First measurements concerning rhytmic circuit inertia and disparition

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The experiment consisted of three tasks: during first a spontaneous motor tempo (SMT) was measured; during the second a child had to synchronise to stimuli with 600ms interstimuli interval (ISI); third task was a continuation/induction task – after being attuned to a 600ms ISI, a child was instructed to continue tapping the same rhythm (IRI) even after stimuli was turned off. This text concerns only the 3rd task in relation to data obtained by SMT measurements of the 1st task.

Crucial for understanding of our method is the concept of "IRI falling into the SMT attractor state". We say that subject's IRI have fallen into the SMT attractor state when an IRI cannot be distinguished from SMT. For practical purposes we define that IRI cannot be distinguished from SMT state when the arithmetic mean of 3 subsequent IRIs is lesser than SMT, e.g. IRI<SMT. As may be noticed from Figure 1, XXXX of our subjects have sooner or later fallen into SMT attractor state during the continuation task.

And more, we can demand when this event have occurred. Thus we label the beginning of 3-tapped sequence specified above as "the moment of passing of an SMT attractor threshold". Having a sequence of taps where 1 denotes first tap, 2 second etc. a number N will be called an "SMT attractor's threshold passing's sequence number" if and only if:

$$\text{mean}(IRI_N\, IRI_{N+1} + IRI_{N+2}) < SMT$$

It is important to understand that once we know SMT attractor's passing sequence number, we can easily calculate the time interval between the beginning of the continuation sequence T0 and a passing of an SMT attractor as a sum of all the IRIs occurred between 0 (e.g. the and of a ISI sequence) and N. This is due to construction of our experiment – we can be more or less sure that measurement of IRI_2 starts in the very moment when IRI_1 ends, with minimal -computer processing speed related- temporal gap between them. We formalize:

$$T_N = \sum_{i=0}^{N} IRI_i$$

Since the beginning of the continuation sentence marks as well the end of an ISI sequence, this summing up of all IRIs which occurred before passing the threshold can be interpreted as a time interval between the moment when ISI was turned off and a moment when a subject's IRI have fallen into the SMT attractor state. For the purpose of this article we'll say that T_N denotes

SEX	AGE	TRAINING	SMT	IFI
f	4	m	360	12411
g	4	m	401	9171
f	5	m	538	29118
g	5	m	568	11137
g	4	n	503,5	11047
f	5	n	558	18006
g	5	n	548,5	15385
f	4	m	542	7583
g	4	m	461	12321
f	4	n	540	15353
g	4	n	377,5	15742
f	5	n	566	14984
g	4	m	567	10288
f	5	m	484	18042
g	5	m	431	13898
f	4	n	402	11161
g	4	n	481	2680
g	5	n	484	4586
f	4	m	552	7270
g	4	m	432	15847
f	5	m	501,5	15990
f	4	n	558	19966
g	4	n	400	518
g	5	n	528	14321
f	4	m	379	14659
g	4	m	525,5	13638
f	5	m	537	11458
g	5	m	564	9838
f	4	n	514	1988
g	4	n	428	7088
f	4	m	564	2332
f	5	n	444	16595
g	5	n	445	8890
f	4	m	446	16747
f	5	n	486	14354

Tableau 1: SMTs and ISI's fadeaway intervals - IFIs (in miliseconds) of 35 subjects whose previously measured SMT<550 as related to their respective sex/age/musical training factors

the *ISI's fadeaway interval* (IFI) . Table 1 shows different IFI's for 27 subjects whose SMT<550 and hence could in comparison with IRI=600 produce measurable results.

Results

A three-factored (sex,age,musical training) ANOVA was run over measured IFIs of 35 subjects whose SMT<550 This analysis revealed a significant main effect of age ($p<0.039$) and indicated a possible effect of sex ($p<0.0691$). No interaction nor effect of musical training was observed. An unilateral Student's test suggests ($p<0.02$) that a mean IFI of 5years old (14440ms) is greater than mean IFI of 4 year olds (10390ms)

Discussion

We use the term "SMT attractor" because we think that SMT can be described as an equilibrium state of child's cognitive system in particular of global oscillatory module . We consider an SMT to be an attractor because

1) it's much more probable that a child will change its IRI from ISI to SMT than the other way around[1]
2) SMT cyclic equilibrium once attained, child's rhytmic cognitive system will tend to rest in it until next perturbation by external stimuli.

Since we had defined IFI as a time interval between the moment when a child was attuned to ISI and a moment when it passed SMT's atractor threshold, we can say that this interval describes the time needed for an irreversible deletion of an initial ISI. We can say that when IRI is departing from ISI and approaching SMT, ISI is rewritten by SMT. More IRI approaches SMT, more information about initial ISI is lost, most it is improbable that IRI will come back to ISI.

Thus we think that IFI can be an interesting notion for measuring certain characteristics of rhytmic memory and maybe a first step towards a new method of studying memory in general. For initial ISI's gradual fadeout can be either interpreted as both

- temporal interval needed for an irreversible disparition/deletion of a certain rhythmic behavior pattern
- temporal interval during which a certain rhythmic behaviour pattern "resists" its deletion.

