movements of his 18 piano sonatas to define the respective lengths of the two repeated sections. By comparing the number of bars in each of the two sections of every sonata form movement, a ratio close to that of the golden mean emerges. However, this paper will argue that counting the bars in a score is rather different from experiencing a piece of music as a sonic artefact. Even if the temporal proportions of many of the movements of Mozart's piano sonatas are structured around the golden mean, are these audible to the listener? This study analyses several complete sets of commercial audio recordings of Mozart's piano sonatas by a range of performers in order to explore whether the temporal proportions of the sonata form movements in the scores are preserved in recorded performance. The findings of this study are often at odds with those resulting from analysis of the scores.

Key Words: recording, Mozart, piano sonatas, analysis, golden mean, temporal proportion.

1 Introduction

Modern audio technology has not only given rise to many new forms of music and music-making practices but also offers musicologists new ways of analyzing music: with the rise of digital production and playback systems, pieces of music, encoded as digital data, become entirely fixed, infinitely repeatable and, most importantly, precisely measurable.

The process of recording offers performers and producers considerable creative opportunities. Timing, tuning and timbre are open to manipulation resulting in recorded "performances" that encapsulate the performer's intentions in ways previously unattainable. Indeed, at times, the "performances" on these highly edited recordings may even surpass the performing ability of the performer. For Western European art music, the practice of editing together ("splicing") a series of recorded takes to produce (the illusion of) an apparently seamless and highly considered single "performance" has been a well-established technique used by recording engineers since the advent of the tape recorder. With modern digital editing systems the use of razor blades and magnetic tape have been superseded by virtual editing on-screen, offering the potential for any number of individual edits.

The manipulative precision possible with both analogue and digital recording systems provides the recording performer/producer with an unprecedented level of control over every sonic aspect of the final recording. As such, each recording that emerges from the studio aims to represent the interpretative zenith of a performer's intentions: not a performance but *the* performance. Working in the studio, the classical music interpreter has "the time and freedom to prepare his conception of a work to the best of his ability, to perfect a statement without having to worry about trivia like nerves and finger slips" [1]. "Only through the use of technology are extremes of rhythmic intricacy, formal control, and sonic immediacy possible" [2].

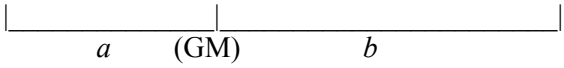
While analysts of popular music and jazz have often relied on recordings, regarding them as the encapsulation of the musician's intentions, analysts of Western European art music mostly continue to base their ideas/findings on scrutiny of the score. For them, the recording is a performer's interpretation, just like any other performance, while it is the score that encapsulates the composer's intentions. Strangely, even when the composer and the recorded performer are one and the same person, it is usually the score that is regarded as the final authoritative manifestation of the art work.

Yet, as it is hoped this article will reveal, recordings of Western European art music, rather than the score, may offer the analyst a different and more pertinent perspective in some circumstances. Audio recordings can provide different ways of approaching 'classic' works of Western European art music, with results that may conflict with or even

contradict analytical data derived from scrutiny of the score.

2 The Golden Mean in Music

Throughout history the proportions of the golden mean and the related Fibonacci number series appears as a structural element in a large number of buildings, paintings and sculptures. Briefly stated, the golden mean is the result of the division of a measured entity into two unequal parts such that the relationship between the smaller of the two parts to the larger is identical to that of the larger part to the whole. E.g.



$a/b = b/(a+b) = 0.618$ or $b/a = (a+b)/b = 1.618$

While these proportions have tended to be noted in the spatial dimensions of the plastic arts, several commentators have suggested that the golden mean may also be found in the temporal parameters of musical compositions. Hence, "theorists and analysts have been studying the use of the ration 1.62:1 by composers as diverse as Barber, Hindemith, Schoenberg, Bartok, Webern, Berg, Prokofiev, Debussy, Ravel, Delius, Wagner, Tchaikovsky, Schumann, Mendelssohn, Chopin, Schubert, Beethoven, Mozart, Haydn, Bach, Handel, Sermisy, Jannequin, Gibbons, Binchois, Dunstable, Ockeghem, Obrecht, Dufay, and Machaut" [3].

In some cases, the golden mean has been found to define the respective lengths of the sections of a binary form movement, although the ratio might also be observable in the relative lengths of contrasting melodies or even in the relationship of tempi between two or more adjacent movements: thus Glenn Gould constructed his entire 1981 recording of Bach's *Goldberg Variations* around a common pulse, stated in the Aria, that underpins and relates in simple proportions to each of the 30 variations [4].

