

On Changing Categories

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Although it is not still clear if the time passing is a result of world changing, or reversely, the world changing is a result of the time passing, I think it is very clear the changing in the external and internal world of the subject is real. The paper examines, from a logical point of view, the abstract categories of changing, no matter the field involved. More precise, it provides the complete list (in the author's opinion) of distinctive types of changing, classified in two fundamental types: a) changing of first order, and b) changing of the second order. Based on this classification, certain analyses and assessments are delivered, regarding the logical features of them.

Keywords: changing, logic, category

JEL classification: B41, F60, O35

1. Introduction

Although it is not still clear if the time passing is a result of world changing, or reversely, the world changing is a result of the time passing, I think is very clear the changing in the external and internal world of the subject is real. This reality is assured by our sensitive natural tools, on the one hand, and by our rational models about the world (of course, this is valid only after and based on the Popper-ian falsification test) (Popper, 1981), on the other hand. The problem I raise is: which is the complete list (the completeness logically implies, in my opinion, the minimumness - Occam's razor, by avoiding the redundancy.) of distinctive types of changing. According to this purpose, other two issues are arising: a) what criterion (or criteria) could classify the changing in the most general sense possible? b) which are the necessary conceptual ingredients to get the evocated purpose?

In the next pages, I will propose a point of view concerning a map of changing. I will begin with the issue of the identity.

2. Identity and Non-Identity

No matter if the time is a cause or an effect of the changing. It is sufficient to establish a valid benchmark that could indicate if a changing occurs or not. This benchmark is the identity. By identity I understand a property of something (i.e. of a general entity, be it of substantial, informational, energy, or formal appearance) to overlap on itself without rests of any „generation” of the entity self-compared. As „mirror” that intermediates such an overlapping I think the most adequate is the clock time, i.e. a selected clock time moment (I consider the clock time but not the proper – internal - time of the entities concerned (the clock time is a

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Newton-ian time, equal with itself, independent from the entity measured, absolute and exogenous). The proper time will be used in a future intervention in the matter) (Figure 1 below). So, the identity of an entity with itself is maintained as long as the overlapping between successive „generations” of the entity gives no „rests”. By „generation” of the entity I understand any clock time-dated hypostasis of the entity (this means the replication or the reproduction of an entity are only particular cases, i.e. species, of the concept „generation”).

How could we do the overlapping between successive generations of an entity to prove the identity (or the non-identity) with itself? I think we need two things:

- a state vector: a clock time-indexed vector, which describes the definition parameters, of any kind (by definition parameters I understand the list of sufficient predicates of the entity concerned - the sufficient predicates are those predicates that, once concomitantly verified, ensure the existence of the entity in case; any sufficient predicates are also necessary predicates, but the inversely is not true), of the entity;
- a memory: a clock time-frozen state vector, i.e. a state vector that doesn't change along the clock time (this is what I called above the benchmark);
- an overlapping procedure (or protocol): a procedure - available for the cognitive subject(it is also presumed the cognitive subject is competent in using the procedure in case , for example, the procedure is not of Divine nature, but of empirical one) - to compare the state vector with the memory (i.e. the clock time-indexed state vector with the clock time-frozen state vector).

