Emergence of Orderliness in Mind: A Probabilistic Causal Approach

Raimo J Laasonen

Vihti/Nummela

Finland

Abstract

The current study concentrates to figure out how orderliness emerges possibly in the mind. A research emulation with random data was usable for generation of the hypothesis. The resulted hypothesis assumed that in a novel situation, quality of a stimulus evokes what kinds of flip-flop dynamic persons generate, and the flip-flop dynamic results in what kind of overt orderliness the persons produce. The variables between were the imaginary word, the concrete word, and the abstract word; planning, organizing, and arranging; the sentence without a regular arrangement, the deficient sentence, and the proper sentence. Structured observation was the method to obtain data. The number of the participants was 100 (53 men, 47 women). Matrix calculus was applicable to research causation with probabilities. Reliability was assed with Cronbach's α-coefficient, and validity with χ^2-test. The hypothesis corroborated, and the causal flip-flop dynamic referred to the direction that the same causal system dynamic deals with dissimilar referents in the mind, and results in different outputs. The essential result of the research was the causal flip-flop where after the inputs the process causes the process, and back again to the modified absorption before the outputs.

KEYWORDS: flip-flop, causal dynamic, disorder, partial order, order, orderliness, stimuli, process, responses, amplification, counteraction.

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Orderliness or state of being orderly is assumed given in mind processes. Seldom attention focuses on origination of orderliness. Therefore, the current study concentrated on behavior where persons had a task from scratch. The only thing the persons got was a stimulus; the rest was up to them to accomplish the task. There was no prior knowledge, and consequently no orderliness. Therefore, the persons had to develop the entire dynamic to solve the task. The framework was the one-way system: Input—>Process—>Output. In a way of one-to-one correspondence, the same is expressible as Stimuli—>Processes—>Responses. The causal probabilities purified of dependencies function as the means to find out action sequences. The device to research the emergent orderliness was language. There are types of behavior such as craftsmanship, sports, and other skill demanding arts, which are usable to the study of the emergent orderliness but this time the research was contended with verbal behavior.

There were three types of stimuli 1) Imaginary words whose referents are in imagination 2) Concrete words whose referents are in reality, and 3) Abstract words whose referents are in thinking. Three mind processes assumed to be essential a) Planning: A person generates a scheme or a plan of a course of action to accomplish the task b) Organizing: A person constructs a system or a workable sentence and c) Arranging: a person produces a specific system or a specific sentence adjusted to the stimulus. In this context, the system is defined as a dynamic behavioral pattern as contrasted with a dynamic random pattern.

In the same way, there were three responses of orderliness A) Disorder that means a lack of regular arrangement in the sentence B) Partial order that is a deficient sentence that lacks a part, and C) Order that is a proper sentence with subject, predicate, and object.

Research emulation with random data was necessary because of the generation of the hypothesis. The results referred to the quality of the stimuli to be a cause of processing, and to a causal flip-flop, which controls the responses. Therefore, the following hypothesis was the outcome of the emulation. In a novel situation, quality of a stimulus evokes what kinds of flip-flop dynamic persons generate, and the flip-flop dynamic results in what kind of overt orderliness the persons produce. The variables between which the pattern occurred were the imaginary word, the concrete word, and the abstract word; planning, organizing, and arranging; the sentence without a regular arrangement, the deficient sentence, and the proper sentence.

Method

Analysis with Random Data

A 120 by 9 pseudorandom matrix was generated. The cells of the matrix consisted of ones, twos, and threes because there were three stimulus types, three processes, and three responses. The columns of the matrix were frequenced, and the frequencies grouped to a 9 by 9 matrix. The classes were in the rows, and the stimuli, processes, and the responses in the columns.

Participants

The number of participants was 100 out of who were 53 men, and 47 women.

Situation

Each participant has a pile of closed envelopes, which included in the stimulus words. The participants did not know the contents of the envelopes beforehand, and the participants could choose whichever envelope they wanted. The task of the participants was to give a roundabout expression (sentence) about the thing the word presented. It was not allowable to define or describe the thing, directly. There was only one envelope per participant.

Operations of Observation

Structured observation was the method to obtain data by means of an observation minutes. The observation minutes was in a tabular form. The participants were in the rows marked with a number. The stimulus words, the processes, and the responses were in the columns. Observation took place from pause to pause. The stimulus words coded as such, and they were classifiable afterwards whereas the processes, and the responses tallied in the behavioral categories.

The planning included in behaviors such as the participant sat still, stared at the word, and was quiet. The organizing was perceptible when the participant groped for the right words, uttered unfinished expressions, and pondered alternative responses. The arranging occurred when the participant formulated a specific sentence. On the response side, when the sentence was messy it lacked a regular arrangement. When the sentence lacked a part, it was a deficient sentence. When the sentence was solid, the result was a proper sentence. The coding took place from videotaped sessions.

