Realization of 18th century musical games: Mozart & Stadler

Denis Lorrain

SONVS, CNSMD de Lyon
3, Quai Chauveau | C.P. 120
69266 Lyon Cedex 09, FRANCE
denis.lorrain@cnsmd-lyon.fr

Abstract. The musical games published during the 18th century belong to an evolution leading to the first 20th century experiments in algorithmic composition. Two of these publications—one attributed to Mozart, the other by Maximilian Stadler—were realized in the form of LISP data and functions. The two works are compared, score excerpts are shown, and complete sound examples are played.

1 Introduction

Numerous games enabling the random composition of musical pieces were published during the 18th century. Leonard G. Ratner numbers more than a dozen: minuets, marches, polonaises, contredanses, and waltzes. "The amusement afforded by these musical games of chance bespeaks pure dilettantism and, perhaps, decadence. Yet, the process by which the games were put together reflects a substantial view of musical construction, one that permeates the seventeenth and eighteenth centuries. In this view, the play of musical elements is controlled so as to achieve a coherent and persuasive flow of rhetoric" [1].

Beyond their function as games—played in gentlemanly company—these attempts to mechanize, to formalize musical composition can be related to the great rationalist and encyclopedist trends of this period. The contemporaneous invention of numerous automata, often musical themselves, from Jacques de Vaucanson to Wolfgang von Kempelen, which partake of the same conceptions, obviously reach further than mere entertainment [2].

Ratner links these games with much more elaborate works making use of combinatorial methods in very serious musical composition treatises (Joseph Riepel, *et al.*). He also shows the use of such procedures in works by Mozart (authentic), Haydn and Beethoven.

Jean-Claude Risset [3] draws a direct line from these musical games to the first modern experiments in algorithmic composition (John Pierce and Lejaren Hiller), not without paying tribute to the visionary algorithmic concepts of the amazing genius of the *analyst metaphysician* Ada Augusta Byron Countess of Lovelace, colleague and friend of Charles Babbage, himself conceiver of the *Analytical Engine*—a never-built mechanical programmable computer. From this point of view, musical composition *created* models capable of nourishing newly born computer sciences, as is precisely the case with Ada Byron-Lovelace in the first half of the 19^{th} century—quoted by Curtis Roads [4].

One shall see below that the two examples realized [5] [6] include a precise algorithmic description of the method to be followed to *compose*, in the specific sense of each case, from the musical material provided... as a *kit*—one would say nowadays. Their realizations carry a certain musicological, algorithmic, or even humorous interest, by the simple fact that they exist in a "full size" rendition. The principle is, of course, known to specialists, but rather as a *conceptual work*, never concretely worked out, and moreover relatively unknown to a larger public—only the matrices of Mozart's game are shown by Roads [7], for instance.

2 Sources

I quote entirely the original sources of the present realizations, together with the first eight measures of each type of musical data. The original spellings are scrupulously respected.

2.1 Mozart K294d

INSTRUCTION Pour composer autant de Walzes que l'on veut par le moyen de deux Dez sans avoir la moindre connoissance de la Musique ou de la Composition

(1) Les lettres A-H, qui sont placées au-dessus des 8 colonnes des tables de nombres, montrent les 8 mesures de chaque partie de la Walze. Par exemple : A, la première, B, la seconde, C, la troisième, etc., et les nombres dans la colonne de sous les lettres montrent le nombre de la mesure, dans les notes.

(2) Les nombres de 2 jusqu'à 12 montrent la somme du nombre qu'on peut jeter.

(3) On jette donc par exemple, pour la première mesure de la première partie de la Walze, avec 2 dés 6, et cherche près du nombre 6 dans la colonne A, le nombre de la mesure 148 dans la musique. L'on met cette mesure sur le papier et voila ce qui fait le commencement de la Walze. Après cela on jette pour la seconde mesure, par exemple 9. On cherche près de 9 sous B, et on trouve 84 de la table de musique. L'on met cette mesure à côté de la première et l'on continue ainsi jusqu'après avoir jeté les dés huit fois, et alors on a achevé la première partie de la Walze ; ensuite on fait le signe de répétition et commence la 2^{nde} partie. Veut-on avoir une Walze plus longue, on recommence de la même manière, et ainsi cela va à l'infini.