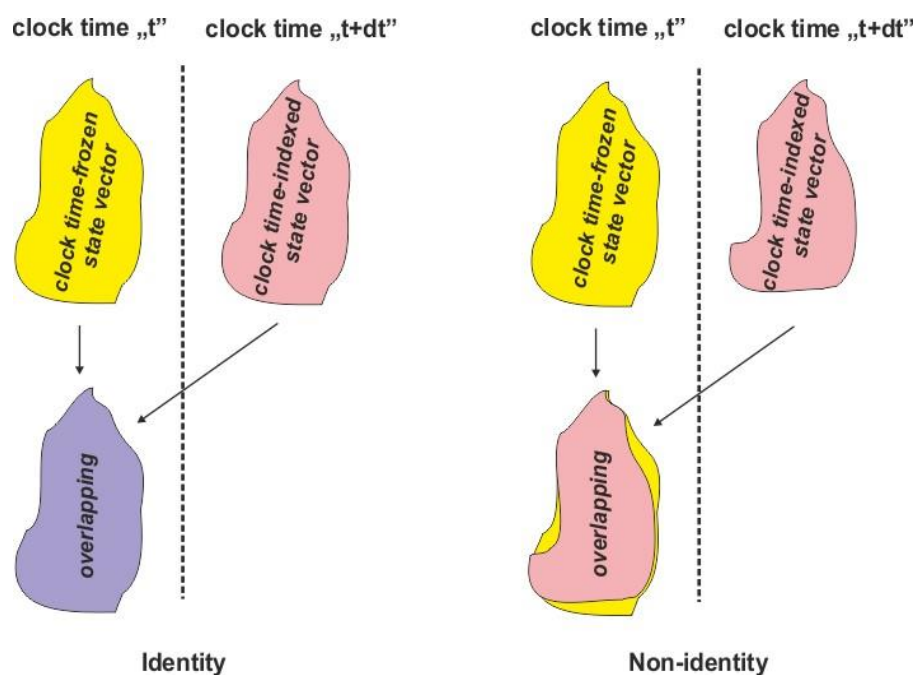


Figure 1. The identity and non-identity by overlapping in the time „mirror”

Source: author

3. Homogeneity vs. Heterogeneity

The most general and unspecified way to discuss the changing starting from the identity is to introduce the concept of heterogeneization. By heterogeneization I understand the emergence (for now, it doesn't matter the nature of the heterogeneization causality, or the fact, more primarily, of the causal or non-causal origine of the heterogeneization itself.) of a new attribute (or predicate) inside the membrane of some entity. Of course, logically, it isn't necessary to establish a membrane, so the heterogeneization could arise also in an undifferentiated initial Universe (that is homogeneous from all the possible criteria). Some questions must here be examined:

- a. Arising of heterogeneization is conditioned by the presence (existence) of a cognitive subject which to „observe” this heterogeneization inside the Universe?
- b. How could be logically described a heterogeneization arising?
- c. There are heterogeneization degrees? What is their relevance for the present discussion?
- d. How is it possible the initial Universe be considered absolutely homogeneous, although we know the final Universe will be, in fact, absolutely homogeneous?

(a) Here we have to decide if the arising of a new attribute is or isn't conditioned by the cognitive subject (by cognitive subject I understand an observer, i.e. a device – physical or non-physical (at limits, such a device could be represented by the Divinity, but in such a hypothesis it must be established if the Divinity is or isn't part of the Universe concerned. If It is part of the Universe but is indiscernible from it, we get again the initial problem, without the distinction between the Divine and non-Divine cognitive subject). If it is part of the Universe but is discernible from it, then we must consider only non-Divine cognitive subjects. If It isn't part of the Universe, then It hasn't any relevance for our discussion (this in the case, of course, of the Deism; in the case of Theism, some difficulties could appear.) – capable to record in some way, the new attribute emergence). If the answer to the question is positive, then all happened in the Universe before the cognitive subject arising isn't of the heterogeneization nature (otherwise, if we accept the concept of heterogeneization as a primary concept in describing a process - the process is a logical negation of a state - then in the absence of the heterogeneization there is no process, but only state, for example, the state of thermic death of the Universe, as a consequence of the second law of thermodynamics; this state doesn't imply anymore a heterogeneization) . Of course, we could accept the subject existing from the beginning, but this hypothesis generates a contradiction: if we can identify a subject as discernible from the rest of the Universe, this implies the subject is the result of a heterogeneization (see also the heterogeneization emergence issue in the works of the Romanian logician and philosopher Stephane Lupasco (Lupasco, 1982)) , so the heterogeneization doesn't imply the subject. However, I „enacted” before I'll consider the heterogeneization as a primary category. This means we cannot condition the heterogeneization existence on the cognitive subject existence, but we must accept the heterogeneization existence independently from some recording device (could we assert here an ontological criterion for the heterogeneization by saying that the heterogeneization existed if it has been assimilated by the entity within which it has emerged? By „assimilation” of heterogeneization I understand non-annulment of it (NB: non-annulment doesn't mean irreversibility – however, an infinite period of time could assure the equivalence between the non-annulment and the irreversibility, because in an infinite period of time any potential will become actual, in the Aristotle-ian words. As it is known, the infinity of time can be avoided if it is accepted the infinity of space: the hypothesis of the infinite number of worlds, see also the David Lewis's works in the plurality of worlds matter: in other words, in an infinite number of worlds, all is possible to happen will happen in one of the worlds, even in this moment of our discussion) (Lewis, 2006).