Results

Reliability and Validity of Observation

Reliability assessment took place with Cronbach's α-coefficient from normalized variables, and categories. The coefficient of the variables was 0.786 calculated from the squared correlation matrix. The coefficient applied to the categories or to the rows of the data matrix, too. The resulted value was 0.863. Reliability seemed to be reasonable.

In validity of observation, the crucial question was: Are the frequencies located in the right categories? In this context, the problem was solvable through χ^2-test. The data matrix was a contingency table. The H_0 was that the frequencies located in the wrong categories. The hypothesis H_1 was the frequencies were in the right categories. The resulted analysis gave χ^2 (4) = 145.533, p = $1.84406*10^{-30}$, one-sided value. H_0 falsified, and the frequencies were in the right categories, most probably. The coefficient of contingency was derivable from χ^2, and calculation of the contingency coefficient gave the value 0.371, which meant the categories to be rather separate. The correlation of attributes resulted in a somewhat lower value than the contingency coefficient 0.283. The former values warranted the observation rather valid.

Analysis Based on Random Frequencies

The calculations with the random, and empirical data were analogical, Therefore, the random start matrix, and the random result matrices occur in this context.

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Table 1

Random Data Matrix

Frequencies	f		f		f
Imaginary word	28	Planning	30	Sentence without regular arrangement	6
Concrete word	51	Organizing	41	Deficient sentence	107
Abstract word	41	Arranging	49	Proper sentence	7

Table 2

Random Causal Dynamic

Input—Process				Process—Process				Process—Process				Process—Output			
T^1	P	O	A	T^1	P	O	A	T^2	P	O	A	T^1	Swra	Ds	Ps
Iw	.815	$3.253*10^{-6}$	.185	P	.185	.000	.815	P	.637	.076	.287	P	$5.241*10^{-7}$	.999	$7.694*10^{-7}$
Cw	.154	.173	.673	O	.076	.906	.018	O	.096	.823	.081	O	.731	$4.417*10^{-7}$	.286
Aw	.032	.827	.142	A	.739	.094	.167	A	.267	.101	.632	A	.269	$9.01*10^{-8}$	.731

Note. The abbreviations mean: Iw=imaginary word, Ce=concrete word, Aw=abstract word, P=planning, O=organizing, A=arranging, Swra= sentence without a regular arrangement, Ds=deficient sentence, and Ps=proper sentence.

The input—process part referred that the different stimulus words influenced in the different processes, and their evolvement. In other words, the quality of the stimulus words determined what kind of flip-flops develop during the dynamic. The process—process parts indicated the existence of the flip-flops because planning produced the specific sentence, and thereafter planning remained in the auto-causality before the output. The same took place vice versa. So that movement occurred between the active causation, and the auto-causality which brought forth the hypothesis: In a novel situation, quality of a stimulus evoked what kinds of flip-flop dynamic persons generate, and the flip-flop dynamic resulted in what kind of overt orderliness the persons produce.

Analysis with Empirical Data

The starting point of the analysis was the frequency matrix in Table 3

Table 3

Empirical Data Matrix

Frequencies	f		f		f
Imaginary word	14	Planning	203	Sentence without regular arrangement	20
Concrete word	61	Organizing	227	Deficient sentence	26
Abstract word	25	Arranging	199	Proper sentence	136

An orthogonalization program converted the frequency matrix into the Householder matrix that was squared. The procedure resulted in the matrix free from linear dependencies, and simultaneously, a double- stochastic matrix in Table 4.

Table 4

Squared Householder Matrix

Probabilities	P		P		P
Imaginary word	.0046	Planning	.985	Sentence without regular arrangement	.0095
Concrete word	.988	Organizing	.0057	Deficient sentence	.0052
Abstract word	.0063	Arranging	.0085	Proper sentence	.985

The double-stochastic matrix was deconstructed into vectors, and Cartesian products calculated between the vectors. In addition, the Cartesian product of the process vector formed with itself, which demanded a different kind of calculation. It is known that P (H|H)=P (H). Therefore, the diagonal values were taken out of the product matrix, and the conditional probabilities calculated. After the calculation, the diagonal values were put back. The total sum of the matrix was scaled to one as it was in the two other matrices. The sum of the matrices divided the matrices, which resulted in the Bayesian probabilities. In another way, the sum of the intersections divided the intersections. The squared Householder method applied to the matrices, and the sum of the matrices divided the matrices, again. The operation was a safeguard to avoid possible dependencies, which may have left because of the method itself. The last phase was to use the squared Householder method to the obtained matrices, and check whether there would be further changes in the matrices. No further changes emerged. Therefore, the resulted matrices were the ones for the analysis of the causal dynamic.

