Monadology and Music 2: Leibniz's Demon
Soshichi Uchii
(Kyoto University, Emeritus)

Abstract

Drawing on my previous paper "Monadology and Music"(Uchii 2015), I will further pursue the analogy between *Monadology* and music. I wish to emphasize that good examples of "pre-established harmony" can be extracted from this analogy. Also, a good illustration of "Leibniz's Demon" can be obtained. This Demon is such that it can tell, given a piece of matter, the whole history of the world, past, present, and future. In terms of finite examples of musical pieces and their performances, Leibniz's point of this Demon can be better understood.

1. Informational Interpretation and Leibniz's Demon

Music lovers (including myself) are often impressed by an excellent performance by a well-organized ensemble, including a large orchestra. For a while it does not matter whether or not the ensemble is directed by a conductor. What I wish to argue is that, if you look at what is going on in each player in such a good ensemble, you are bound to realize that some of Leibniz's assertions in *Monadology* can be well understood.

But, first, for the sake of reference, let me repeat the list (in Uchii 2015) of 11 features of Leibniz's assertions.

(1) All monads are created by (rational) God.

(2) The world of monads is governed by the Pre-established harmony.

(3) The world of monads is without space.

(4) The world of monads is without time.

(5) Each monad changes its state (perception) according to its own distinctive transition function (according to my interpretation), and the whole sequence of its states is given at once (Uchii 2014a, sect. 1)

(6) The unity or individuality of each monad is defined by its sequence of states (in other words, by its initial state and its transition function and both are given by God).

(7) Monads are organized into many groups, each of which is governed by a single dominant monad, called *anima* or *entelechy*. And such groups are again organized into a nested structure, *ad infinitum*. The whole is a single world, ultimately governed by God (Uchii 2014a, sect. 12).

(8) There are many invariant structures in the world of monads. Most important is that the information is conserved, and for each monad, the order of state-transition does not change. As a consequence, the order of world-states does not change either, where a "world-state" is a conjunction of all the states of monads with *the same order* in each sequence (Uchii 2014b, sects. 20, 21).

(9) The activities (i.e., state-transitions) of these monads produce phenomena (appearances) for each monad. N.B., that phenomena are quite different from states, since there is a distinction between well-founded phenomena and others. I have adopted the notation for this, and expressed a state by *R(W)* and a phenomenon by *Ph(W)* , where *W* is a world state, *R* signifying "representation (perception)", and *Ph* signifying phenomenon (Uchii 2014a, sect.1 (3), 2014b sect. 21).

(10) The genesis of phenomena, which may well be different depending on the grade of monad, depends on God's coding. That is, the same world state *W* may well appear differently to humans and to angels, for instance. Likewise, the perception *R(W)* of a monad should be different so that, to be exact, we need a subscript for *R* and *Ph*; but for the sake of simplicity we will ignore this (Uchii 2014b, sects. 21, 27).

(11) Further, notice that the *quantitative* features of phenomena, including the magnitude of space and time (in other words, length and duration) must be generated by God's coding of *Ph*, by preserving the invariant structures of the monadic world. According to my interpretation, no other elements of *Monadology* can be responsible for this job (Uchii 2014b, Sects. 23-27. For a possible way out from Leibniz's difficulties for constructing dynamics on monadology, see Uchii 2014c).

To this list, I wish to add a brief description of Leibniz's Demon (Uchii 2014a, sect. 13). This Demon appears in section 61 of *Monadology*:

> every body is affected by everything that happens in the universe, to such an extent that he who sees all can read in each thing what happens everywhere, and even what has happened or what will happen, by

> observing in the present what is remote in time as well as in space. (Ariew and Garber 1989, 221)

I named this person, "he who sees all," *Leibniz's Demon*. Notice that Leibniz's Demon appeared *well before* the famous demon described by Laplace, and much stronger than it! Laplace's demon is such that, if it is given *the present state of the world*, then on the basis of its knowledge of the laws governing the world, he can tell any past state and any future state of the world (see English translation by Dale 1995, 2). Leibniz's Demon, in contrast, needs only a single body ("each thing" in the preceding quotation) now, for such retrodiction and prediction.

Leibniz's Demon may seem extravagant to us. But it is *logically possible*, given Leibniz's assumption of the monadic world. For, all monads together with their transition functions are given *at once*, with the *pre-established harmony* among them. This means that the total information of the whole world is somehow reflected in a single body; and his Demon can read off (although Leibniz does not specify "how") this information from that single body. I have to add that the Demon is assumed to be constituted by monads of a higher grade, as I am going to point out shortly. But the most crucial point here is that a single monad can reflect the *total information* of the world in its own way, and that such information is, in some way (via coding) preserved in a single body in the phenomenal world. From this alone, you may see how strong Leibniz's theory of monads is. Its assumption of spaceless and timeless character is one of the keys for this "philosophical magic."