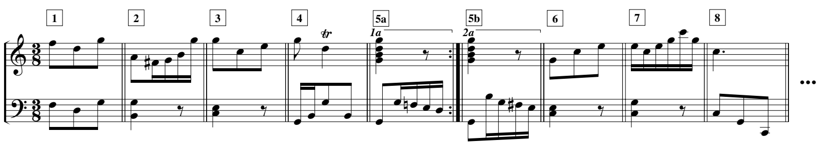
Première partie

	A	B	C	D	E	F	G	H
2	96	22	141	41	105	122	11	30
3	32	6	128	63	146	46	134	81
4	69	95	158	13	153	55	110	24
5	40	17	113	85	161	2	159	100
6	148	74	163	45	80	97	36	107
7	104	157	27	167	154	68	118	91
8	152	60	171	53	99	133	21	127
9	119	84	114	50	140	86	169	94
10	98	142	42	156	75	129	62	123
11	3	87	165	61	135	47	147	33
12	54	130	10	103	28	37	106	5

Seconde partie

	A	B	C	D	E	F	G	H
2	70	121	26	9	112	49	109	14
3	117	39	126	56	174	18	116	83
4	66	139	15	132	73	58	145	79
5	90	176	7	34	67	160	52	170
6	25	143	64	125	76	136	1	93
7	138	71	150	29	101	162	23	151
8	16	155	57	175	43	168	89	172
9	120	88	48	166	51	115	72	111
10	65	77	19	82	137	38	149	8
11	102	4	31	164	144	59	173	78
12	35	20	108	92	12	124	44	131

2.1.1 Excerpt from the musical material, Mozart (total: 2 × 8 × 11 = 176 meas.)



2.2 Stadler

TABLE Pour Composer des Menuets et des Trios à l'infinie Avec deux Dez à Jouer
EXPLICATION De la manière dont il faut s'y prendre pour composer des menuets et des trios

Les lettres alphabétiques placées sur les colonnes de la Table de chiffres indiquent les mesures, comme par exemple A, la première, B la seconde, C la troisième, etc.

Les chiffres hors de la table désignent les nombres des dés jetés. Voici comment on s'y prend. On jette d'abord deux dés au hasard. Supposons que le nombre soit 6 on cherche la case qui se trouve à côté du 6 dans la colonne A et l'on trouve n° 148. Alors on copie la mesure de musique qui porte le même numéro, ce qui formera le commencement du menuet ; supposons encore que le second coup de dés porte un 9 on cherche dans la case de la colonne B qui est parallèle au 9 et on trouve le n° 84 alors on copie la mesure de musique qui porte le même n° que l'on joint à la première. Après avoir joué 8 coups de dés, la première partie du menuet se trouve faite et on y met le signe de reprise ci-joint [...] *on continue de même pour la seconde partie, etc.*

Chaque répétition de cette expérience donnera un menuet nouveau et différent des autres.

Table des chiffres

[Stadler then gives exactly the same two matrices as Mozart—although with an unfortunate misprint in D-8 of the second, where one reads 157 instead of 175. But above all he adds two extra matrices, with the corresponding musical material, for the composition of a trio of sixteen measures to be inserted before the minuet's *Da Capo*.]

Table pour le trio

Première partie

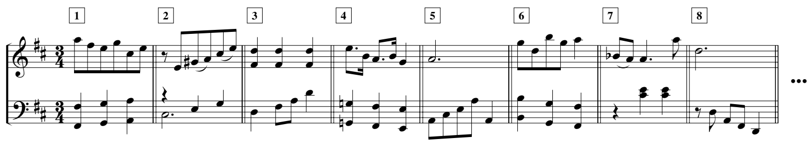
	A	B	C	D	E	F	G	H
1	72	6	59	25	81	41	89	13
2	56	82	42	74	14	7	26	71
3	75	39	54	1	65	43	15	80
4	40	73	16	68	29	55	2	61
5	83	3	28	53	37	17	44	70
6	18	45	62	38	4	27	52	94

