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Cultural Alienation Through the Lens of Development

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Abstract

Studying cultural alienation and development is important for understanding the meaning and the implications of cultural alienation for development. The problem is to set an integrated framework for apprehending the two notions in terms of coexisting divergent cultures within a same society and development of human societies. As method, to elucidate the coexistence of divergent cultures within a society, the African tradition has been retraced from 4236 BCE to date and compared to the transplanted and enforced capitalist system, regarding the typical socio-economic agents and the rule of wealth concentration. Meanwhile, an analysis framework of culture and development has been set in terms of criteria (or conditions) of development, satisfaction of basic needs, social priorities and the integrity of culture. Then, the learnings of the aforementioned comparison of systems has been addressed within this analysis framework. In addition to its known negative effect on satisfaction, as results, first, cultural alienation traduces into erratic social priorities and needs satisfaction. Second, cultural alienation implies the perversion of the criteria of development and thus the perversion of development. These results are significant because erratic priorities may impede efficiency of resources mobilization and allocation. In addition, solving cultural alienation problem is essential to engage contemporary Black Africa in its appropriate course of development. About solutions to cultural alienation, some of them are approached in light of the aforementioned analytical framework.

Keywords: Cultural conflict; Cultural integrity; Development criteria; Erratic satisfaction; Equations of satisfaction; General History of Africa; Social complexity.

JEL classification: C30 ; C31 ; F54 ; N00 ; O10 ; P0

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1. Introduction

In contemporary Africa, both cultural alienation and development concepts are tied to colonialism consequences. Regarding development, Itagaki (1968) shows that colonialism is a necessary historical factor in the emergence of dual economies and plural societies. Wambari (1973) envisages colonialism as an antecedent to cultural alienation that has widespread perverse consequences on social organization. He considers cultural alienation as the estrangement of indigenous Africans (a whole group) from their own culture and tradition. But, cultural alienation is not the sole approach to address this problem of estrangement. More, the concept of development might be problematic from a similar perspective (Mazama, 2001) to cultural alienation.

Indeed, the afrocentric theory by Molefi Asante proposes the notion of “dislocation” which is the condition of a given group developing a “sense of location [historical, biological and cultural “spaces”]

that is not congruent with its history, culture, and biology” (Mazama, 2005: p. 220). While this definition is more explicit about biology and history than the definition of cultural alienation in the sense of Wambari (1973), the two remain openly reconcilable through the concept of culture. About development, Itagaki (1963) envisages different types of development, while Ziai (2013) points to different culturally grounded notions to their respective milieus to replace the notion of development. This suggests reconsidering the concept of development before using it.

The reconsideration of the notion of development points towards the sociological perspective. Indeed, Philips (1977) suggests interesting in development outside the capitalist perspective for more heuristic possibilities and, thus to focus on social forces that accompany industrialization. In addition, arguing why the concept of development in the sense of capitalism should be abandoned, Ziai (2013) considers development as the process of social change. This is interesting because Wambari (1973) points among other consequences of cultural alienation to be social mal organization around “development” and the powerlessness of African states to decide about resources distribution. This means that cultural alienation and development finds a common point within the sociological perspective. Nevertheless, if development may be reconsidered under the perspective of social change, the approaches in terms of dislocation and cultural alienation might not provide operational descriptions of the contemporary African culture for the development field.

Indeed, the condition of a group being culturally alienated or being dislocated neither means that this group is not living following a culture nor this group is not culturally located. Egunlusi (2017) contemplates the cultural confusion [an “infinitesimal” approach] while Archie (2009) illustrates a case of multipositional or multicultural location [a “discrete” approach], henceforth cultural confusion. This situation makes difficult the real-time localization of the dislocated subjects and requires untangling the confused culture. An interesting illustrative hint in development field is provided by Dia (1996: p. 29) who contemplates a crisis of institutions in Sub-Saharan Africa “mainly due to a structural and functional disconnect, or lack of convergences between, formal institutions that are mostly transplanted from outside and informal institutions that are rooted in African history, tradition and culture and that generally characterize the governance of civil society.” However, this constitutes a postulate that is not farther substantiated in development field; but it is supported further in this study.

The question the paper wants answering is this: how addressing cultural alienation and development within the same analysis framework, given the requirements of, on one hand, the reconsideration of the notion of development under the sociological perspective and, on the other and, the elucidation of the notion of cultural confusion? The objective of the paper is to understand the implications of cultural alienation for development. The investigation is significant since addressing cultural alienation in contemporary Africa allows better understanding and rising awareness of this diffuse problem. The paper intends to rise this awareness particularly in development field. More, studying cultural alienation along with development is relevant for theoretical advancement in the sense of enrichment of the development field analyses. This may allow better considering solutions for the real world problems that cultural alienation implies in terms of development.

The paper structure follows: section 2 is about a literature review, section 3 addresses the methodology, section 4 is about a historical analysis of a failed mix of systems, section 5 provides the framework of analysis of cultural alienation and development, and the last section concludes the investigation.

2. Conceptual literature review

Before talking about cultural alienation, it is important to clarify the notion of culture because there seems not to be a unanimous definition about it (Apte, 1994 cited by Spencer-Oatey, 2012). Discussions on culture particularly rest in anthropology field. Kroeber and Kluckhohn (1952) review 169 definitions of culture, White (1959), and Willhelm and White (1974) discuss a distinction between

a science of culture (“culturology”) and a science of behaviour (psychology). All this may be because culture merges with human (Geertz, 1966) and non-human (Laland and Hoppitt, 2003; Addressi et al., 2008; Schuppli and van Schaik, 2019) natures such that a definition of culture has to deal with all species.

Some suggestions from a psychology perspective are to use the characteristic of culture that interests a study (Jahoda, 1984: p. 141) or even talk about culture without defining it (Jahoda, 2012: p. 300). Some far non-exhaustive but relevant characteristics of culture follow. Li and Fung (2020) highlight three assumptions: (1) culture is lived but often implicitly (culture cannot be isolated as a variable), (2) philosophical origins illuminate cultural core value (culture is not a rootless phenomenon) and (3) cultures differ (culture underlies the group’s identity). In addition, White (1959: pp. 234–235) locates culture within a network (social interactions) of persons (with their concepts, attitudes, beliefs, etc.), material objects (pottery, bowls, axes, machinery, etc.) and their meanings; these locations are designated by “symbolates” which means things and events dependent upon symboling: ideas and attitudes, overt acts, material objects (pp. 233, 239).

Without adding novelty about the concept of culture, this latter may be defined as the way of living. This definition remains consistent with the above preview on the concept. Indeed, living interests all symbolates, living is often implicit, there are philosophical origins to the way of living, etc. One might suggest not to define what is to live in each of the life aspects, and might be right to some extent... Therefore, cultural alienation may be considered as the estrangement of a group from its own way of living. This definition of culture still operational to reconcile the notions of dislocation and cultural alienation. Indeed, a way of living of a group includes the way of developing its sense of biological, historical and way-of-living locations (or the group identity). Nevertheless, this approach on cultural alienation or “cultural dislocation” (henceforth cultural alienation) requires more precisions.

Cultural alienation is addressed in terms of its antecedent, attributes and consequences. The antecedent of cultural alienation are the events that take place before the appearance of the concept, attributes are the inherent values and meanings underlying the concept and, the consequences are the events occurring as a result of the concept (Vo, 2020). Thus, reading through some investigations, colonialism may be considered as an antecedent to the following attributes: cultural conflict (Wambari, 1973), confusing behaviour of ruling elites and lack of loyalty of people to nation-states (Wambari, 1973; Irele, 2011), devaluation of indigenous knowledge (Shizha, 2013), Africans self-devaluation and dual states (Eegunlusi, 2017). Taken together, the diffuse consequences contemplated by these studies follow: powerlessness to decide on resources (re)distributions, lack of national integration, ethnic conflicts, mental alienation, colonized minds in “independent” Africa, crisis of identity, cultural confusion, etc. However, these consequences require a common and transdisciplinary basis such that it may interest the development field.