Causal Dynamic

The participants began the dynamic from scratch, which meant the null matrices filled in succession. Matrix power was the device to clarify the dynamic. The dynamic advanced

Table 5

Empirical Causal Dynamic

$MP^{1=0}$	Planning	Organizing	Arranging
Imaginary word	.999	$3.858*10^{-7}$	$2.961*10^{-10}$
Concrete word	$3.521*10^{-7}$	.896	.104
Abstract word	$3.402*10^{-8}$	.104	.896
MP^{1}	Planning	Organizing	Arranging
Planning	.096	.903	.001
Organizing	.000	.001	.999
Arranging	.903	.096	.000
MP^{2}	Planning	Organizing	Arranging
Planning	.009	.088	.902
Organizing	.903	.096	.001
Arranging	.087	.816	.097
MP^{3}	Planning	Organizing	Arranging
Planning	.816	.096	.088
Organizing	.088	.815	.097
Arranging	.096	.089	.815
MP^{1}	Sentence without regular arrangement	Deficient sentence	Proper sentence
Planning	$1.676*10^{-7}$	$5.238*10^{-6}$	.999
Organizing	.889	.111	$1.320*10^{-6}$
Arranging	.111	.889	$4.085*10^{-6}$

vertically, in Table 5. The greatest values in Table 5, and calculation of the successive differences between the probabilities revealed the dynamic that is not deducible, directly.

Discussion

The random results warranted the hypothesis: In a novel situation, quality of a stimulus evokes what kinds of flip-flop dynamic persons generate, and the flip-flop dynamic results in what kind of overt orderliness the persons produce. The hypothesis corroborates. There emerge three causal chains, which have the same causal flip-flop structure with different processes, and results. In this context, a process equalizes a cause or doing is causation.

In the scrutiny, the persons who get the imaginary word generate the plan of action. Based on the plan of work the persons construct the approximate workable sentence that they transfer back into the plan of operations. The persons modify the plan of action, further, and result in the proper sentence.

Those persons who get the concrete word do not accomplish the workable sentence. However, the persons use the generated sentence as the basis to construct the failed specific sentence. The persons apply the failed specific sentence to the generated sentence but they mess up the generated sentence, uphold confusion, and result in the sentence without a regular arrangement.

In the case of the abstract word, the persons try to construct the specific sentence. Based on the unfinished specific sentence the persons generate the plan of action, afterwards. The persons alter the unfinished specific sentence according to the plan of work, and they modify the unfinished specific sentence, further. As a response, the persons result in the deficient sentence.

As with the emergence of the orderliness in the mind language offers an opportunity to have a tinge about the mind dynamic. However, it is exaggeration to put the equal sign between the language, and the mind. It is highly probable that the language shapes the mind, and behavior according to Boroditsky (2009, p. 1). On the other hand, Harnad presents an inductive hybrid model of the mind where the mind is constructed through elementary symbols to novel connected symbols (1990, pp. 335-346). It is fertile to pucker up the symbolic model, and the connectionist one where contents form from iconic, categorical representations. However, when persons discuss about dogs, for example, they have a certain dog or dogs in the mind, which is the subjective component of the mind. However, the ground of a language is in one's social environment, which seems as given. There is a but, the social environment includes in significant persons whose importance to us is greater than others. Some have given you real knowledge about how things work, some not. It concerns language acquisition, too. The language however, has constraints. The constraints start when one has to extricate from doing things, which is a matter of motorics. Therefore, there is a certain difference between saying and writing a chair than making a chair. Consequently, the language tackles several mind processes but not necessarily those, which stay outside of linguistic communication. Consistently, adherence to language is a flaw of the current research.

The nature of the task was such, which does not presume invention but discovery. Theoretically, the output of the one-way system has three kinds of orderliness, which emerge through different processes: order, disorder, and partial order.

The causal flip-flop dynamic refers to the direction that the same causal system dynamic deals with dissimilar referents, and results in different outputs. Maruyama differentiates between positive, and negative feedbacks, which lead to two stochastic processes: a deviation-amplifying mutual causal process, and a deviation-counteracting mutual process or a mixture of them (1972, pp. 304-313).

Evidently, the process that started from the imaginary referents is deviation-counteracting where as the process of the concrete referents is deviation-amplifying, and the process of the abstract referents is the mixture, because the scheme works up the specific sentence. Maruyama accents mutuality of the causal feedbacks (Ibid. 304). Mutuality, however, is a question about tolerances of symmetry or how much asymmetry the causal mutuality tolerates. Therefore, it would be valuable to figure out thresholds where amplification changes into counteraction or vice versa, and when amplification or counteraction turns into a mixed process. It might clear up action in the mind. The essential result of the current research, however, is the causal flip-flop where after the inputs the process causes the process, and back again to the modified absorption before the outputs. The back and forth causation may be characteristic of the mind but it remains to be seen.

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