Seconde partie

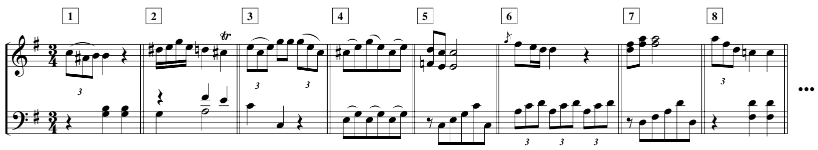
	A	B	C	D	E	F	G	H
1	36	5	46	79	30	95	19	66
2	76	20	64	84	8	35	47	88
3	9	34	93	48	69	58	90	21
4	22	67	49	77	57	87	33	10
5	63	85	32	96	12	23	50	91
6	11	92	24	86	51	60	78	31

Les règles pour composer un trio sont les mêmes que celles du menuet, excepté qu'il ne faut se servir que d'un seul dé.

2.2.1 Excerpt from the *Table de musique pour le menuet,* Stadler (total: 2 × 8 × 11 = 176 meas.)



2.2.2 Excerpt from the *Table de musique pour le trio,* Stadler (total: 2 × 8 × 6 = 96 meas.)



2.3 Comments

In the same way as the *Cent mille milliards de poèmes* by Raymond Queneau [8], this algorithm implies a myriad of possibilities: 11^{16} (*ca* 4.6×10^{16}) possible minuets with Mozart, which must again be multiplied by 6^{16} (*ca* 2.8×10^{12}), if one adds Stadler's trio, which totals 1.2963×10^{29} in the case of the latter. Such astronomical quantities dumfound the imagination... although they do not amount to much more than a trifle compared to the number of elementary particles in the universe, which can be conservatively estimated in the vicinity of 10^{80} [9].

But rest assured! The data redundancy, particularly with Mozart, already somewhat reduces this plethora. For instance, the latter only gives a single possibility for the *prima* and *seconda volta* of his *A*—one leading down to the Tonic, the other modulating towards the Dominant of the Dominant: all of the measures numbered in column H of the first matrix (30, 81, 24, 100, etc.) are in fact the same. Above all, the harmonic homogeneity enforced on all measures of a same matrix column introduces such a homophony between all possible results that, notwithstanding obvious variants, one clearly remains, in a given work, in face of avatars of a musical discourse which uniformly embodies a unique coherence.

Moreover, none of the authors wished to endanger the certainty of always obtaining a *well behaved* result. This keeps them, even Stadler, in a relative melodic and rhythmic monotony. Nowadays, considering such games from the frame of our own context, we would certainly allow more room for surprises, burlesque successions, etc.

The material attributed to Mozart is exceedingly simple. This very fact lets one doubt this abusive attribution: one believes that such a vivid genius would have made a much better use of the resources of the system, for which he would have devised a subtler discourse. The results obtained with these data remain simplistic.

Besides the fact that he takes position in another, slightly more sophisticated key, Stadler (1748-1833) carries much further the elaboration of the material he assigns in the same matrices. He is tonally more developed, modulates more—ambiguously at times—mixes binary and ternary rhythms, etc. His addition of a trio demonstrates a true creative spirit. In spite of the reduced number of possibilities revealed by its limitation to a single die, the trio's material shows an authentic research in subtlety.

It is as if Stadler, familiar with Mozart's game, had deliberately transposed the idea in a more elaborate discourse, and had decided not to be satisfied with the sole minuet matrices and to create those of the trio on the same principle. This musicological hypothesis remains purely intuitive, being backed by no specific bibliographical or biographical research. It also contradicts the strict chronology of the two publications.

3 Realization

This realization has been entirely written in *Common LISP* [10].

A *combinatory* function uses each matrix to compose the appropriate parts—*A*, *B* of minuet and/or trio, as the case may be. These parts can then be put together in traditional manner, with or without repeats, etc.

The actual note sequences, which result from assembling the measures which constitute the pieces, are prepared by a *sequencer* function. This function operates from databases representing the musical measures transcribed from the publications. It is also capable of performing tempo variations.