Under the sociological perspective, all widespread consequences of cultural alienation may end up related to the question of the satisfaction of basic human needs. Indeed, Etzioni (1968: p. 881) refers to a social condition as “... authentic, when the appearance and the underlying structure are both responsive to basic human needs; as alienating, when both the appearances and the structure are unresponsive; and as inauthentic, when the underlying structure is unresponsive but an institutional or symbolic front of responsiveness is maintained.” In addition, Taormina and Gao (2013) argue that people experience low levels of satisfaction due to their distance with their traditional values. Therefore, all aforementioned consequences of cultural alienation in terms of conflicts, crises, cultural confusion, colonized minds in “independent” region, etc. lower the satisfaction of basic needs. This is a working hypothesis. Nevertheless, at this point, the sole orientation provided by the sociological perspective in terms of basic needs does not elucidate the way to approach the notion of development.

In order to reconsider the notion of development in a neutral perspective from any possible cultural type of development, but under a sociological perspective, simple questions may be answered,

thanks to some investigations on the concept of development. (1) What is developing? This is related to the “object” of development. (2) How is it developing? This question is related to a common path/ pattern to any type of development. (3) What or who develops? This is about the agent or other influences to development. (4) What is the motivation or the aim of the agent who develops? The answers follow. Basically, the object of development is the society, indifferently of whether it is a society of people or a society of nations. Indeed, Wallerstein (1984) notes how the object of development shifted from society to the global world. About how societies develop, Turchin et al. (2017) argue on a complexification of social organization mostly explained by population growth.

Basically, the people may be considered as the agent of development; e.g. Peel (1978) considers the people as the subject of concepts and theories of development and mentions the ends (goals) of development that are not common to each venue. Concerning what may influences development, it is about population growth and environmental constraints. Diop (1981: pp. 165 – 171) argues that various type of states result from the combination of different environmental constraints, principally natural environment, security attitude (defensive, offensive, etc.) regarding the neighbour or remote societies, cultural aspects of social hierarchy and ethnic acceptance/ rejection of cultural differences. About the aim of development, the approach in terms of capability (Sen, 1988; 1993; 2003) focuses on the aim through the notions of “being” and “doing” as per the preferences (style of life) of the agents. The motivation behind development may be considered as the improvement of human conditions (Ziai, 2013).

At this step of the investigations, the paper research question has beginnings of the answer. Indeed, cultural alienation and development may be integrated in a framework in terms of satisfaction of human basic needs. However, what this framework is made of and the elucidation of cultural conflict, considered as the crux of the cultural confusion problem, are still in suspense. In addition, about basic need themselves, a psychological approach is indicated instead of basic needs considered in normative context. Indeed, the normative context of basic needs refers to the relation of human being with the environment (organization, institutions, infrastructure, etc.), while the psychological approach considers needs in the context of inner state of being (Pölzler, 2021: pp. 2–6). But it is already known that the environment in the latter sense is culturally defined and cultures differ. Thus the psychological approach is appropriated to neutrally analyse the consequence of cultural confusion for basic needs satisfaction.

Drawing from this review and complementary requirements, the next section addresses the way the paper research question is answered.

3. Methodology

The paper methodology consists in four steps distributed in two stages. The first stage is divided in two independent steps. First step: a simple mathematical model of development is set in terms of satisfaction of basic needs. The Sen’s capability approach, the utility concept and the necessity of social hierarchization for a growing population (Turchin et al., 2017) are compatible with the model to some extent (respectively, appendices 1 and 2). In addition, the model specification may endorse any definition of sector of activities related to any type of development. Second step: a systemic analysis based on the Black Africa experience elucidates, in a historiographical way, the cultural conflict in the coexistence of divergent cultural societal models. In the second stage, third step, the model of development and the explanatory and conceptual learnings from the failed mix of cultures are considered jointly. The fourth step contemplates some solutions to cultural alienation using this unified framework. These four steps are congruent with the Itagaki’s (1968) requirements that a development approach should include past (history), present (theory) and political options (future).

3.1 A mathematical model

The used mathematical model consists in a system of linear equations:

$$b_i = p_1 b_{1i} + p_2 b_{2i} + \dots + p_h b_{hi} + \dots + p_n b_{ni}$$

Where $i=1,2,\dots,m$, the coefficients (b_i and b_{hi}) represent satisfaction levels and the unknowns (p_h) represent priorities regarding meeting needs, or prepotency of basic needs in the sense of Maslow (1943). Each equation of the system or henceforth the equations of satisfaction, represents the decomposition of satisfaction, overall satisfaction or “life satisfaction” (b_i) of people whose principal activity a_i is related to the production of satisfiers for the basic need i . A component of satisfaction (b_{hi}) represents the satisfaction an individual or a group experiences about the need h at the occasion of the realization of the activity a_i . The conditions of solvability of the linear system has been considered in appendix 2 for the following two main cases about representation of satisfaction levels: the case of random real numbers while applying Girko’s (1990) approach and some considerations from Higham (1987; 2008), and the case of deterministic real numbers.

The case of real numbers included the subcase of an infinitely many activities (equations or population) while applying Polya’s (1938) theorem and following Petersen and Thompson (1964), and the subcase of finite (composite) activities. The case of infinitely many activities concerns the congruence of a social complexity approach with the model. The remaining cases of deterministic real numbers and random quantities has been cross-checked with the lessons drawn from the historical analysis that elucidate the cultural conflict. In addition, the conditions of solvability of the satisfaction equations has been considered in terms of conditions to the determination of priorities within a society. These conditions are related to the satisfaction profile (how life satisfaction is composed) and the deterministic or randomness natures of satisfaction. The appendix 1 discusses the design of satisfaction equations.

However, briefly, the equations of satisfaction was designed through the similitude between the idea of population affectation to human activities and the original approach by Ngoie et al. (2019) on a voting decision problem (Mean-Median Compromise Method for Multicriteria Decision problem/ 3MCD). In addition, the equations of satisfaction has been cross-checked with some empirical considerations of Rauschenberger et al. (1980), Wicker et al. (1993), Hagerty (1999), Tay and Diener (2011), and Taormina and Gao (2013) to test the accuracy of the equations of satisfaction to represent social priorities or the prepotency of basic needs in the sense of Maslow (1943). This is discussed in the appendices 3 and 4. Apart from population growth, the dynamics behind development (“what develops?”), is exogenous to the equations of satisfaction.

3.2 The criteria of development

The dynamics elements of development has been envisaged through the notion of criteria of development. This notion is constructed as follows. First, the idea of criteria of population assignment to human activities emerges with its similitude with the criteria of decision in the 3MCD approach (appendix 1). Second, this criteria of population assignment are assimilated to the criteria of development relatively to the aforementioned Diop’s (1981) environmental constraints (what develops). Third, the criteria of development are categorized following an adaptation of the Maslow’s (1943) categories of basic needs considered at a collective [or aggregate] level following the Neher’s (1991: pp. 93–94) recommendations. Therefore, the physiological, safety and security, love and belonging, esteem, and actualization needs at the individual level are respectively commuted into subsistence, predictability, openness, authenticity and sovereignty, and actualization needs at the scale of a human society.

These specified adaptations allowed to define five basic human activities accordingly; a basic activity is thus an activity that produces a satisfier for the related basic need. Therefore, a criterion of development is what generates, shapes and/or influences a basic activity. The criteria of development

has been used as a basis to contemplate the meanings of cultural alienation consequences for development. These criteria may approach various notions such as some principal components of social complexity (Turchin et al., 2017), economic system (Heilbroner, 1999), development economics and protectionism arguments (Lewis, 1954), self-referential approach (Asante, 1998; Mazama, 2001), cultural monitoring system (DiBianca Fasoli, 2020). In addition, the notion of criterion of development is interesting since it envisages the motivation behind development.