However, it is unfortunate that Leibniz has failed to point out the importance of *coding*. Maybe he did not have an appropriate word for expressing this, but his notion of "expression" and "reflection" presupposes this. Any monad's state itself *cannot* be transferred to another monad; it can only be mapped into it in a form compatible with the total sequence of states of the latter. Supposing one monad's (instantaneous) state is *x*, its representation in another monad should be *R(x)* so that this mapping takes a form of *function R*, and that's coding. Expressed more informally, "*R(state x of monad* m*)" represented in monad* n*. And if representation (perception) needs coding, *a fortiori*, phenomenon needs *another different* coding, as I have pointed out ((9)and (10) above). It should be pointed out that such *R*'s (and *Ph*'s also) involve *recursive* structures, like two mirrors reflecting each other. Although Leibniz did not have the concept of *recursion*, he was *in effect* well aware of it. This is my interpretation.

I have shown (Uchii 2014b, sects. 26, 27) that Leibniz's Demon is indeed possible according to my informational interpretation, even in *relativistic* reconstruction of

Leibniz's dynamics (*ibid*. sect. 27), as well as in classical reconstruction (*ibid*. sect. 26). This hinges on the *velocity of the flow of information* in the *phenomenal* world, which in turn depends on the *metric* of space and time. But as I have pointed out in (10) and (11) above, the *metric* comes from God's *coding*, and the possibility is open that God changes coding depending on different grades of monad. For instance, that velocity may be closer to infinity for angels, although it is finite for humans (see Fig. 14, *ibid*.). Some physicists have speculated on variable speed of light (VSL), and I merely applied the same idea to my own reconstruction of Leibniz's Demon.

2. Good musicians resemble Leibniz's Demon

Now, let us turn our attention to music. In my previous paper (Uchii 2015), I have picked out voice parts of a score. This time, I will pick out each player in a good ensemble. For the sake of simplicity, let us assume that each voice part is played by a single musician. What is it that makes their ensemble a *good performance (interpretation)* of a musical piece? I would argue that each musician should be like Leibniz's Demon, despite the undeniable fact that any musician is a finite being with finite capacity. But they can be a "mini-Demon," depending on their talents, experience, and practice.

In order to assist the reader's imagination, take a specific example, the original version of Bach's "Air on the G string" (Air of the orchestral suite 3, BWV 1068). This beautiful piece must be played with utmost care by several string players. Now, according to Leibniz's *Monadology*, each player is controlled by a single monad (called *anima* or *entelechy*), and hence the performance of this ensemble is produced as a phenomenon resulting from the activities of these several *animae* and the bodies governed by them. But for a while we may identify each player with a single *anima*, in order to avoid clumsy descriptions.

Now some of the conditions for good performance are obvious. The invariant structure of that musical piece must be preserved, and the tempo must be within a reasonable range (the composer says "Lento"). The strength of sounds must be controlled according to the written directions (*piano*, *pianissimo*, *crescendo*, etc.) and the intended effect (harmony and occasional discordant sounds). In short, each voice part must be played correctly. But these are not sufficient for a good, moving performance. Each player has some freedom, and within that range, has to exercise it to improve the whole performance. And how? In a word, each has to adjust to each other, and this can be masterfully done by a good musician, by seeing and listening to other player's performance. But what else?

In order to contribute to a good performance of such tunes as Bach's Air, each player has to *know all other voice parts*, and share the *same interpretation* of the tune. Otherwise, however carefully he or she tries to pay attention to other player's performance, it may be hard to make an immediate adjustment. Without such knowledge of all voice parts, it is almost impossible to adjust one's own performance to others', since the overall harmony depends on one's *relations to each other*, just as one monad's state (perception) reflects all other monads' states. In our case of Bach's Air, it is composed as a polyphony where each voice part is somehow autonomous but governed by a "pre-established harmony." The lower voice parts are going on with steady tempo and rhythm. And when one higher part plays a long tone, some other parts fill in another moving passage. Without knowledge of such complementarity, how can one fill in, or adjust to others, with good timing?