The interface from the final sequences to MIDI format rests on *CLCE IV* [11]—an extension to Common LISP. An output in CLCE format proper is also possible. This last option essentially differs from MIDI in that it integrates the concept of *notes* endowed with durations—whereas MIDI, being a tablature, does not directly translate this musical entity, and only represents it through discrete mechanical events: *KeyOn* and *KeyOff*.

The sound recordings have been realized with an Akai S3200 sampler, using the factory *Grand Piano* timbre.

3.1 The dice

The heart of the algorithm thus consists of the random choice of measures from the possibilities in each matrix column. This choice follows x, a discrete random variable in the interval [2,12].

One must take care that this variable, intended to simulate two dice, cannot be equiprobable. It is indeed the sum of two equiprobable variables in the interval [1,6], and thus shows a triangular shaped histogram. One has, for instance:

$$P\{x=2\} = P\{x=12\} = 1/36,$$
$$P\{x=3\} = P\{x=11\} = 2/36,$$
$$\bullet\bullet\bullet$$
$$P\{x=6\} = P\{x=8\} = 5/36,$$
$$P\{x=7\} = 6/36.$$

If the conceivers of the games had been conscious of this non-equiprobability, one may presume that they would have favored the "funniest" measures by placing them in the central matrix lines—numbered 6, 7 and 8, for instance. This fact is not obvious, but can be disputed.

Stadler's trio part forms an exception, in that his matrices are devised for a single die.

3.2 Measure databases

The databases are ASCII files, consisting of concatenated measures, in any number. The following formalism is used to encode measures. (Its description is here kept at a minimum. Without further details, it makes use of certain standard LISP forms, of some features of the metalanguage of Steele [10], of MIDI format standards and of pedagogical examples by the author.)

mesure := a list of form (*ChfMes* {*note*(*s*)}*).

ChfMes := number_of_beats multiplied by beat_note_value (in *Fig*). For instance: 3/4 (3 quarter note beats), 5/8 (5 eighth note beats), etc. Equivalent to the traditional measure time signature, expressed as a rational number.

Fig := note value (1 = "whole note", 1/2 = "half note", 1/4 = "quarter", etc.). Other examples: 3/20 = dotted eighth note in a sixteenth note quintuplet; 2/6 = half note in a quarter note sextuplet, equal to 1/3 = half note in a half note triplet; 1/12 = triplet eighth note, etc.

note := list containing note parameters in the following order...

- *SymNot* := dotted pair of type SymNot (note_name . octave). Cf. +init.clce file [(c . 3) := Middle C = MIDI pitch 60 by default].
- *DebNotMesFig* := beginning of note relative to the measure's beginning. In *Fig* [0 by default].
- *DurNotFig* := note duration. In *Fig* [1/4 by default].

EpsDurFig := quantity of duration to be added to *DurNotFig* for phrasing purposes. In *Fig* [0 by default]. Examples: 1/20 will result in a legato; -1/16 in a staccato, etc.

Nua := number in [1,12.7]. It will be multiplied by 10 to give the note's MIDI velocity [6 := *mf* = MIDI 60 by default]. For instance:

4*p* 3*p* 2*p* *p* *mp* *mf* *f* 2*f* 3*f* 4*f* would be coded as...
1 2 3 4 5 6 7 8 9 10.

As a last resort, the effect will depend on the MIDI instrument used.

Tim := MIDI channel number in [1,16] [1 by default].

The default values apply in the first note of a measure.

A *nil* standing for a parameter will maintain it at the same value as in the *lexically* preceding note (N.B.: not *musically*)—or at its default value if it is used in the definition of a measure's first note.

Any number of such *nil* at the end of a note can be omitted.