The criteria of development has been characterized as primary or secondary. The primary criterion is the criteria that basically generates an activity. A primary criterion for an activity it generates becomes a secondary criterion for other activities and the related outcomes it can influence. For example, the criterion related to subsistence may generate farming and hunting activities, while the criterion related to authenticity or sovereignty will delimitate the hunting and the farming area. The primary criteria are described below. For subsistence, the primary criterion is the existence and the accessibility of resources. The basic activities generated by the subsistence' criterion are devoted to render available and accessible the resources for subsistence; e.g.: child-raising/ basic education, feeding/self-serving or tapping in the natural environment, fishing, hunting, agriculture, healthcare, people security, etc.

For the safety and security, the considered primary criterion is the predictability or the entropy of the living environment (natural environment, symbolates in White's sense, neighbour human societies, etc.). The activities generated by the predictability criteria are devoted to organizing the society (through institutions/ system of basic needs satisfaction: communitarian system, market system, etc.), understanding the living environment (science, spirituality, religion, etc.) and updating/upgrading the way of living. The openness criterion refers to the sufficiency of internal capacities of the society to satisfy its needs. The activities generated by the openness criterion are geared towards exterior exploration (scientists, soldiers, merchants, etc.), exterior exploitation (cooperation, trade, etc.), and foreigners or newcomers management. The differential of capacities across societies confers a certain degree of freedom of the concerned society vis-à-vis the rest of the world.

The conscience of the concerned society towards other societies, recognition, strength and prestige constitute the authenticity and sovereignty criterion. The activities generated by this criterion concern the integrity of the society (its members, capacities, tools, outcomes, etc.) for its self-esteem. These activities may be summarized into the notion of protectionism and the development of the society autonomy. The actualization criterion may be defined as the conscience of a meaning of Existence by the society. The generated activities by this criterion are devoted to finding and applying the society meaning of the Existence in the meaning of the life and further in the meaning of the universe and the Existence. The generated activities are categorized as avant-garde activities whose outcomes characterize and identify the way of living of the society comparatively to others. Some of these aspects of the way of life are retraced through African history.

3.3 *Historiography*

The verification of the failed mix of the indigenous African culture and the colonialist transplanted culture is based on two elements considered jointly: the socio-economic agent model and the institution of wealth concentration with regards to the land ownership, the trade, and the taxes collection. Therefore, the manifestation of cultural conflict is envisaged through the existence of internal contradiction or incompatibility within both the institutions and agent model. It is assumed that the contemporary African model is made from two divergent models emanating from divergent cultures. On the one hand, the well-known economic agent model made of government, private sector, non-profit organization and household, with the capitalist system and, on the other hand, the reminiscent African model made from African traditional traits. The reminiscent African model is rooted in the African past at least as far back as Ancient Egypt (-4236 to -340) followed by Imperial Africa (-341 to 1880) and the colonialist era (1880 to 1935), up to contemporary Africa (after 1935).

The presented descriptions on the socio-economic agent and institutions are neither uniform in time nor space but allow the consideration of a historical pattern of a systemic change. The subdivision of eras is mostly inspired by the corpus General History of Africa (GHA) undertaken by UNESCO (United Nations Educational, Scientific and Cultural Organization) since 1964. It is assumed that the fall of ancient Egypt, a lock to major external influences on Africa, opened considerable changes that spread through time and space. These changes occurred through the aforementioned eras from the North to the South and/or from East to West. Some of them may be summarized as the destructuring, restructuring/ emergence and/or adaptations of African polities due to various migration waves from ancient Egypt towards the rest of Africa (Diop, 1979) and/or within the rest of Africa. See for illustration a timeline of African kingdoms and empires at Ankhonline ¹

4. A Failed mix of systems

The date 4236 before the current era (BCE) is considered the oldest attested year of use of the ancient Egyptian calendar (Diop, 1989: 354–358) while 340 BCE marks the end of the reign of the last native pharaoh of the 30th and last dynasty. More, ancient Egypt is a crystallization of African traditional traits inherited from several millenaries and exempt of significant foreign influences. The expression “Imperial Africa” is preferred to “precolonial Africa” in order not to reference African history periods to colonialism or deportations. This expression, illustrated for example by Omotunde (2018), allows rectifying the historical perspective of what Bohaen (1987a) calls the colonialist school of historiography about Africa, which school suggests that Africans welcomed colonialism for “progress”. To go farther, the interested reader can refer to Bohaen’s (1987b) discussions on the impact and significance of colonialism.

Before addressing the change pattern of institutions and the socio-economic agent model, it is worth describing the philosophical contours at the starting point of the analyses. Following Obenga (1990: pp. 101, 156 – 186) and Menu (2018: pp. 135 – 228), in ancient Egypt, Maat, the universe order, justice and truth was a whole way of life presiding over the pharaoh’s ideology, spirituality, social organization, justice, etc. Pharaoh as one of the hyphens between humans and the remaining world (metaphysical and physical), redistributed wealth to the population through delegation of power to the clergy and the head of government, and had prerogatives on the production assignments. Then this “transposed” philosophy towards the rest of Africa occurred before or somewhat concomitantly with external influences.

Indeed, during Imperial Africa, Islam and Christianity “coexisted” and/or competed with traditional spirituality (El Fasi et al., 1990; Niane et al., 1987; Ogot et al., 1999; Ade. Ajayi et al., 1996), the king privilege was weakened about the monopoly on trade (Diop, 1987b; Cissé, 1988), populations were deported through the Bat or raids (El Fasi et al., 1990; Ogot et al. 1999). During colonialism, Islamisation and Christianisation intensified along with the Europeanization [and/or Arabization] of Africans through education and the teaching of oneself interest (Boahen, 1987a; 1987b). For example, the following two channels were used for black Africans cultural and identity relocation. It is about the “falsification of history” (Diop, 1979: 37–70) to blacks detrimental and the enforced renunciation of the pre-Islamic or traditional past through Islamisation in Africa (Diop, 1987b: 171–172; El Fasi et al., 1990: 136 – 138, 270). But the historical traditional traits survived.

4.1 The socio-economic agent and the land ownership

In ancient Egypt, the socioeconomic agency model rested on large sets: the pharaoh (royal family), the clergy/ temples, the public administration/officials and the family domains (Vercoutter, 1980: p. 765; Obenga, 1990: pp. 449 – 450; Menu 2018: pp. 234, 249–251). During Imperial Africa, drawing

1. Ankhonline (Accessed on 13/04/2022). “7. Tableau synthétique de l’histoire de l’Afrique noire jusqu’au 16ème siècle” [Summary table of the history of black Africa until the 16th century] in *Civilisation Africaines [African Civilizations]* http://ankhonline.com/civilisations_africaines.htm.

from Cissé (1988: pp. 96–97), the prevailing proximate model rested on: (1) nobilities including the ruling elite and master of the soil (Diop, 1987b) or priest of the land (Ogot et al., 1999: pp. 390 – 397), traders' families and clans/tribes of peasants, and (2) castes (Sutton, 1980: p. 619; El Fasi et al., 1990: pp. 127, 807; Niane et al., 1987: p. 159), guilds, etc.

The colonialist domination brought a split in the structure into the urban groups (civil servant, professional and commercial elite and sub-elite, and the urban proletariat) and the rural groups (peasant and rural proletariat) (Boahen, 1987b: p. 853). After 1935, in addition to the colonialist structure, the politicians' class emerged (Boahen, 1987b: p. 863; Mazrui, 1998: pp. 963–964) along with unreligious non-profit organizations.

Considering the economic agent model, all the above could make one think of the progressive atomization of the large sets agents reduced to individualized household agents; which is not the case. The colonialist period laid foundations of the economic agent model that contemporary Africa attempts to implement simultaneously with the survived large sets based agent. More, following African philosophy, the historical relationship of social organization to the land and the contemporary notion of community land suggests the idea of the survival of a large set-based agent.