(b) Here we need to decide about the threshold where a heterogeneity (i.e. a new attribute) emerged. I think the question cannot be solved without calling the concept of identity. What must be understood by identity? More exactly, what sufficient predicates (logically, not empirically) are needed in order that an entity (for example, a system) be considered identical with itself? Firstly, we must note the qualification of a system identity doesn't imply an observer, as established above. So, the conservation of identity could occur even in the absence of a subject which has to verify the logical conditions of this conservation. This result doesn't exclude the fact that for the heterogeneization occurrence before the subject arising, the assessment of identity could be performed only post-factum, while for the heterogeneization occurrence after the subject arising (we could call the moment of the cognitive subject arising as the self- awareness moment of the world - Universe), the assessment of identity can be performed also ante-factum (either normative, or predictive). Secondly, we must note the operation of comparing and deciding on the identity conservation needs at least two moments of time in the system evolution (so, it is necessary for a process - however, it is possible do not require a process, but only a pair of successive events, in an event the causality doesn't matter, while in a process it does). The two moments of time will be ordered by the time arrow, that is, the moment of time when the identity assessment is performed must be associated to greater global entropy than the entropy associated to the benchmark moment of time. If one notes the two moments of time with t_r (the moment of reference, or the benchmark), respectively t_e (the moment of assessment), then the identity assessment of a system must verify the strictly inequality $S_g(t_e) > S_g(t_r)$, where $S_g(x)$ is a measure of the global entropy (we must refer the global entropy but not the entropy of the assessed system because in the case of the dissipative systems, i.e. the logically vivid systems, the entropy inside the system membrane could decrease, paid by a faster increasing of the environment entropy, so at the level of logically pair „system – environment” we always record an increasing of the entropy (according to the second law of the thermodynamics.) at the moment „x”. Thirdly, it is necessary to establish what must commonly contain the two „versions” of the analyzed system, so the cognitive subject can decide on the identity conservation. In other words, a list of contingent (i.e. non-necessary and possible) attributes is needed in order to be verified in the two „versions”(to be noted that such a list doesn't contains any of sufficiency or necessary predicates of a system or logically living systems, because the analysis is focused not on a generic system, but on a particular (empirical) system.). So, to decide on the identity conservation implies to compare two lists of contingent attributes between two moments of time

related to a given system. From a logical point of view, any non-coincidence between the two lists of attributes associated to the two moments of time (t_r , respectively t_e), signifies the emergence of a heterogeneization. Of course, there are two cases of such a non-coincidence: a) appearing: an attribute (the case of more attributes is an „application” of the case of one attribute) exists in the moment t_e , but it doesn't exist at the moment t_r ; b) disappearing: an attribute exists at the moment t_r , but it doesn't exist at the moment t_e . Every case signifies the emergence of a heterogeneity. If is noted with $E(t_e^x)$ the emergence of a heterogeneity „x” at the moment t_e , with $A(t_e^x)$ the appearing of an attribute „x” at the moment t_e , with $D(t_e^x)$ the disappearing of an attribute „x” at the moment t_e , then we can write: $E(t_e^x) = A(t_e^x) \vee D(t_e^x)$. (to be observed that, logically, the simultaneously appearing and disappearing (or, equivalently, the simultaneously disappearing and re-appearing) of the same attribute at the moment t_e related to the moment t_r maintains the contingent identity of the analysed system. But, what is the signification of such a case? In my opinion, philosophically, we have here a non-actualized potentiality. This result is extremely important from a theoretical point of view because it „says” that the validation of the system identity at the moment t_e doesn't reject the possibility to lose this identity at a moment t_a , where $S_g(t_a) > S_g(t_e)$. This conclusion thus assures against a static vision on the systems and is, otherwise, consistent with the time arrow indicated by the global entropy increasing. However, we cannot say anything about the moments of time when there are not observations: it is possible a system loses its identity within the un-observed period of time and regain it at the moment of observation. So, again, establishing of the system identity is an empirical question.). So,

$$\bar{E}(t_e^x) \equiv I(t_e^x) = [\bar{A}(t_e^x) \wedge \bar{D}(t_e^x)] \vee [A(t_e^x) \wedge D(t_e^x)]$$

Taking into consideration the commutativity of the „ \wedge ” operation, it isn't necessary to add the third logical expression: „ $\vee [D(t_e^x) \wedge A(t_e^x)]$ ” - \bar{E} signifies the non-heterogeneization, and I signifies the identity conservation.