For instance, the following measure, as an extreme example, would contain four repetitions of the default note in "4 4":

```
(4/4 nil (nil 1/4) (nil 2/4) (nil 3/4)).
```

3.2.1 Data excerpt, Mozart, corresponding to musical excerpt 2.1.1 above

```
(3/8 ((f  . 2)    0  1/8             )  ;001
     ((d  . 2)  1/8                  )
     ((g  . 2)  2/8                  )
     ((f  . 4)    0                  )
     ((d  . 4)  1/8                  )
     ((g  . 4)  2/8                  ))
(3/8 ((b  . 1)    0  1/4             )  ;002
     ((g  . 2)                       )
     ((a  . 3)    0  1/8             )
     ((f+ . 3) 2/16 1/16             )
     ((g  . 3) 3/16                  )
     ((b  . 3) 4/16                  )
     ((g  . 4) 5/16                  ))
(3/8 ((c  . 2)    0  1/4             )  ;003
     ((e  . 2)                       )
     ((g  . 4)    0  1/8             )
     ((c  . 4)  1/8                  )
     ((e  . 4)  2/8                  ))
(3/8 ((g  . 1)    0 1/16             )  ;004
     ((b  . 1) 1/16                  )
     ((g  . 2)  1/8  1/8             )
     ((b  . 1)  2/8                  )
     ((g  . 4)    0  1/8             )
     ((d  . 4) 5/40 1/40  1/82       );tr~
     ((e  . 4) 6/40                  )
     ((d  . 4) 7/40                  )
     ((e  . 4) 8/40                  )
     ((d  . 4) 9/40                  )
     ((e  . 4) 10/40                 )
     ((d  . 4) 11/40                 )
     ((e  . 4) 12/40                 )
     ((d  . 4) 13/40                 )
     ((e  . 4) 14/40  nil    0       ))
(3/8 ((g  . 1)    0  1/8             )  ;005 1a
     ((g  . 2) 2/16 1/16             )
     ((f  . 2) 3/16                  )
     ((e  . 2) 4/16                  )
     ((d  . 2) 5/16                  )
     ((g  . 3)    0  1/4      0 5.3)
     ((b  . 3)                       )
     ((d  . 4)                       )
     ((g  . 4)                       ))
(3/8 ((g  . 1)    0  1/8             )  ;005 2a
     ((b  . 2) 2/16 1/16             )
     ((g  . 2) 3/16                  )
     ((f+ . 2) 4/16                  )
     ((e  . 2) 5/16                  )
     ((g  . 3)    0  1/4      0 5.3)
     ((b  . 3)                       )
     ((d  . 4)                       )
     ((g  . 4)                       ))
(3/8 ((c  . 2)    0  1/4             )  ;006
     ((e  . 2)                       )
     ((g  . 3)    0  1/8             )
     ((c  . 4)  1/8                  )
     ((e  . 4)  2/8                  ))
(3/8 ((c  . 2)    0  1/4             )  ;007
     ((g  . 2)                       )
     ((e  . 4)    0 1/16             )
     ((c  . 4) 1/16                  )
     ((e  . 4) 2/16                  )
     ((g  . 4) 3/16                  )
     ((c  . 5) 4/16                  )
     ((g  . 4) 5/16                  ))
(3/8 ((c  . 2)    0  1/8             )  ;008
     ((g  . 1)  1/8                  )
     ((c  . 1)  2/8                  )
     ((c  . 4)    0  3/8             ))
...
```