African philosophy is such that the land belongs to the dead, the living and the unborn (Oshio, 1990: p. 46), and the case of ancient Egypt constitutes a necessity for a material organization (Obenga, 1990: pp. 36, 255, 451; Menu: pp. 2018: 82–96). Thus, in ancient Egypt, the ownership of the land belonged to the pharaoh who delegated the use right to temples and public administration/ officials, who in turn could delegate to families (Obenga, 1990: p. 449; Menu 2018: pp. 229–452). During Imperial Africa, the “master of the soil” (earliest occupant or long-lasting conquerors) attributes the use right of the land to newcomers (Diop, 1987b: p. 149; Cissé, 1988: p. 84; Ogot et al., 1999: pp. 390–397). The social organization was such that the peasants – or nobilities who owned the use right of the land – were organized in kinship or large set based/ functional groups.

During colonialism, there was a generalized cession/ loss of the use right of the land (Boahen, 1987b). In the contemporary world, community and/or indigenous lands within countries are more prominent in Africa than elsewhere. Indeed, the continent exhibits the highest proportions of community land (Alden Wily, 2018: p. 5) while in other areas, reading data from Dubertret and Alden Wily (2015), community and/or indigenous land disappeared. Ultimately, the reconciliation of the socio-economic agent model and the survival of large sets based on kinship, profession or social function suggests that what is commonly called tribalism in contemporary Africa can be partially understood as the survival of conscience of large set organizations coexisting with what Boahen (1987b: 852 – 853) envisages as the colonialist stress on individual merit.

4.2 The rule of wealth concentration

In Africa, the rules of wealth concentration suggests that the chief (pharaoh, king, chiefs of tribes/clans/ elders of families or officials, etc.) is the richest or among the wealthier of the group/ polity despite the obligation of redistribution. Bassong (2013: p. 92) argues that wealth concentration is polarized to the chief to avoid the lust and the disorder that would result from a multipolar and divergent quest for abundance in the same society/ group. This state of affairs manifests overtime at least through the right of the chief over foreign trade and people activities/ production. In ancient Egypt, the pharaoh had the monopoly on trade (Obenga, 1990: p. 457; Warburton, 1997: pp. 234, 309) and collected taxes over crop production through public administration and temples (Obenga, 1990: p. 443; Warburton, 1997: pp. 80, 94, 99).

During Imperial Africa, foreign trade opened to some dignitaries along with the king, the king possessing rights on foreign trade (Cissé, 1988: pp. 50, 97, 104–105; El Fasi et al., 1990: p. 161; Niane et al., 1987: p. 227; Ogot et al., 1999: pp. 219, 437, 634). The king collected taxes over the production of communities or activities (Diop, 1987b: p. 155; Cissé, 1988: pp. 78, 90; Niane et al., 1987: pp. 221, 227, 325–326, 669; Ogot et al., 1990: pp. 592–593) through the royal administration

along with other nobilities who could – as an exception – collect taxes “independently” from the king (Ogot et al., 1999: pp. 49–50, 59) or through a kind of decentralization (pp. 893–894). During colonialism and the loss of sovereignty in almost all African regions, it would not make sense to talk about foreign trade and taxes. In contemporary Africa, foreign trade is generalized down to individuals, compared to previous eras where the activity required large and militarised expeditions.

The historical pattern of systemic change suggests the following plan. It is about a progressive slide/ transfer of the pharaoh’s exclusive privilege of the largest concentration of wealth in ancient Egypt to the kings, masters of the soil, and other nobilities during Imperial Africa. Then this transfer reached the lambda individual in contemporary Africa, while the whole way of life shifted from the traditional way (Maat system) to its coexistence with Islam or Christianity and attempt at market system generalization. Colonialism accelerated and enforced the trend through the teaching of the individual struggle for one’s interest for actually serving the metropole and/or the colonialist settlers.

In the context of motivation based on one’s own best monetary advantage in contemporary Africa, the inherited and reminiscent pharaoh/ nobilities’ privilege over wealth/resources transferred to the political elites in the way of “privatisation of the state” (Mazrui, 1998: p. 967). This privilege also transferred to individuals and manifests as one among primary ways of enrichment, while the requirements of a capitalist system (industrialization and related skills, etc.) did not develop (pp. 965–966). Consequently, the attitude of persons acting in one or another socio-economic agents categories (government/ officials/ politicians, profit and non-profit organisations or micro-business, and household) toward public resources (taxes due, public treasure, public goods or services) is partly to find in the chief privilege on enrichment.

4.3 Partial conclusion

In the context of cultural conflict, various concepts may have divergent meanings depending on which culture is used as the point of view reference. The reminiscence of the African agency model in terms of large sets coexisting with the “household” agent (or atomized large set) suggests a divergence of the resulting contemporary agency model. The rule of “household” mobilization or recruitment is marred with a problem that could be named tribalism from a formal transplanted institution’s perspective while it would be a normal situation under the informal reminiscent indigenous perspective. In addition, the reconciliation of the right of the chief idea in the informal perspective and the institutional transplanted rules suggests the divergence of the economic system. Indeed, from an institutional perspective, when it is not about opportunistic behaviour due to a lack of loyalty to the State (Boahen, 1987b: p. 843), greed or behaviour of survival, the overt act generated by this divergence could sometimes take the names of resources diversion, corruption or fiscal incivility.

The divergence of reference cultures from which the behaviour is based suggests a discomfort within social organization. This discomfort is not only about the decreased level of satisfaction due to alienation² or the distance from traditional values³. In addition, the lack of comfort may be due to the unpredictability of people behaviour in a society plagued by cultural alienation. As result, unpredictable levels of satisfaction are possible due to unpredictable behaviours. As it happens, it is not predictable when a civil servant will apply the reminiscent idea about the right of the chief over resources or the preference for kinship in recruitment instead of other rules. Thus, the expected needs’ satisfaction corresponding to the concerned (public) goods/ services provision would be marred with discomfort. Indeed, it is not only a matter of the existence, accessibility or level of provision, but also about the provision’ predictability characterizing the existence or the accessibility of the concerned (public) services/ goods.

The explanatory and conceptual learnings from these analyses are discussed below.

2. Etzioni (1968: op. cit)

3. Taormina and Gao, op. cit

5. The Analysis Framework

At this point of the investigations, in addition to the satisfaction equations and the criteria of development, the analysis framework that emerges requires the notions of erratic satisfaction and cultural integrity. All these notions are discussed and/or applied below.

5.1 Erratic satisfaction

The erratic satisfaction or random-by-nature satisfaction may be defined as a satisfaction state plagued with unpredictability of its level for an applicant with reduced adaptability in comparison to the complexified behaviour of an advantaged applier exposed to a realized or a potential observer. From the informal or the formal perspective, the application of a rule by an agent (the applier) results in an outcome in terms of level(s) of satisfaction for another agent (the applicant). The possibility of recourse to more than one reference set of divergent rules adds up to the possibilities for the applier choices and the complexity of the choice process. As it happens, it is not only about a dichotomy between either informal rules or not, either formal rule or not, but about a choice between informal rules, formal rule, survival behaviour, opportunism or greed. Consequently, many satisfaction levels are possible for the applicant in the same circumstance.

The problem is to find a law about how the rules applier chooses which rule to apply. Following Chabal and Dalloz (2006: pp. 171–222), it depends on the context. However, the consideration of the context suggests the existence of an observer, which can be realized during an experiment and/or in everyday life or potential (e.g. the one who would access official records such as an auditor). Following Aerts and Aerts (1995), the consideration of the observer in psychological studies suggests the behaviour of the observed agent rests somewhere between the pure quantum statistic and classical (probabilistic) statistic when the possibilities of choice increase (to at least three) and when the choices become unknown a priori. This points to the responsiveness of the applicant to the behaviour of the rules applier.

Indeed, the notion of erratic satisfaction does not imply that the applicant is passive to the unpredictable behaviour of the agent applier. As it happens, the above consideration of an observer does not suggest that the applicant is unable to adapt to the non-deterministic behaviour of the applier nor does the applicant has necessarily no choice. Thus, for the erratic satisfaction background to hold it is needed another factor, let be the advantage of the applier (e.g.: authority level, information, networks, etc.), to shrink the applicant possibility of adaptation. In these circumstances, to consider satisfaction as probabilistic by nature in cultural alienation context is a compromise between reduced possibilities of adaptation for the applicant and the unpredictable behaviour of the applier.