(c) Based on the above results, I believe we can accept heterogeneization degrees. Of course, by accepting heterogeneization degrees, we must also accept, logically, identity degrees, and this requires a discussion about the signification thresholds issue. The simplest and most intuitive way to introduce the heterogeneization degrees is to accept we can record more appearing/disappearing of attributes between the moments of time t_e and t_r (where $t_e > t_r$). Indeed, it seems clear that within $[t_r, t_e]$ could appear/disappear „k” ($k > 1$) attributes (I want to insist on the fact that, from the perspective of the system identity, the appearing and the disappearing of an attribute are equivalent from the logical point of view. In other words, the epistemic subject has only to establish the non-coincidence between the two lists of attributes, no matter the causes of the non-coincidence. So, the appearing and the disappearing of the attributes are two indiscernible concepts, from the perspective involved in our discussion) of the analyzed system. As the appearing/disappearing of a single attribute is sufficient to record a losing of the system identity, we could ask on the theoretical utility of the discussion about the appearing/disappearing of „k” attributes. The utility is related to the fact that the appearing/disappearing of more than one attributes signifies the emergence of a heterogeneization of a superior quantitative degree. The hypothesis of the heterogeneization degrees will be useful when we want to discuss about some macroscopic concepts of the heterogeneization.

(d) The possibility of an initial homogeneous Universe is one of the major logical challenges of this part of paper. The debate about the homogeneous character (in the most general sense) of the Universe is pegged along the concept of entropy. The entropy is viewed, in this context, as a measure of the structuring degree of the Universe, that is, of its degree of organizing. The issue of measuring the degree of structuring and organizing is a difficult one. From a qualitative point of view, a delivered suggestion is to use the identifiable quantity of information as proxy: the higher such an indicator, the higher the structuring/organizing degree. The difficulty consists in the fact that between the novelty and the quantity of information there is a directly proportionality relationship (there is no information if there is no novelty. If somebody says me I will die at a moment, I do not qualify that as being information because I already know that. Generally, there is no information if the referent, i.e. the denoted, of any kind: an object, a process or an event, is logically and ontologically necessary, of course, in the accepted hypothesis in which we can acquire the knowledge on the necessity).

In addition, the novelty is a function of the structuring degree, so we can accept that increasing of the global entropy in the Universe makes the Universe more homogeneous, so less structured. But, a less structuring will generate less information. Since the entropy increasing is irreversible, the Universe's decreasing of the structuring degree is also irreversible. So, we must accept the initial Universe (for example, at the big bang moment of time) had a maximum degree of structuring, capable to generate a maximum of

novelty, therefore of information. In other words, we face two kinds of homogeneities: the first given by the maximum degree of structuring (the initial Universe), the second given by the minimum degree of structuring (the final Universe). Except the case we accept an oscillating Universe (i.e. a perpetual reversibility of the global entropy, or, equivalently, a reversibility of the time arrow), we must consider the initial Universe as a homogeneous one, but at a minimum level of the global entropy. On the other hand, by accepting this hypothesis, how could we make plausible the arising of the first heterogeneity in the initial state of the homogeneity? If the initial state of the homogeneity requires a maximum degree of the Universe structuring, as we said before, then no novelty is possible, so no information. Indeed, this logical conclusion is even the key of the problem: the possibility of the novelty is arising simultaneously with the first heterogeneization, which expresses a first reducing of the initial structuring degree of the Universe. But this means that, less the structuring degree becomes (by appearing of heterogeneities, so by increasing of the global entropy), more novelty (i.e. more potential information) becomes available for the cognitive subject. Or, as I showed before, the necessary irreversibility of the global entropy reduces till annihilation (at the maximum level of the global entropy) the novelty, i.e. the information. We arrived at a contradiction. The way out is to introduce the concept of the dissipative systems. At a certain threshold of the global entropy increasing (it is not yet clear - at this moment of research - if this qualitative jump caused by a quantitative accumulation of the entropy at the global level is a necessary process or a contingent one.), the Universe generates the dissipative systems (a dissipative system is a system capable to be in an equilibrium, i.e. in a long term stable - state that is not identical with its finality state. For the non-dissipative systems, the equilibrium state is identical with the finality state, of course, in the case of human being dissipative systems, the finality must be replaced by the purpose). Thereby, while at the global level the entropy increases (and, consequently, the degree of structuring, of novelty, and of available information decreases), at the local level (the dissipative systems level) we have a reversal process: the degree of structuring, of novelty, and of available information increases. Probably, after achieving a critical level of the global entropy, no one of the dissipative systems will be able to reduce or even maintain the intra-membranatical entropy, that moment being an inflexion point of the Universe evolution (i.e. an entropic collapse point), beyond which an acceleration of the entropy will arise (I don't develop here the complicated dynamics of a Universe „endowed” with dissipative systems, but I think the idea of inflexion points in the entropic process is interesting enough to be resumed in the future.).