3.2.2 Minuet data excerpt, Stadler (*Table de musique pour le menuet*), cf. 2.2.1 above

```
(3/4 ((f+ . 1)    0   1/4          )  ;001
     ((f+ . 2)                     )
     ((g  . 1)   1/4               )
     ((g  . 2)                     )
     ((a  . 1)   2/4               )
     ((a  . 2)                     )
     ((a  . 4)    0   1/8          )
     ((f+ . 4)   1/8               )
     ((e  . 4)   2/8               )
     ((g  . 4)   3/8               )
     ((c+ . 4)   4/8               )
     ((e  . 4)   5/8               ))
(3/4 ((c+ . 2)    0   3/4          )  ;002
     ((e  . 2)   1/4  1/4          )
     ((g  . 2)   2/4               )
     ((e  . 3)   1/8  1/8          )
     ((g+ . 3)   2/8  nil  1/20    )
     ((a  . 3)   3/8  nil     0    )
     ((c+ . 4)   4/8  nil  1/20    )
     ((e  . 4)   5/8  nil     0    ))
(3/4 ((d  . 2)    0   1/4          )  ;003
     ((f+ . 2)   2/8  1/8          )
     ((a  . 2)   3/8               )
     ((d  . 3)   2/4  1/4          )
     ((f+ . 3)    0   1/4          )
     ((d  . 4)                     )
     ((f+ . 3)   1/4               )
     ((d  . 4)                     )
     ((f+ . 3)   2/4               )
     ((d  . 4)                     ))
(3/4 ((g  . 1)    0   1/4          )  ;004
     ((g  . 2)                     )
     ((f+ . 1)   1/4               )
     ((f+ . 2)                     )
     ((e  . 1)   2/4               )
     ((e  . 2)                     )
     ((e  . 4)    0   3/16         )
     ((b  . 3)  3/16  1/16         )
     ((a  . 3)  4/16  3/16         )
     ((b  . 3)  7/16  1/16         )
     ((g  . 3)   2/4   1/4         ))
(3/4 ((a  . 1)    0    1/8         )  ;005
     ((c+ . 2)   1/8               )
     ((e  . 2)   2/8               )
     ((a  . 2)   3/8               )
     ((a  . 1)   2/4   1/4         )
     ((a  . 3)    0    3/4         ))
(3/4 ((b  . 1)    0    1/4         )  ;006
     ((b  . 2)                     )
     ((g  . 1)   1/4               )
     ((g  . 2)                     )
     ((f+ . 1)   2/4               )
     ((f+ . 2)                     )
     ((g  . 4)    0    1/8         )
     ((d  . 4)   1/8               )
     ((b  . 4)   2/8               )
     ((g  . 4)   3/8               )
     ((a  . 4)   2/4   1/4         ))
(3/4 ((c+ . 3)   1/4   1/4         )  ;007
     ((e  . 3)                     )
     ((c+ . 3)   2/4               )
     ((e  . 3)                     )
     ((a+ . 3)    0    1/8  1/20   )
     ((a  . 3)   1/8   nil     0   )
     ((a  . 3)   2/8   3/8         )
     ((a  . 4)   5/8   1/8         ))
(3/4 ((d  . 2)   1/8   1/8         )  ;008
     ((a  . 1)   2/8               )
     ((f+ . 1)   3/8               )
     ((d  . 1)   2/4   1/4         )
     ((d  . 4)    0    3/4         ))
...
```