The applicant's possibilities of adaptation here are not to be assimilated to the notion of consumer preferences among possibilities of consumption. Qadir (1978) argues that the consumer preferences about commodities reveal when the requirements for commodities are inquired into but not a priori, this suggesting a quantum approach of consumer preferences. Nevertheless, it is suggested a deterministic approach to the realization of the consumer preference once this later is known (p. 125). This is congruent with the present reasoning since it is interested in the realization of the applicant adaptability. In addition, the adaptability of the applicant is critical to the satisfaction predictability.

Indeed, the satisfaction randomness-by-nature is considered as a negative function of the applicant adaptability to the applier behaviour, this latter being represented by a law falling between classical and quantum statistic or even an unknown. Consider that the certainty level of satisfaction occurrence increases from a quantum statistic to a probabilistic statistic and then up to a deterministic phenomenon. Therefore, the satisfaction the applicant experiences might be observable following a deterministic way, a probabilistic statistic or, respectively a quantum statistic when the applicant adaptability is close to its maximum, its medium or respectively its lowest level. In addition, a perfect or almost perfect applicant adaptability might explain the case of deterministic satisfaction or negligible randomness despite the context of cultural alienation... On the other hand, the erratic satisfaction might elucidate

some unexplained phenomenon. Indeed, the experiment results reported by Brock-Utne (2007) can be further interpreted using this notion.

The erratic state of satisfaction under cultural alienation may explain why, starting from the sole use of an indigenous language, the variance of student performances (satisfaction) on an easy examination increased with the introduction of an unfamiliar/ colonialist language to be used jointly with the indigenous language, and increased further with the withdrawal of the indigenous language to make way for the only colonialist language. In this experiment, the student's performances declined while the performance variance increased with the distance of the language of instruction from the indigenous language. All the ingredients to simulate the randomness-by-nature of satisfaction in this context are present: the applicants (students), the applier (teachers, researchers) with the related advantage (teacher authority), the students bending (low adaptability) to the three modes (rules) of language usage, etc. Finally, in a more comprehensive context, the consequence of erratic satisfaction levels may be random social priorities, given the diffuse nature of cultural alienation.

Indeed, assuming that a random (probabilistic) variable represents satisfaction level in the case of cultural conflict implies that random coefficients make the linear system of the satisfaction equations. Consequently, drawing from Girko (1990), the sets of priorities as solutions to the systems of satisfaction equations, if these solutions exist, are provided by a probability density function when this function is operational (appendix 2). That is to say cultural alienation distances from possibility of uniqueness of the set of deterministic priorities in a society; at best, it might generate random sets of priorities and at worst the law of social priorities occurrence would be unknown. All the above may explain the feeling of confusion or confusing behaviours and collective powerlessness under the cultural alienation context... The possibility of a failure in the mix of different cultures thus suggests to consider the notion of integrity of culture.

5.2 Cultural integrity

Integrity of culture, culture integrity or cultural integrity can be considered as the culture characteristic indicating the traditional ability that allows understanding and adapting to the change coming from abroad. This notion is different from that of hybridity of culture envisaged by Bhabha (1996) for minorities in the context of integration. Cultural integrity is more concerned with the operational character of culture in the context of the whole society or even for a minority. In addition to the responsiveness state of social conditions to the satisfaction of basic human needs in sufficient and predictable ways, cultural integrity is concerned with the consistency of culture or, as it happens, the lack of consistency of the contemporary African way of life conceivable in any life aspect.

The notion of culture integrity should rather be reconciled with the notion of culture self-monitoring of a community in relation to other cultures/ outsiders contemplated by DiBianca Fasoli (2020: pp. 6-7). It is also close to the notion of system integrity in computer sciences, where the integrity of a system (O'Shea, 1991) is concerned with preventing unauthorised or undesirable modification of information in an operating system. As it happens, the operational character of culture is about the compatibility of informal rules (of enrichment, grouping/ recruitment, language of instruction) with the transplanted formal rules or the cultural proximity of artefacts (language, socioeconomic agent model, approach to public resources diversion) emanating from different cultures, and their ability to jointly provide satisfaction considered in terms of acceptable levels of both satisfaction per se and its predictability. Nevertheless, any level of contradiction or incompatibility within a culture or a system does not imply a lack of cultural integrity.

This requires separating contradictions relating to cultural alienation from negligible cultural inconsistencies. On one hand, about negligible intra-cultural inconsistencies, for example, Bell (1972) contemplates the cultural contradiction of capitalism as the coexistence of rational (economics) and antirational (art, popular culture) ways of life through a dynamic of a changing society. Dwairy (2015) interprets the contradictions within proverbs and some religious texts as intra-cultural conflicting

forces that allow culture to advance. Akanbi (2020) considers contradictory proverbs as portraying unpredictable behaviour of human nature. On the other hand, Henricks (1982: pp. 213–218) proposes a series of five questions and pre-set answers that allows a scholar to ascertain for a subject or to lead the subject⁴ toward ascertaining the state of alienation.

The rule of verification is such that a deviation from a predetermined answer (Yes) leads away from alienation. Wambari (1973) proposition about varieties of alienation (political, economic, cultural, etc.) authorizes using Henrick's questions for ascertaining cultural alienation in contemporary African context. The application of the five Henricks' questions to the situation of cultural conflict allows ascertaining the experience of cultural alienation as following. (1) Is the condition noticed? Yes: living simultaneously through conflicting rules/cultures. (2) Is it wrong? Yes, e.g. large sets agent vs. atomized agent, right of the chief vs. fiscal incivility, resources diversion, "corruption", "tribalism". (3) Does it matter to the subject? Yes: alienation consequences (see section 2 and erratic satisfaction). (4) Whom or what is to blame, is there a variety of answers? Yes: colonialists, politicians, the whole society, Fate, etc. (5) Can the subject do anything about it? No: Powerlessness (from an alienating perspective).

Comparatively to systemic or cultural contradictions due to cultural alienation, the previews examples of negligible intra-cultural inconsistencies are not socially unaddressed. The studies review of Bell (1972), Dwairi (2015) and Akanbi (2020) reveals that there is no reason to go further than question 1 about the portrayed intra-cultural inconsistencies. Indeed, while these inconsistencies of culture are ascertained, they are not presented as wrong, they do not matter, there are no perverse consequences for satisfaction, there are nobody to blame and no feeling of powerlessness. Consequently, they do not generate erratic satisfaction, unless the generated unpredictability of satisfaction is considered negligible or as an isolated case. Following all the above and Henricks (1982: 203) analysis, Marx's sense of alienation may fit a case of negligible intra-cultural inconsistencies while the consequences of Durkheim's notion of anomie when generalized to a society scale, may be similar to those of the aforementioned failed mix of systems in terms of erratic satisfaction and priorities...

While the notions of erratic satisfaction and cultural integrity may be operational in the context of cultural conflict, they do not provide farther, broader and predictive possibilities with regards to development dynamics than the randomness of social priorities. But the notion of criteria of development do.

5.3 *Criteria of development*

Envisaging inconsistencies within the criteria of development allows explaining or predicting contradictions in the context of the failed mix of divergent cultures in Imperial and contemporary Africa. For the subsistence criterion, existing but inaccessible resources for subsistence appear to be the result of what Boahen (1987b) considers as the restructuring of agriculture toward crop exportations during Imperial Africa and colonialism periods. This has not been mentioned previously, but the notion of development criteria allows predicting the case. Regarding the predictability criterion, the illustration about the failed superposition of indigenous (communitarian/ economy of State) and transplanted (individualist-capitalist) systems is eloquent with its consequences in terms of randomness of the social priorities. Concerning the criterion of openness, the contradictions within internal capacities were illustrated through the case of colonized minds in purported post-colonial milieu due to the lack of indigenous knowledge in the African school curriculum (Shizha, 2013).