If we adhere to the second interpretation, we can say that an IFI measure can be an interesting clue to what we call *inertia* of a given behaviour pattern/neural circuit. What our data shown us is, rhytmic behaviour patterns of 4year olds have lesser inertia than those of 5years old. In other words, neural rhytmic loops of 5 years old resist better the tendance to be deleted from the rhytmic memory than those of younger children. Simply said, more a child is older, more the contents of its memory have a capacity to become "frozen" - more solid is an energetic equilibrium of all neural loops concerned . We think that these conclusions are consistent with other results of child memory development research

Bibliography ???

The functional emergence of prefrontally-guided working memory systems in four- to eight-year-old children

1 In the language of dynamical systems: SMT drains the basin of attraction composed of all other IRI states

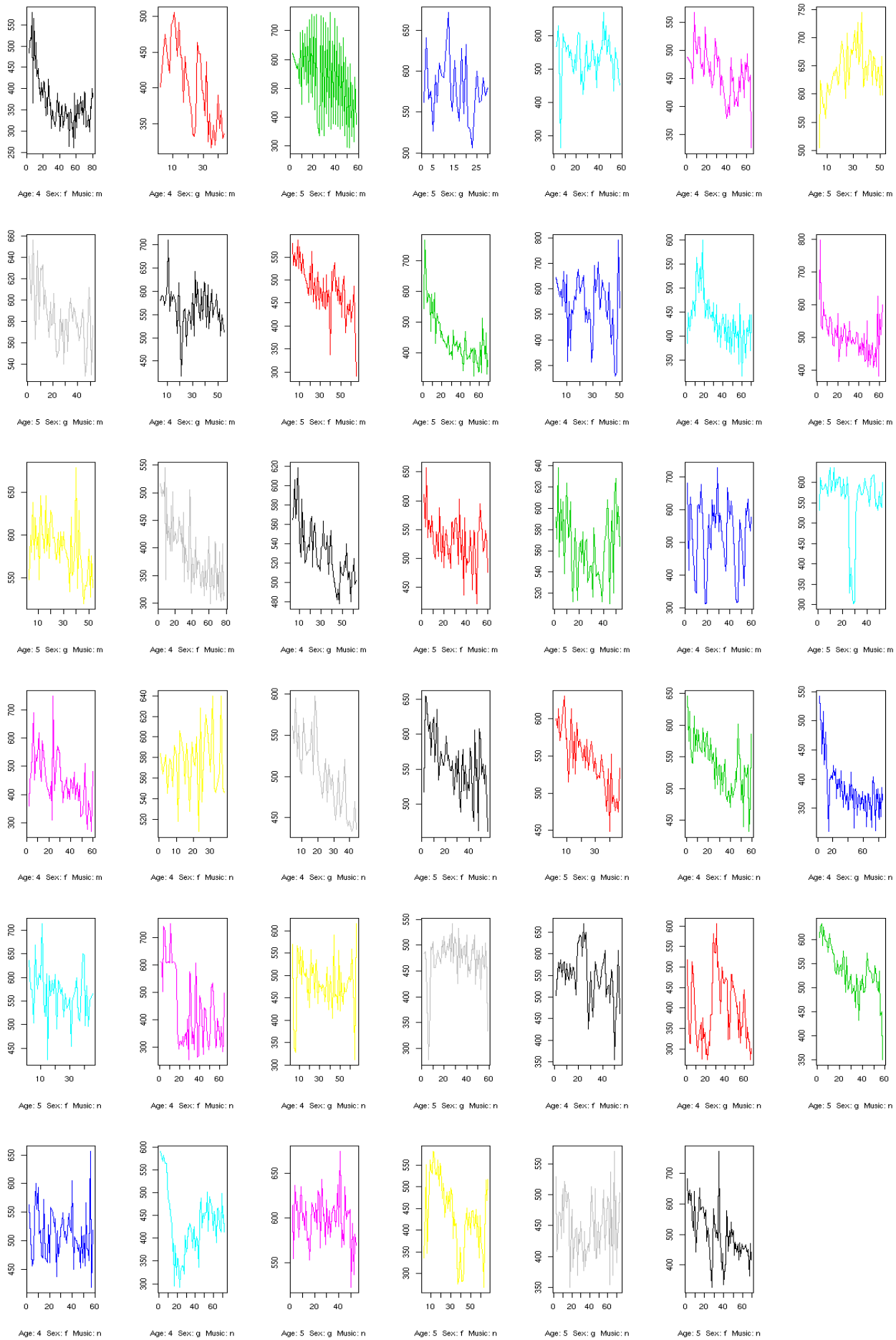

Illustration 1: Diagrams representing an execution of a continuation task by 41 children subjects. X axis is the tap's sequence number, Y axis signifies the IRI value. Observed left-to-right gradual decrease of IRI can be interpreted as a fall into an SMT attractor state.