4. What Kinds of Identity?

To move forward, an abstract typology of the identity is needed. To this end, I will remember the sufficiency predicates of a system:

- a. a membrane (M) (in my opinion, there are only three types of membranes: 1) physical membrane; 2) institutional membrane; 3) logical (i.e. cognitive) membrane. For example: a human being has a physical membrane, an economic organization has an institutional membrane, while a concept has a logical (i.e. cognitive) membrane. Of course, an empiric system could be characterized, concomitantly, by more than one type of the mentioned membranes.): that assures the discernibility between the system and its environment;
- b. a set of components (E) (no matter their nature.): these components must be indiscernible among them at least for one attribute (parameter, characteristic);
- c. a set of connections among the components (F): these connections generate the functionality of the system;
- d. a set of connections among the components and the environment (B): these connections generate the behaviour of the system.

Based on such a definition of a generic system, I will introduce the following four fundamental types of the identity:

1. (α) individual identity: conservation (conservation is logically equivalent with non-alteration.) of the M ($M_{t_r}^i \approx M_{t_e}^i$) - the logical constant „ \approx ” means „identical”, i.e. equivalent from the point of view of membranes overlapping, in this case.
2. (β) species identity: conservation of the B ($B_{t_r}^i \approx B_{t_e}^i$)
3. (γ) genus identity: conservation of the F ($F_{t_r}^i \approx F_{t_e}^i$)
4. (δ) formal identity: conservation of the E ($E_{t_r}^i \approx E_{t_e}^i$)

By combining all the possibilities among the four „atomic” identities, other 11 cases of identities can be derived, so we have in total 15 distinct cases of identities. The 11 „molecular” cases of identities are the followings:

- $(\alpha\beta) (M_{t_r}^i \wedge B_{t_r}^i) \bowtie (M_{t_e}^i \wedge B_{t_e}^i) \leftrightarrow (M_{t_r}^i \bowtie M_{t_e}^i) \wedge (B_{t_r}^i \bowtie B_{t_e}^i)$ - here we have the rule „the identity of conjunctions is equivalent with the conjunction of identities”.
- $(\alpha\gamma) (M_{t_r}^i \wedge F_{t_r}^i) \bowtie (M_{t_e}^i \wedge F_{t_e}^i) \leftrightarrow (M_{t_r}^i \bowtie M_{t_e}^i) \wedge (F_{t_r}^i \bowtie F_{t_e}^i)$
- $(\alpha\delta) (M_{t_r}^i \wedge E_{t_r}^i) \bowtie (M_{t_e}^i \wedge E_{t_e}^i) \leftrightarrow (M_{t_r}^i \bowtie M_{t_e}^i) \wedge (E_{t_r}^i \bowtie E_{t_e}^i)$
- $(\beta\gamma) (B_{t_r}^i \wedge F_{t_r}^i) \bowtie (B_{t_e}^i \wedge F_{t_e}^i) \leftrightarrow (B_{t_r}^i \bowtie B_{t_e}^i) \wedge (F_{t_r}^i \bowtie F_{t_e}^i)$
- $(\beta\delta) (B_{t_r}^i \wedge E_{t_r}^i) \bowtie (B_{t_e}^i \wedge E_{t_e}^i) \leftrightarrow (B_{t_r}^i \bowtie B_{t_e}^i) \wedge (E_{t_r}^i \bowtie E_{t_e}^i)$
- $(\gamma\delta) (F_{t_r}^i \wedge E_{t_r}^i) \bowtie (F_{t_e}^i \wedge E_{t_e}^i) \leftrightarrow (F_{t_r}^i \bowtie F_{t_e}^i) \wedge (E_{t_r}^i \bowtie E_{t_e}^i)$
- $(\alpha\beta\gamma) (M_{t_r}^i \wedge B_{t_r}^i \wedge F_{t_r}^i) \bowtie (M_{t_e}^i \wedge B_{t_e}^i \wedge F_{t_e}^i) \leftrightarrow (M_{t_r}^i \bowtie M_{t_e}^i) \wedge (B_{t_r}^i \bowtie B_{t_e}^i) \wedge (F_{t_r}^i \bowtie F_{t_e}^i)$
- $(\alpha\beta\delta) (M_{t_r}^i \wedge B_{t_r}^i \wedge E_{t_r}^i) \bowtie (M_{t_e}^i \wedge B_{t_e}^i \wedge E_{t_e}^i) \leftrightarrow (M_{t_r}^i \bowtie M_{t_e}^i) \wedge (B_{t_r}^i \bowtie B_{t_e}^i) \wedge (E_{t_r}^i \bowtie E_{t_e}^i)$
- $(\beta\gamma\delta) (B_{t_r}^i \wedge F_{t_r}^i \wedge E_{t_r}^i) \bowtie (B_{t_e}^i \wedge F_{t_e}^i \wedge E_{t_e}^i) \leftrightarrow (B_{t_r}^i \bowtie B_{t_e}^i) \wedge (F_{t_r}^i \bowtie F_{t_e}^i) \wedge (E_{t_r}^i \bowtie E_{t_e}^i)$
- $(\alpha\gamma\delta) (M_{t_r}^i \wedge F_{t_r}^i \wedge E_{t_r}^i) \bowtie (M_{t_e}^i \wedge F_{t_e}^i \wedge E_{t_e}^i) \leftrightarrow (M_{t_r}^i \bowtie M_{t_e}^i) \wedge (F_{t_r}^i \bowtie F_{t_e}^i) \wedge (E_{t_r}^i \bowtie E_{t_e}^i)$
- $(\alpha\beta\gamma\delta) (M_{t_r}^i \wedge B_{t_r}^i \wedge F_{t_r}^i \wedge E_{t_r}^i) \bowtie (M_{t_e}^i \wedge B_{t_e}^i \wedge F_{t_e}^i \wedge E_{t_e}^i) \leftrightarrow (M_{t_r}^i \bowtie M_{t_e}^i) \wedge (B_{t_r}^i \bowtie B_{t_e}^i) \wedge (F_{t_r}^i \bowtie F_{t_e}^i) \wedge (E_{t_r}^i \bowtie E_{t_e}^i)$