The works of Wolfgang Amadeus Mozart have been a particularly popular subject for research in temporal proportion. For instance, Douglas Webster boldly stated over fifty year ago: "Mozart's piano sonatas have all been analyzed; and almost all show that they have golden mean form, certainly in sonata form movements" [5]. William S. Newman was less convinced, stating that "the several theories of the 'golden mean' in sonata form proportions [...] have not proved here to have any consistent validity" [6]. However, on the same page Newman also noted that the three sections of Mozart's sonata form movements in his piano sonatas have the proportional ratio of "10:5.5:10.8" [7]. If we then combine the final two sections into one, the resulting proportion is 10:16.3 or 1:1.63, which is remarkably close to the golden mean (1:1.62).

Further studies on the presence of the golden mean in Mozart's compositions were produced by Jane Perry-Camp [8] and John F. Putz [9]. When Putz analyzed the proportional characteristics, as represented in the scores, of the 28 movements in Mozart's piano sonatas that follow a sonata form structure (i.e. approximately 52% of the entire œuvre), he found that the double bar (i.e. end of the exposition and beginning of the development sections) regularly appears around 38% of the way through the entire movement. In other words, the double bar – probably the most structurally significant moment in any 'classic' sonata form movement – is close to, and often coincides with, the point of the golden section.

Putz, whose interest and focus was primarily mathematical, responds rather cautiously to these seemingly remarkable findings: "Mozart may have known of the golden section and used it [...] and perhaps Mozart, through his consummate sense of form, gravitated to it as the perfect balance" [10]. Such caution is understandable: in the absence of contemporary written testimony, there is no evidence to suggest that Mozart consciously employed the golden mean as a structural device in many of the movements of his piano sonatas. From a musical perspective, however, the more important consideration here, and one which is seldom addressed, is whether the golden mean or other proportions can actually be accurately perceived at this kind of temporal level: "we experience spatial proportions at once [...] while temporal information comes to us in a fixed order and at a given rate" [11]. This inevitably leads to the question: "just how relevant those proportions are relative to our perception of formal balance?" [12].

In his analysis of the temporal relationship between the first and second sections (i.e. a/b) and the temporal relationships between each section and the whole (i.e. $a/(a+b)$ or $b/(a+b)$), Putz finds that figures for the latter are rather more consistent than those for the former. The aural implications for this are interesting: the listener, by comparing the length of one of the sections to the whole movement, will be more likely to find golden mean proportions than if comparison between each of the two sections is made. In other words, golden mean proportions are more audible if the listener is able to remember the relative temporal lengths of each of the sections in relation to the length of the entire movement, rather than the seemingly simpler option of comparing the temporal relationships between the two sections. While both these processes represent a level of abstract temporal thinking that rarely forms part of a listener's appreciation of music and are perhaps impossible without strictly counting beats, the

former (i.e. *a/(a+b)*) would seem to present the listener with an even greater challenge.

Putz's study concentrates on the written scores of Mozart's piano sonatas: the proportions he finds in the 28 movements are the result of counting the bars on either side of the double bar point, and crucial to his findings are the repeat signs for both sections within these movements.

3 Repetition in Sonata Form

In Mozart's piano sonatas, all but one (the last) of the sonata form movements have repeat markings for both sections (i.e. at the end of the exposition and at the end of the entire movement). "In all but their last sonatas, Haydn and Mozart enclosed each of the two 'halves' of their first quick movements within repeat signs" [13]. However, some eighteenth century writers were already questioning this practice: "A sonata is a discourse. What would we think of a man who, cutting his discourse in two, repeated each half?" [14]. William E. Caplin notes that "after 1780, composers began to stop repeating the development and recapitulation together so that by 1800 the practice seemed 'archaic'" [15].

A possible reason for this change is suggested by Michael Broyles: in a fascinating and wide-ranging article, he posits the notion that the rather sudden disappearance of the second section repeat markings represent a fundamental aesthetic shift in the art music of the late eighteenth century [16]. As he points out, "Within a form governed by symmetry, balance, and elaboration, the repetition of both halves is logical and consistent. As part of a tonal drama, the repetition of the second half results in a severe dilution of the dramatic effect. [...] Innocuous as the notational differences may seem – four dots (or in some cases only two) – the effect upon proportions and upon the course of the movement is substantial" [17]. He also suggests that changes "in the very basis upon which instrumental form proceeds from the mid to the late 18th century [...] parallels closely the contemporaneous shift in scientific thought from mechanistic to organic" [18]. He points out that the practice of "embellishing" the second parts of repeated sections was inevitably more prevalent for solo sonatas than for pieces that required larger instrumental forces, and notes that, as a possible consequence, the dropping of the second part repeat occurs earlier in Mozart's symphonies than in the piano sonatas.