About the authenticity and sovereignty criterion, the inconsistency of conscience of self may be contemplated through mental alienation (Eegunlusi, 2017) consecutive to the colonialist falsification

4. It is argued (p. 214) that the subject does not have certain analytical skills and external viewpoints to look at the issue compared to the observer/ the scientist. This is convergent with Lystad (1972: p. 96) review of individual alienation regarding certain social structures in industrial and rapid social changing situations: there is a negative relationship between the alienation level (powerlessness) and the amount of knowledge about the concerned type of alienation.

and teaching of African history for exploitation purposes (Diop, 1979), or the forced renunciation of historical traditions (Diop, 1987b; El Fasi et al., 1990) for the same goal. About the criterion of actualization, consider the crisis of identity (Wambari, 1983; Egunlusi, 2017); it is as an amnesic people trying to live consciously without neither efforts for remembering nor treatments...

Since the development of a society is conceivable as the complexification of the organization due to population growth, which complexification black Africa does not lack, contemporary Africa does not have a problem of development per se. The problem is rather the lack of cultural integrity since this lack engenders the perversion or the collapse of the development conditions, degrades the satisfaction of basic needs, makes it erratic, and generates erratic social priorities, all the above requiring appropriate solutions.

The solutions proposed in the context of cultural alienation are not foreign to the notion of development criteria. However, an approach through the criteria of development would only point to the treatment of inconsistencies but not how. In addition, the identification of the primary criterion that interests cultural integrity is required to avoid confusion between societal crises in a broader way and the crises due to cultural alienation. The primary criterion that interests cultural integrity is the criteria of authenticity and sovereignty. Consequently, inconsistencies envisaged within the remaining criteria are due to the criterion of authenticity and sovereignty acting as a secondary criterion. The search for comprehensive solutions to the alienation or dislocation problems orients towards the proposals of Wambari (1973), Diop (1979, 1987a) and Asante (1998). The primary or secondary criteria of development may help to approach these solutions.

Indeed, in terms of a self-referential approach based on the African experience, world view and self-consciousness-based action, afrocentricity seems to fit theoretically and for policy design, the criteria of sovereignty and authenticity in the broadest way. Indeed, following Asante (1998), Afrocentricity constitutes the starting point for analysis, synthesis and action in African problem-solving. Meanwhile, Wambari (1973: pp. 114 – 129) reports solutions for overcoming alienating human relations at a country scale. These solutions fit the criterion of openness with some influence of subsistence, predictability or authenticity and sovereignty. These solutions are the majority of state business in a country, the collectivization (e.g. Kibbutzim, Ujamaa village, etc.) and the strengthening of labour unions (e.g.: the Yugoslav model).

Diop (1987a) proposes solutions at the continental scale in terms of a whole program whom the displayed guidelines follow. It is about both the restoration of African historical consciousness – the history of the black world and its contribution to Civilization ... – and the regional specialization in terms of industrialization within a Federate Black African State, with a single African lingua franca (Swahili) for culture and government without abandoning the remaining African languages. The authenticity and sovereignty criterion with the influence of predictability criteria is related to the African lingua franca and the restoration of historical consciousness. Predictability per se may fit the industrialization to be reconsidered in congruence with the Maat system, while all five criteria fit the Federate Black African State. While the overview of solutions above is not exhaustive, these solutions remain complementary.

6. Conclusion

It has been proposed the meaning of cultural alienation for the development of human societies. A limitation of this study is that it mainly focused in a few aspects of the socioeconomic perspective about culturally contradictory institutions registers in contemporary Africa. However, these aspects are sufficient to concern a whole society. Similar and complementary analyses on cultural conflict can be conducted in fields such as the political system, spirituality/ religion, education, health, conflicts, etc. These analyses might provide more insight while more and more substantiating and developing solutions to cultural conflict. Finally, further researches might address the modelling of the dynamics elements described by the criteria of development.

Biography note

Guy Pierre Kabemba Luembe is an independent researcher who studies the development of human societies. His research focuses on the systemic historical pattern of the development of black Africa from Antiquity to the present day. This is in order to draw lessons that shed light on the understanding of the contemporary situation in order to consider an increasingly precise development policy. Thus, he is interested in multidisciplinary approaches including but not limited to the analysis of socio-economic systems, the philosophy of economics, economic history, cultural conflict, and modelling. He also works in the financial and administrative management of organizations. He obtained his license (university second cycle) in Economics and Management from the Catholic University of Bukavu. He lives in Kinshasa.

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Appendix 1: The Conception of the satisfaction equations

The conception of the model consisted in a drawing using a tracing paper on the original voting decision problem by Ngoie et al. (2019). This appendix first presents correspondences between the elements of the voting decision problem and the factors contributing to population distribution on activities for needs' satisfaction. Second, the main result of the voting decision problem is replicated and reconsidered for the paper model.

Correspondences

1. A Candidate in the original 3MCD model corresponds in the present adaptation to an activity for particular need satisfaction, or shortly the activity. The activity provides an output/ satisfier both for auto-consumption and/or to be sold or bartered for acquiring other required satisfiers.
2. The Elector corresponds to the person who chooses (as an elector) or is principally assigned to an activity (due to time she/he spends performing a particular activity of need satisfaction, etc.), given one or more characteristics such as the personal ability or productivity, personality, wealth, etc. The assignment to an activity does not exclude participation in other activities.
3. The criterion: it is what models, defines, shapes or generates an activity. It plays the role of the interface between the activities and the expectations (needs) of the population. The characteristics of an activity are related to the environment in which the activity is performed. From 3MCD to the equations of satisfaction, the notion of criterion found no other correspondence than the notion of criterion.
4. Elector note (or grade) corresponds to the level of need satisfaction that a person experiences regarding a criterion evaluated on an activity. Each criterion favours more or less a particular basic activity and its outcomes. Similarly to the choice in the 3MCD approach where the grade indicates the choice of the elector on a candidate, the highest satisfaction level may indicate the principal assignment of a person to an activity.
5. The Weight corresponds to the prepotency of the (basic) need satisfaction that characterizes a particular criterion for a person, such that the criterion impeding a need satisfaction is weighted in the opposite sense (of need satisfaction) and thus indicates the prepotency level of a need (or activity); the more restrictive a criterion, the less the related need is satisfied.

Equations of satisfaction

The implicit quantity g_{ilh} in the original 3MCD approach has to be defined first. For the person j , it is the satisfaction level (or score) experienced from the consumption of the satisfiers produced by the activity i relatively to the criterion h (or activity h). Note the absence of the apostrophe “'” on the expression of the satisfaction score, meaning that the table 1 is about the satisfaction from the activity' satisfier and relatively to only one criterion but not the inter-median (collective) satisfaction. The summary tables that allowed to envisage the system of linear equations from the 3MCD approach are presented below.

Table 1. Tables of personal activity satisfaction

Person j (j = 1,2,...,n)							
Prepotency		p_{1j}	p_{2j}	...	p_{hj}	...	p_{sj}
Criteria		c_1	c_2	...	c_h	...	c_s
Activity	a_1	g_{11j}	g_{12j}	...	g_{1hj}	...	g_{1sj}
	a_2	g_{21j}	g_{22j}	...	g_{2hj}	...	g_{2sj}
	...	...	...	...	...	...	...
	a_i	g_{i1j}	g_{i2j}	...	g_{ihj}	...	g_{isj}
	...	...	...	...	...	...	...
	a_m	g_{m1j}	g_{m2j}	...	g_{mhj}	...	g_{msj}

Table(s) constructed by the author from the numerical tables examples of Ngoie and. al. (2019)

Where p_{sj} is the prepotency the person j experiences relevatively to the criterion s.