3.2.3 Trio data excerpt, Stadler (*Table de musique pour le trio*), cf. 2.2.2 above

```
(3/4 ((g  . 2)   1/4   1/4     0 3.5) ;01 T.
     ((b  . 2)                      )
     ((g  . 2)   2/4                )
     ((b  . 2)                      )
     ((c  . 4)     0  1/12  1/25    )
     ((a+ . 3)  1/12                )
     ((b  . 3)  2/12   nil     0    )
     ((b  . 3)   1/4   1/4          ))
(3/4 ((g  . 2)     0   1/4     0 3.5) ;02 T.
     ((a  . 2)   1/4   2/4          )
     ((f+ . 3)   nil   1/4          )
     ((e  . 3)   2/4                )
     ((d+ . 4)     0  1/16          )
     ((e  . 4)  1/16                )
     ((g  . 4)  2/16                )
     ((e  . 4)  3/16                )
     ((d  . 4)   1/4  1/4           )
     ((c+ . 4) 16/32  1/32  1/70    );tr
     ((d  . 4) 17/32                )
     ((c+ . 4) 18/32                )
     ((d  . 4) 19/32                )
     ((c+ . 4) 20/32                )
     ((d  . 4) 21/32                )
     ((c+ . 4) 22/32                )
     ((d  . 4) 23/32   nil     0    ))
(3/4 ((c  . 3)     0   1/4     0 3.5) ;03 T.
     ((c  . 2)   1/4                )
     ((e  . 4)     0  1/12  1/25    )
     ((c  . 4)  1/12                )
     ((e  . 4)  2/12   nil     0    )
     ((g  . 4)   2/8   1/8          )
     ((g  . 4)   3/8                )
     ((g  . 4)  6/12  1/12  1/25    )
     ((e  . 4)  7/12                )
     ((c  . 4)  8/12   nil     0    ))
(3/4 ((e  . 2)     0   1/8  1/15 3.5) ;04 T.
     ((g  . 2)   1/8   nil     0    )
     ((e  . 2)   2/8   nil  1/15    )
     ((g  . 2)   3/8   nil     0    )
     ((e  . 2)   4/8   nil  1/15    )
     ((g  . 2)   5/8   nil     0    )
     ((c+ . 4)     0   1/8  1/15    )
     ((e  . 4)   1/8   nil     0    )
     ((g  . 4)   2/8   nil  1/15    )
     ((e  . 4)   3/8   nil     0    )
     ((c+ . 4)   4/8   nil  1/15    )
     ((e  . 4)   5/8   nil     0    ))
(3/4 ((c  . 2)   1/8   1/8     0 3.5) ;05 T.
     ((e  . 2)   2/8                )
     ((g  . 2)   3/8                )
     ((c  . 3)   4/8                )
     ((c  . 2)   5/8                )
     ((f  . 3)     0                )
     ((d  . 4)                      )
     ((e  . 3)   1/8                )
     ((c  . 4)                      )
     ((e  . 3)   1/4   2/4          )
     ((c  . 4)                      ))
(3/4 ((a  . 2)     0  1/12     0 3.5) ;06 T.
     ((c  . 3)  1/12                )
     ((d  . 3)  2/12                )
     ((a  . 2)  3/12                )
```

```
     ((c  . 3)  4/12                    )
     ((d  . 3)  5/12                    )
     ((a  . 2)  6/12                    )
     ((c  . 3)  7/12                    )
     ((d  . 3)  8/12                    )
     ((g  . 4)     0  1/32  1/70        )
     ((f+ . 4)  1/32  3/32     0        )
     ((e  . 4)  2/16  1/16              )
     ((d  . 4)  3/16                    )
     ((d  . 4)   1/4   1/4              ))
(3/4 ((d  . 2)   1/8   1/8      0 3.5) ;07 T.
     ((f+ . 2)   2/8                    )
     ((a  . 2)   3/8                    )
     ((d  . 3)   4/8                    )
     ((d  . 2)   5/8                    )
     ((d  . 4)     0                    )
```

```
     ((f+ . 4)                          )
     ((f+ . 4)   1/8                    )
     ((a  . 4)                          )
     ((f+ . 4)   1/4   2/4              )
     ((a  . 4)                          ))
(3/4 ((f+ . 2)   1/4   1/4      0 3.5) ;08 T.
     ((d  . 3)                          )
     ((f+ . 2)   2/4                    )
     ((d  . 3)                          )
     ((a  . 4)     0  1/12              )
     ((f+ . 4)  1/12                    )
     ((d  . 4)  2/12                    )
     ((c  . 4)   1/4   1/4              )
     ((c  . 4)   2/4                    ))
...
```

3.3 Examples

Below are shown scores of a *walze* obtained from Mozart, together with a complete minuet and trio from Stadler. Numerous complete sound examples can be played.

3.3.1 Example of *walze*, Mozart

3.3.2 Example of minuet with trio, Stadler

4 Conclusion

Exactly as one can link these 18th century musical games to the beginning of computer compositional algorithms in the 20th, one can also travel back in time and integrate them in a grand tradition of speculative and combinatorial music. By essence, music lends itself to this type of approach, which appears for instance in *Ars antiqua* isoperiodicity followed by elaborate *Ars nova* isorhythmic structures. *Ars combinatoria* reappears with Father Marin Mersenne as well as with Webern... These crossed relations among artistic, scientific and technological realms are nothing more than natural if one admits that the sources of the human mind and imagination, after all, can only be the very same as those of the universe itself [12].

Through this vast process, the 18th century stands out as an important stage, when conceptions of the intelligence of the living were confronted with technological advances making it possible to simulate some of their aspects. "The opposing categories, human and artificial intelligence, life and machinery continually redefined each another, and the early history of artificial life was driven by two contradictory forces, the impulse to simulate and the conviction that simulation was ultimately impossible. [...] These contradictory convictions [...] still compel us, in discussions of modern technologies of artificial life from robotics to cloning: the conviction that we can understand life and intelligence by reproducing them, and the conviction that life and intelligence are defined precisely by our inability to reproduce them" [13].

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Acknowledgments

Thanks to Alan Cassar and Dan Albertson for their help in preparing this article.