We can observe that the δ -identity is the most independent kind of identity (it depends only on its internal logics and the environment pressure). It is followed by the α -identity, that is depending on the δ -identity, the environment and its internal logic (for the moment, no matter the causality of identity conservation or of the environmental pressure). The β -identity, and the γ -identity are necessary effects of the δ -identity (as it is well known from the system theory, the structure generates the function (i.e. the functionality and the behaviour)). However, it cannot be said we have only two kinds of the identity, α -identity, and β -identity (Figure 2).

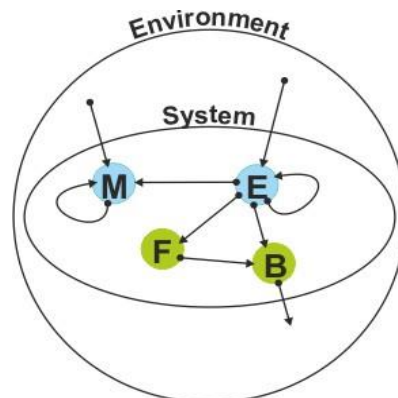


Figure 2. The phenomenology of identity
Source: author

5. From Identity to Changing

What is changing, in the most general sense of the concept? I think the changing is simply an alteration (that is, non-conservation) of the identity. Based on this definition, it seems there are six distinct classes of changing (it is used, sometimes, the denomination becoming to denote the changing. I think the denomination becoming implies some connotations concerning a cultural subject - subject endowed with purposes, values etc.- what means it is too restrictive denomination for an alteration of the identity), as follows:

• (C1) *modification*: alteration of the quantitative identity. The quantitative identity can be of two kinds:

➤(C1a) *movement*: is the kind of modification that alters the spatial identity (for example, the coordinates of the three dimensional space we currently experience in our Universe)

➤(C1b) *growing*: is the kind of modification that alters the size identity (it is very important to mention that the movement type of modification can generate effects on the growing type by simply space agglomeration (accumulation). For example, stars arising are, initially, an effect of pure movement and agglomeration of primordial matter. In the Figure 68 such a connection from movement to growing is included)

➤(C2) *evolution*: alteration of the qualitative identity (since the quality of a system is an effect of its structure, we can say also the evolution means the alteration of the structural identity. Because the causal relationship between the structure and the function, we can say also the evolution means the alteration of the system functioning. In order to assure a certain symmetry of the terminology, I preferred call this class of changing as alteration of the qualitative identity)

➤(C3) *development*: evolution generated by growing

➤(C4) *transformation*: evolution generated by purposes (goals)

➤(C5) *progress*: evolution generated by values.