Not only such overall knowledge, but also many adjustments in details must be necessary, since one player may wish to somehow slow down at the end of his or her solo part (as part of his or her interpretation). Thus other players must adjust to such minor changes every now and then, and that's one of the reasons for rehearsing the tune; this applies to experienced good musicians too. In this way, "fine tuning" among the players can be accomplished, and their efforts culminate in a single, *unified interpretation* of the tune, and in a "pre-established harmony" of each *performance* (N.B., in addition to the harmony of the tune itself). Maybe we should say "good harmony is created *as if* it was pre-established."

Thus, ideally, each player must be like Leibniz's Demon, so that at each moment, each has to play in view of the whole tune (corresponding to the whole monadic world), and in view of other players (unified interpretation, or coded appearance, corresponding to the phenomenal world).

3. Analogy with some Differences

Despite the preceding overall similarity, we have to point out a few differences in our analogy. First of all, our musicians with finite capacity must study the score in advance, and their knowledge of the tune depends on it. In addition, they need a few rehearsals (or practices) before their actual performance on a stage.

This may look a big difference from the Demon's case. But on a closer examination, the Demon case also presupposes at least *potential knowledge* in advance. That is, without its knowledge of *how to decode* God's coding for phenomena, any close examination of a given piece of matter should be useless for retrodiction and prediction. If Demon knows how to decode and recover the original information of the *monadic world* encoded in the phenomenal world (a piece of matter is enough),

this certainly corresponds to our musicians' knowledge of the score (see Uchii 2015, sect. 3). In a word, "knowledge of coding *cum* information from the piece" amounts to, logically, "knowledge of the whole world," given the reasoning ability of Demon.

Leibniz's brief phrase "he who sees all" clearly presupposes this, in the single word of "all." Maybe Demon *decodes* very quickly the given information, but our musicians can likewise quickly *recall* their knowledge of the score, and transform the relevant part into actual sounds. Notice that this process strongly resembles that of decoding, since any performance of a given voice part is nothing but a *transformation* of a piece of musical information into a series of sounds. This transformation is certainly a *reversed* process of decoding, but it is basically straightforward to recover the original score from any correct performance of the tune; "correct" in the sense that the performance preserves the *invariant information*.

I cannot deny that the process of decoding, i.e., recovering the invariant information of the monadic world from the phenomena, is a hard job. Even Demon may have to work hard. But Leibniz is describing an ideal state of knowledge in terms of his Demon. And, since he always (often implicitly) assumes the existence of *homomorphisms* (partial isomorphisms) between the monadic world and the phenomena, the picture of *Monadology* is not radically different from our case of musicians.

Another difference was already pointed out in my previous paper Uchii (2015), and it applies here too. In the Demon case, coding is prepared by God, and Demon decodes it. In our musician case, coding from score to actual performance is *created*, so to speak, by musicians. This process is often called "interpretation" of a given tune. But this musical interpretation is nevertheless *informational* and it *is* a kind of coding, so that a strong resemblance to God's coding still remains.

I would imagine that the crucial difference boils down to the infinity of scale. The monadic world is infinite, whereas any musical work is finite. There are infinitely many layers even in the phenomenal world, since Leibniz holds that a body is infinitely divisible. However, aside from this unbridgeable gap, our analogy between Demon and musicians work pretty well.

The most important features of this analogy are summarized in the following Table.

4. Summary Table

	Leibniz's Demon	Each Player
What ability?	Given a piece of matter, it can know the **whole history** of the phenomenal world.	At **any instant** of performance of the given tune, it can recall the **whole tune**, including other parts, so that it can adjust its own performance to other player's.
Prerequisite	The piece of matter, given now, and it must be able to decode God's **coding** for phenomena.	A tune to be performed, and examination and rehearsals of it, to the extent that each can share the **same interpretation** of the tune.
Space	Metric of space can be read off from the piece by its knowledge of **coding**.	Geometrical arrangement of each player depends on the **common interpretation**.
Time	Metric of time can be read off from the piece, and this metric may be **interconnected** with that of space.	Overall tempo, and any partial changes also, depend on the **common interpretation**. And on the leading player's sign, other can follow any "ad lib."
Flow of information	Must be either immediate or nearly immediate. And this is possible because the metric for Demon can be different (**multi-metric coding** by God).	Must be either immediate or nearly immediate.
Invariant structures	Come from the order of state-transition of the monadic world. Since this is timeless, Demon can retrieve it by decoding phenomena.	Come from the score of the tune, and its knowledge is shared by each player throughout the performance.
Coding	Made by God, and decoded (interpreted correctly) by Demon	The score itself presents the composer's coded information of the tune. An interpretation (coding from the score to each performance) is created by players.

Table. Leibniz's Demon and a Musician

(In this Table, Player is called "it" for parallelism with Demon, and in order to avoid the clumsy phrase "he or she.")

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