Broyles clearly shows that *both* the repeat markings in the sonata form movements of Mozart's piano sonatas are there to be followed. For Broyles, they reflect a performance practice and an aesthetic stance that were quickly abandoned during the last two decades of the eighteenth century, to be replaced by a more dramatic and organic notion of musical form with less emphasis on the performer adding embellishments to the repeated sections. However, as shall become clear when the various recordings of Mozart's piano sonatas are scrutinized later in this article, the repeat marks at the end of the first section are usually followed, but the repeat signs of the final section are commonly disregarded. For the golden mean to work at a structural level in time, any performance must either repeat both the exposition *and* the development and recapitulation sections, as Mozart indicated, or neither.

4 Analyses and Findings

Four sets of recordings of Mozart's complete solo piano sonatas were chosen: those by Mitsuko Uchida [19]; Jean-Bernard Pommier [20]; Klara Würtz [21]; and Georges Pludermacher [22]. From these, the 28 sonata form movements in two repeated parts, as identified by Putz, were auditioned. The overall length (in seconds) of each movement and the point from the start of the movement when the second section began (i.e. at the double bar, once the first section had been repeated) were noted. From this point it was simply a matter of calculating the temporal proportions thus: *a/b*, *a/(a+b)* and *b/(a+b)* where *a*=length of first section, *b*=length of second section, and *a+b*=length of entire movement. The resulting data – four sets of figures for 28 movements and the resulting proportions – cannot be included here for reasons of length, but may be obtained from the author on request.

This data shows that following Mozart's repeat marks for both sections in recorded performances was the exception rather than the rule: Uchida repeats the second section of only three of the 28 movements (K.283, 2nd movement; K.310, 1st movement; and K.545, 1st movement); Pommier one (K.282, 3rd movement); Würtz five (K. 281, 1st movement; K. 282, 1st and 3rd movements; and K.283 1st and 2nd movements); and Pludermacher six (K.280, 1st and 3rd movements; K. 282, 1st and 3rd movements; K. 310, 1st movement; and K. 311, 1st movement). Surprisingly, none of these performers repeat the second section of the second movement of K.333, even though it has short, yet slightly different, first and second time bars. Repetition of the first section, on the other hand, is usually carried out: Uchida repeats the first section of all of the 28 movements; Pommier omits five first section repeats (K.279, 2nd movement; K.281, 2nd movement; K. 282, 1st movement; K.533, 1st and 2nd movements); Würtz omits two (K.333, 2nd movement; and K.533, 2nd movement); and Pludermacher omits three (K. 280, 2nd movement; K. 281, 2nd movement; and K. 332, 3rd movement). Hence the performers, whose recorded performances form the basis of this study, largely follow the repeat

sign for the first section, while usually ignoring the repeat for the second. The result of this practice is to double the temporal length of the first section in relation to the second, and thus undermine any temporal proportions within the score that may be based on the golden mean.

There is no consistency as to which of the few of the second sections of these movements are repeated, nor which of the first sections are not. Furthermore, no temporal constraints seem to have been imposed on these performers as a result of the medium: these disks usually contain around 60 minutes of recorded time, while modern CDs are capable of holding rather more – around 80 minutes. In other words, the decision to not repeat the second sections of these movements is a characteristic of modern performance practice and, as such, represents an aesthetic decision, in spite of the fact that this simultaneously overturns both the composer's written intentions and, more importantly for this study, any golden mean temporal proportions that might be present in the scores.

In the light of this practice, it would seem that temporal proportions, which may be based upon the golden mean, were either deemed structurally insignificant or were simply not perceived in any meaningful way by these interpreters when making these recordings. And, since most listeners will become familiar with these works through recordings and concert performances such as these, any possibility of perceiving the recurrence of golden mean temporal proportions in Mozart's piano sonatas is undermined: while one can *see* a consistent approach to golden mean proportions in the scores, one will not *hear* these proportions in performance, since the performers do not follow the repeat directions in those scores.

Even so, what emerges from these recordings is a remarkable consistency in the temporal proportions of these movements, although resulting ratios are not particularly close to the kind of proportions produced by the use of the golden mean. If we ignore the few non-repetitions of the first sections and repetitions of the second sections in these recordings, we find that the temporal length of the first sections fall between 50-61% of the overall length of the movement. Moreover, the average length of the first section is 55% of the overall length of the movement, and 22 of the 28 movements fall between 53-57%.