Some observations are arising from this taxonomy of changing:

a) the modification is appearing to the observer either as movement, or growing, that is the movement and growing are species of the genus modification

b) the modification species are of quantitative alteration of the identity

C1, C2, and C3 are changings of, let's say, general possibility, that is they are possible no matter what kind of subject is involved - non-cultural subject or cultural subject - non-cultural subject is a subject that does not have consciousness (this means it can have perceptions, but not representations – a representation does not require an in actual object of perception), while a cultural subject is a subject that has consciousness (this means it can have both perceptions and representations). NB: Do not confuse between representation capability and the simple memory (the non-cultural subjects could be endowed with memory), while C4 and C5 are changings of local possibility; we can also say the C1, C2, and C3 are changings of order 1, while C4 and C5 are changings of order 2 (see figure 3)

d) since are based on the evolution, C2, C3, C4, and C5 are species of changing of the qualitative alteration of the identity

e) what about clone? In my opinion, a clone is simply a growing type of changing, but seen not at the individual level, but at the species level; in other words, the cloning leads to a quantitative alteration (more precise, to a size alteration) of the species identity. Indeed, the cloning of the individuals will alter the B predicate of the system (i.e. the identity).

Synoptically, the changing conceptual family could be represented as in the Figure 3:

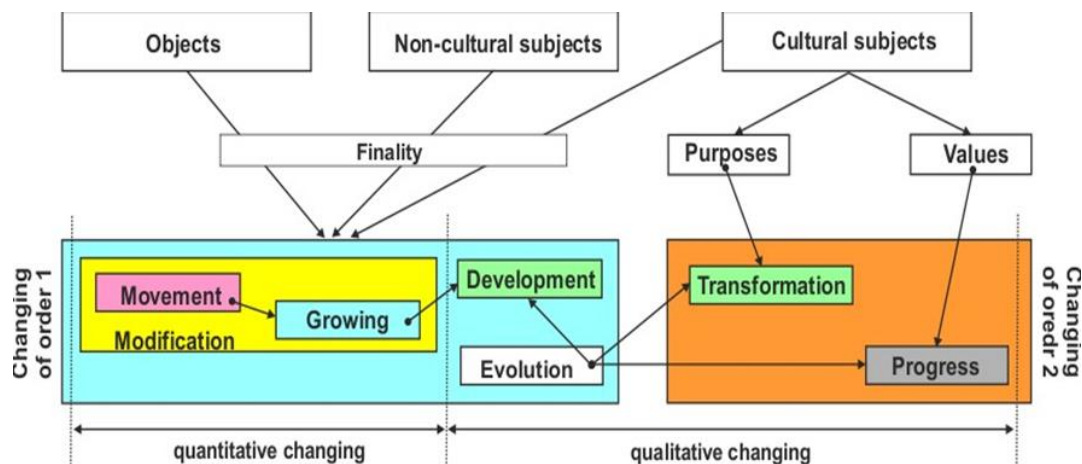


Figure 3. The phenomenology of changing

Source: author

6. Identity and Changing

It could be of theoretical utility (at least) to build the causal relationships between the identity and the changing. In the Table 1 we deliver such a relationships map:

Table 1. The basic relationships between identity and changing

	Alteration of the identity					
	Quantitatively		Qualitatively			
	C1a	C1b	C2	C3	C4	C5
$\alpha(M)$						
$\beta(B)$						
$\gamma(F)$						
$\delta(E)$						
$\alpha\beta(M\wedge B)$						
$\alpha\gamma(M\wedge F)$						
$\alpha\delta(M\wedge E)$						
$\beta\gamma(B\wedge F)$						
$\beta\delta(B\wedge E)$						
$\gamma\delta(F\wedge E)$						
$\alpha\beta\gamma(M\wedge B\wedge F)$						
$\alpha\beta\delta(M\wedge B\wedge E)$						
$\beta\gamma\delta(B\wedge F\wedge E)$						
$\alpha\gamma\delta(M\wedge F\wedge E)$						
$\alpha\beta\gamma\delta(M\wedge B\wedge F\wedge E)$						

Source: author

So, it seems there are four cases in which no changing is possible: 1) $\alpha\beta$ (simultaneous identity alteration of the membrane and the behaviour); 2) $\alpha\beta\gamma$ (simultaneous identity alteration of the membrane, behaviour, and functioning); 3) $\alpha\beta\delta$ (simultaneous identity alteration of the membrane, behaviour, and structure); 4) $\alpha\beta\gamma\delta$ (simultaneous identity alteration of the membrane, behaviour, functioning, and structure). So, we can write successively (the logical constant „ \bar{x} ” must be read as „non-identity of x”).