Table 2. Collective activities satisfaction

Overall or sectorial Prepotencies		$f^{mm}(c_1)$	$f^{mm}(c_2)$	...	$f^{mm}(c_h)$	...	$f^{mm}(c_s)$	b_i
Criteria		c_1	c_2	...	c_h	...	c_s	
Activity	a_1	$f_1^{mm}(a_1)$	$f_2^{mm}(a_1)$	...	$f_h^{mm}(a_1)$	...	$f_s^{mm}(a_1)$	b_1
	a_2	$f_1^{mm}(a_2)$	$f_2^{mm}(a_2)$	...	$f_h^{mm}(a_2)$	...	$f_s^{mm}(a_2)$	b_2
	...	...	...	...	...	...	...	...
	a_i	$f_1^{mm}(a_i)$	$f_2^{mm}(a_i)$	...	$f_h^{mm}(a_i)$	...	$f_s^{mm}(a_i)$	b_i
	...	...	...	...	...	...	...	...
	a_m	$f_1^{mm}(a_m)$	$f_2^{mm}(a_m)$	...	$f_h^{mm}(a_m)$	...	$f_s^{mm}(a_m)$	b_m

Where $f_h^{mm}(a_i)$ is the average majority compromise of satisfaction from the activity a_i relatively to the criterion c_h , and $f^{mm}(c_h)$ is the average majority compromise of prepotencies p_{sj} relatively to the criterion c_h . It represents the prepotency (in the sense of Maslow) or the weight (in the 3MCD way) of the criterion c_h or simply the priority level of the satisfaction of the basic need h.

The score (or overall satisfaction) from the activity a_i for the associated population, with $i \geq 2$, is given by:

$$b_i = \sum_{h=1}^s f^{mm}(c_h) \times f_h^{mm}(a_i) \quad (1)$$

This formula represents a system of m linear equations (activities) in s unknown or variables, as it happens prepotency of each criterion, with $m \times s$ coefficients (needs satisfaction relatively to each criterion and for the concerned group of people per activity). The greater b_i denotes the most satisfying activity for the associated population. For simplicity of notation of the sectorial prepotency score and the average majority compromise of an activity, $f^{mm}(c_h)$ may be replaced by p_h and $f_h^{mm}(a_i)$ by b_{hi} . Then the relation (1) may be rewritten as follows:

$$b_i = \sum_{h=1}^s p_h \times b_{hi} \quad (2)$$

Where $i=1,2,3,\dots,m$. h_i subscript notation in b_{hi} is adopted for convenience such that the second letter (i) of h_i indicates the line and the first letter (h) indicates the column.

Linear equations, satisfaction, capability and utility

With 3MCD original version, weights are assigned by the voter independently from both the activities scores and overall grade. However, with the equations of satisfaction, weights or prepotencies are not independent of overall satisfaction. People do not attribute a weight to an activity but the weight reveals from satisfaction decomposition. At this point, one could think about independent equations of satisfaction; that is to say, the overall satisfaction of a need (activity) could be written as a linear combination of satisfaction scores. This would be inconsistent with the simultaneity of the equations suggested by the summary provided by the 3MCD approach: the set of activities' prepotencies must simultaneously be valid for each linear equation or each decomposition of overall satisfaction.

Independent equations would mean that the satisfactions of needs are independent, which is not necessarily true. Envisaging that the number of activities matches the number of criteria is thus conceivable. This in order to avoid both situations of exclusive auto-consumption and unproductive or isolated activities. However, an identic set of prepotencies that holds for all needs decomposition might seem problematic at first sight. Meanwhile, conceiving that a prepotencies set is not identic for all needs decomposition suggests that there would be infinitely many prepotencies sets holding for both the same overall satisfaction and the related satisfaction components (a single equation with m unknowns); this would be an unrealistic situation. More, if satisfaction is decomposed in the satisfaction equations, the needs are not. There is thus no reason to have globally different prepotency levels for the same need. The utility concept and the capability approach are compatible with the equation of satisfaction.

The concept of satisfaction is fundamental in the sense that it can serve to define both capability and utility. A simple approach to satisfaction is that it is an inner state of comfort. This comfort may be intra-personal (individual) or interpersonal, that is to say collective. Capability is considered as a set of functionings which in turns are composed with various beings. The elementary components of capability is thus the beings which may also be defined as states of comfort, e.g.: being full regarding a meal or being respected are states of comfort regarding physiology and social relationships. About utility, it is defined as the satisfaction level acquired from the consumption of a certain amount of goods. Mathematically, utility may be defined as an integral of an element of satisfaction to the extent that utility would not be confined to the consumption of marketable or marketed commodities, but extended to all kind of consumption or usage of things such as language, collective history, etc.

About the approach of Sen (1988; 1993; 2003) in terms of functionings and capability, it can be reconciled with the equations of satisfaction. Indeed, it is somewhat necessary that the satisfactions (and satisfaction components) not concerned with the principal activity of the considered individual (table 1) be negligible. And it would be enough to add prepotency and overall satisfaction to functionings to make a correspondence, this in addition to the context of the Sen's approach as discussed below. Condition one is trivial. About, condition two, consider the case of an atomistic society, in which each person performs a distinct activity from that of other people and where people may be redistributed (permuted) among activities, and where new activities can be created, and some activities suppressed. Let be the simplified equations of need satisfaction $b_i = \sum_{h=1}^s p_h b_{hi}$, where $i=1,2,3,\dots,m$ and $h=1,2,3,\dots,s$.

If each element b_{hi} of the matrix $(b_{hi})_{m \times s}$ can be likened to a possible "being", then each row vector $(b_{1i}, b_{2i}, \dots, b_{hi}, \dots, b_{si})$ of these elements can be likened to a functioning, and the set of these m row vectors or functioning can be likened to the capability. That is what Sen (1988) called n -tuples (or m -tuple) of functioning. Considered as that, each functioning is related to what is called the principal activity performed by the concerned population under the equations of satisfaction. As the functioning in Sen's approach is related to a person, to be consistent with this, in the proposed

model, each activity has to be performed by only one person and each activity has to be unique. Additionally, to be consistent with the possibility of alternative functionings for a person, population redistribution must exist among activities since these activities are, as it happens, considered distinct. Overall satisfaction in the satisfaction equations corresponds to a linear combination of “beings” ...

About the utility, the modelling is about satisfaction (a variable) but not about utility (a function or consumer preference). If utility is envisaged as a relationship between satisfaction and consumption, the model is only interested in satisfaction or an element of utility to some extent. It is not about any consumer preference (possibility of choice), but about concrete realization. To be clearer, imagine the utility as a more or less full tube. What the paper is interested in is neither the whole tube nor its longitudinal profile, but only interested in a cross-section or the finest slice of it. Then, one describes the composition of this cross-section. It is about to say which component of satisfaction (or the aforementioned coefficients of equations) is present in the “utility” slice and in which proportion (prepotency) compared to other components. It is not about total utility (satisfaction acquired from the consumption of a certain amount of some good or service) but global satisfaction from all consumptions (e.g. the “consumption” or use of a language), not confined to market commodities. Nevertheless, to some extent, the total utility may be considered like a coefficient of the system of equations of satisfaction.

Appendix 2: The Conditions of Solvability

The case of random real numbers

a. The finite number of activities

For a finite number of activities or finite population size, the system (2) may have no solution (inconsistent system of equations), a unique solution or infinitely many solutions. To be consistent (that is to say, to admit at least one solution), following the Gauss method of elimination, the row echelon form of the augmented matrix of satisfaction scores must not contain any contradictory equation such that $b_i^* = \sum_{h=1}^s p_h \times 0$ where $b_{hi}^* = 0$ for all criteria and $b_i^* \neq 0$. Where the * indicates the transformed quantity from the original (observed) form to the row echelon form. The equations of satisfaction will have either a unique solution or respectively infinitely many solutions if the row echelon form of the augmented matrix of satisfaction score has no free variable or respectively has at least one.