Perhaps ironically, it is in a movement of a Mozart piano sonata that Putz does not include in his study that one finds a structural temporal relationship in recorded performance that closely follows the proportions of the golden mean. The second movement of the Sonata in A (K.331) is a minuet and trio, and in all four recordings the beginning of the trio coincides with the point of the golden mean (i.e. around 38% of the overall length of the piece). It should be noted, though, that "proportions can too easily become the type of study where one finds what one wants by looking hard enough" [23].

It is worth mentioning at this point that there is one recording of all Mozart's piano sonatas that *does* consistently retain the temporal proportions of the scores: that of Glenn Gould [24]. In every movement that Putz identifies, Gould repeats neither the first nor the second sections and in so doing retains the proportions indicated in the scores. By not repeating either section of the sonata form movements, one might argue that Gould's recordings take even greater liberties with the score than those of the other performers. And it is consequently rather ironic that of all the recordings consulted only those by Gould manage to consistently recreate the temporal proportions as specified by Mozart in his scores.

Gould's recordings of Mozart were generally not well received by critics and he himself said that he was "quite sure Mozart would not approve of what I do to his music" [25]. Yet Gould was highly aware of the opportunities that recording technology offered the performer: in 1964, at the age of 31, he stopped performing 'live' and devoted the rest of his life to recording. "Technology permitted Gould to exercise maximum control over a performance, to present his conception of a work as fully, clearly, and definitively as possible" [26]. Moreover, Gould understood that recordings could be played many times, providing the listener with as many repetitions as they felt necessary, and this facility would tend to challenge any repetitions contained within the score.

5 Conclusions

If, as Broyles suggests, the majority of Mozart's mature sonata form movements for the piano tend to favour a formal approach that places greater emphasis on symmetry, rather than tonal drama, then the use of temporal proportions based on the golden mean to produce such a sense of structural balance would seem appropriate. However, most later commentators, performers and listeners have tended to regard all sonata form movements as being primarily concerned with tonal drama, rather than formal balance, and felt that repetition of the second section, as expressly directed by Mozart, would tend to undermine this sense of drama.

Nevertheless, it is perhaps significant that several analysts of Mozart's sonata form movements have focused on issues of temporal proportion, almost as if the music itself tends to encourage such research. There is a deceptively simple, 'natural' quality in much of Mozart's music and this seems to suggest that notions of balance and symmetry are an important aspect of its appeal. Whether this is the result of a conscious formulaic process underpinning these pieces, or simply an exceptionally highly

developed sense of temporal proportion on the part of the composer is perhaps less important.

In 1993 the psychologists Frances Rauscher, Gordon Shaw and Katherine Ky of the University of California at Irvine published 'Mozart and Spatial Reasoning' [27]. The article describes experiments they had conducted that involved three groups of college students listening for 10 minutes to either Mozart's Sonata for Two Pianos (K. 448), a relaxation tape or silence. "Immediately after listening to these selections, students took a spatial reasoning test (from the Stanford-Binet intelligence scale). The results showed that the students' scores improved after listening to the Mozart tape compared to either the relaxation tape or silence. Unfortunately, the researchers found that the effects of the music lasted only 10 to 15 minutes" [28].

The findings of this research came to be known as the "Mozart Effect", which was registered as a trademark. It generated much media attention, as well as a considerable number of overblown claims as to the beneficial qualities of Mozart's music, which were often quite out of proportion to the original published findings. If, as posited above, Mozart's music might have a tendency to encourage speculation on notions of balance and symmetry in the temporal domain, then it is perhaps not stretching a point too far to suggest that hearing this music may, in some small way, better prepare people for spatio-temporal reasoning.

The primary objective here is neither to prove nor disprove the notion that Mozart, intentionally or unintentionally, used the golden mean or any other simple mathematical proportion as a large-scale structural device to organize time in the 'sonata form' movements of his piano sonatas (although a high level of temporal proportional consistency between movements is evident). Rather, the question is whether, or at what level, such structural temporal proportions might be perceived by performers and listeners, either consciously or sub-consciously. Certainly, the proportional divergence between score and performance, largely a result of the practice of not adhering to the repeat of the second section, suggests that performers do not consciously follow any golden mean proportions that may be identifiable in the score. As a consequence, the music that listeners hear is often somewhat different from the scores that performers and most analysts see, in the same way that, for most people, physical dimensional proportions seem to be more easily perceived than their equivalents in time.

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