$$\begin{aligned}
 C1a \rightarrow & \bar{M}V \bar{\bar{E}}V \bar{\bar{M}}(M\wedge E) \leftrightarrow (M_{t_r}^i \bar{\bar{M}}_{t_e}^i)V(E_{t_r}^i \bar{\bar{E}}_{t_e}^i)V[(M_{t_r}^i \bar{\bar{M}}_{t_e}^i)V(E_{t_r}^i \bar{\bar{E}}_{t_e}^i)] \\
 & \leftrightarrow (M_{t_r}^i \bar{\bar{M}}_{t_e}^i)V(E_{t_r}^i \bar{\bar{E}}_{t_e}^i) \\
 C1b \rightarrow & \bar{M}V \bar{\bar{F}}V \bar{\bar{E}}V \bar{\bar{M}}(M\wedge F)\bar{\bar{V}} \bar{\bar{M}}(M\wedge E)\bar{\bar{V}} \bar{\bar{F}}(F\wedge E)\bar{\bar{V}} \bar{\bar{M}}(M\wedge F\wedge E) \\
 \leftrightarrow & (M_{t_r}^i \bar{\bar{M}}_{t_e}^i)V(F_{t_r}^i \bar{\bar{F}}_{t_e}^i)V(E_{t_r}^i \bar{\bar{E}}_{t_e}^i)V[(M_{t_r}^i \bar{\bar{M}}_{t_e}^i)V(F_{t_r}^i \bar{\bar{F}}_{t_e}^i)]V[(M_{t_r}^i \bar{\bar{M}}_{t_e}^i)V(E_{t_r}^i \bar{\bar{E}}_{t_e}^i)]V[(F_{t_r}^i \bar{\bar{F}}_{t_e}^i)V(E_{t_r}^i \bar{\bar{E}}_{t_e}^i)]V[(M_{t_r}^i \bar{\bar{M}}_{t_e}^i)V(F_{t_r}^i \bar{\bar{F}}_{t_e}^i)] \\
 \leftrightarrow & [(M_{t_r}^i \bar{\bar{M}}_{t_e}^i)V(F_{t_r}^i \bar{\bar{F}}_{t_e}^i)V(E_{t_r}^i \bar{\bar{E}}_{t_e}^i)] \leftrightarrow [(M_{t_r}^i \bar{\bar{M}}_{t_e}^i)V(F_{t_r}^i \bar{\bar{F}}_{t_e}^i)V(E_{t_r}^i \bar{\bar{E}}_{t_e}^i)] \\
 C2 \rightarrow & \bar{B}V\bar{\bar{F}} \bar{\bar{E}}V \bar{\bar{B}}(B\wedge F)\bar{\bar{V}} \bar{\bar{B}}(B\wedge E)\bar{\bar{V}} \bar{\bar{F}}(F\wedge E)\bar{\bar{V}} \bar{\bar{B}}(B\wedge F\wedge E) \leftrightarrow \dots \\
 \leftrightarrow & [(B_{t_r}^i \bar{\bar{B}}_{t_e}^i)V(F_{t_r}^i \bar{\bar{F}}_{t_e}^i)V(E_{t_r}^i \bar{\bar{E}}_{t_e}^i)]
 \end{aligned}$$

Of course, the above simple formal illustrations of the changing are valid only for events (i.e. for appearing/disappearing of something without considering the processes, including their causality). Future developments could introduce the actional subject (in the case of the human being, the actional subject will be named agent) in order to deliver formal expressions of *to do* or *to forbear* logic of changing. Also, the purposes and the values could be introduced in order to get the transformation or the progress classes of changing.

7. Conclusions

The paper had as main objective to identify and construct a complete map of the types of changing in the most general and abstract way. So, it seems there are only six kinds of changing and no more. Related to the subject involving in these changes, there are two categories of changes: a) changes of order I (whose lack the subject); b) changes of order II (which involve the subject). Of the most interested are, of course, the changes of order II, where we have: i) transformation – that is, that evolution induced by the purposes, ii) progress – that is, that evolution induced by values. For Economics, such a typology is of a great signification taking into consideration the confusions between, for example, growth and development are frequently and enthusiastically made almost every day. Based on our proposal, a more rigour and generality are introduced in the economic and social thinking.

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