A free variable is a variable that can take arbitrary value, that is to say, it can be set as a parameter. The first condition means the equations of satisfaction have no equivalent (obtained after elementary operations on rows) system in the row echelon form containing an equation where overall satisfaction is not zero while its components are all zero. In addition to the absence of a contradictory equation in the row echelon form, the condition for solvability to a unique solution means there is no sectorial prepotency or priority that can be set arbitrarily.

b. Infinitely many activities

In the case of infinitely many equations (activities), Polya (1938) proposes a theorem constituting a simple and sufficient condition of solvability of a system of infinitely many linear equations. According to this study, the basic problem with this kind of system is the convergence of the left-hand side of equations for any b_i . As it happens, it is about the convergence of the linear combination of the satisfaction components for each activity, using the prepotencies set. At this point, the conditions of solvability are presented and interpreted following the satisfaction equations model. For demonstration, the interested reader may consider the original paper from Polya (1938). Formally, the infinite system $p_1 b_{1i} + p_2 b_{2i} + \dots = b_i$ ($i=1,2,3,\dots$) is solvable under the following two sufficient conditions:

Condition 1: The sub-matrix

$$\begin{matrix} b_{q+1,1} & b_{q+2,1} & \dots \\ \dots & \dots & \dots \\ b_{q+1,n} & b_{q+2,n} & \dots \end{matrix}$$

formed from those elements of the matrix $[b_{hi}]$ that belong to the first n rows and do not belong to the q first columns, is of rank n (i.e. contains a non-zero determinant with n columns) for any n and q .

Condition 2:

$$\lim_{h \rightarrow \infty} \frac{b_{h,i-1}}{b_{hi}} = 0 \quad (i = 1, 2, 3, \dots)$$

Petersen and Thompson (1964) showed that this second condition of Polya's theorem is also a necessary condition. Indeed, drawing from Polya (1938), the theorem remains true even if the first condition is replaced by the sentence "there exist infinitely many non-null satisfaction components b_{h1} (in the first line)" and the second condition is replaced as follows:

$$\lim_{h \rightarrow \infty} \inf \frac{|b_{h1}| + |b_{h2}| + \dots + |b_{h,i-1}|}{|b_{hi}|} = 0 \quad (i = 1, 2, 3, \dots)$$

Thus, so that solutions of the infinite system should exist for all choices of b_i ($i=1,2,3,\dots$) such that the left-hand sides of the system are absolutely convergent, it is necessary that condition 2 must be satisfied for infinitely many activities.

Let us consider the interpretation of both conditions 1 and 2 and next reconcile the second condition with the results of a social complexity analysis by Turchin et al. (2017). Condition 1 suggests that one may choose n first activities (rows) and ignore some q first needs or criterion (columns) such that the resulting square matrix $n \times n$ (or respectively $q \times q$) have the rank n (or q). That is to say, it can be chosen a subset of n first activities, and the q first criteria or needs can be ignored, such that the resulting sub-matrix lines be independent. Or equivalently, from the resulting sub-matrix, any subset of satisfaction components of a given overall satisfaction cannot be written as a function of another subset of satisfaction components of an overall satisfaction.

Condition 2 suggests that for infinitely many activities (or population size) there must exist layers of increasing (or decreasing) components of needs satisfaction for prepotencies to be determined, whatever the values of overall satisfactions. Because the adopted approach of satisfaction is about a decomposition of (overall) satisfaction, it is needed the satisfaction components to reflect overall satisfaction, without violating condition 1. Both increasing and decreasing overall satisfactions b_i with layers of increasing satisfaction components does not violate condition 1. However, increasing overall satisfactions with layers of increasing satisfaction components best reflects the approach in terms of the decomposition of satisfaction.

Then, in this last circumstance, condition 2 may justify the existence of inequalities (but not necessarily precariousness) or layers of satisfaction within an infinitely large society for prepotencies to be determined. That is, activities can be arranged in such a way that the components of satisfaction increase from the left (less satisfying component) to the right (most satisfying component) for each line (activity), and such that each activity is more satisfying than the activity that comes before from the first to the last equation. Thus, the necessary solvability condition of the satisfaction equations may be reconciled with Turchin et al.'s (2017) conclusion about social complexity and population size.

Indeed, on one hand, this conclusion is such that population size explains the global variation of social complexity including social hierarchy. On the other hand, the existence of layers of increasing (or diminishing) levels of satisfaction as a condition for prepotencies determination in the case of infinitely many activities is close to the association of social hierarchy and privileges of satisfaction or both transformation and concentration of wealth within a positive correlation. That is to say, the model suggests the increase in population size requires social hierarchy for social priorities to be determined.

The arguments about the similarity between the choice of a candidate in the original 3MCD model and the assignment to an activity in the present adaptation follow. These arguments are necessary and perhaps sufficient for the validity of the connection between conditions of priorities determination for infinitely many activities (needs) and social complexity analysis. First, the highest personal overall satisfaction must indicate the main assignment of the concerned person to the related activity. Otherwise, the identification of people's assignments to activities would be exogenous to the model and the hierarchy of satisfaction would only be informative. Indeed, the people less satisfied than others from satisfiers produced by their own activity would be conceivable; consequently one could not be able to identify to which activity the most satisfied person is principally assigned.

Second, other overall satisfactions (and the related satisfaction components) must be negligible comparatively to the highest overall satisfaction. Otherwise, the notions of sectorial satisfaction (or social classes' satisfaction) and overall satisfaction could not be interchangeable. The meaning of sectorial satisfaction here is overall satisfaction experienced by people principally assigned to their respective sectors of activity. If the notions of sectorial satisfaction and overall satisfaction are not interchangeable, the condition for prepotencies determination for infinitely many activities would

only require a hierarchy of degrees within satisfactions components rather than a social (or sectorial) hierarchy; then, in this case, the model would allow inconsistency such as highest overall satisfaction made from lowest satisfaction components and vice versa.

In this case of inconsistency, the problem would not be the equations of satisfaction but the realism of data to be used in these equations. Consider the equation $E = mc^2$, where E is the energy, m the mass and c is the light speed in vacuum. One may for example use data such as $m = 2$ Kilograms and $c = 10$ meters per second. The equation would provide a solution even if the value attributed to light speed in vacuum is wrong.

The case of random real numbers

Let us consider the matrix form of the equations of satisfaction:

$$[b_{hi}][p_h] = [b_i] \quad (3)$$

Where $[b_{hi}]$ is the matrix of satisfaction scores of activities, $[p_h]$ the prepotency vector and $[b_i]$ the vector of overall satisfaction.

Girko (1990) provides a formulation for a solution to a normal system of linear equations under specific conditions. Let be the equations system of needs satisfaction is normal if the entries (satisfaction scores) of the matrix $[b_{hi}]$ or the prepotency vector $[p_h]$, or if the entries of both of them are distributed according to the joint normal law. Then, a unique and probabilistic solution exists under the following conditions: (1) $[b_{hi}]$ is a squared matrix (of dimension n), (2) $\text{Prob} \{ \det[b_{hi}] = 0 \} = 0$ and (3) the vector $[b_i]$ does not depend⁵ on the matrix $[b_{hi}]$ and is distributed according to a non-degenerate normal law. Let be $[\mu_i]$ and $[T_{hi}]$ the parameters of the non-degenerate normal law. Consequently, the probability density of the solution is provided by:

$$\text{prob}([p_h]^*) = (2\pi)^{-\frac{n}{2}} \det[T_{hi}]^{-\frac{1}{2}} E \det[b_{hi}] \exp \left\{ -\frac{1}{2} ([T_{hi}]^{-1} ([b_{hi}][p_h]^* - [\mu_i]), ([b_{hi}][p_h]^* - [\mu_i])) \right\} \quad (4)$$

Where $[T_{hi}]^{-1/2}$ is the square root of the matrix $[T_{hi}]$, **det** is the abbreviation for “determinant of”, E represents the mathematical expectation, the comma “,” denotes the scalar product of vectors and $[p_h]^*$ is a solution. Within the specification of this solution rests a particularity. It is about the quantity $[T_{hi}]^{-1/2}$. The theory of matrices’ square roots is not trivial and a square real matrix might have infinitely many square roots including complex matrices (Higham, 1987; 2008). All the above suggests that the density function of the solution is not unique and tends to be rare.

Discussion

The conditions of solvability of satisfaction equations for a finite number of activities are consistent with the results of Wambari’s (1973) investigation of alienation in Africa. The behaviour of the model regarding both absence of the randomness of satisfaction and default of cultural integrity (sections 5.1 and 5.2) is consistent with Wambari’s (1973) proposition on economic consequences of alienation. Indeed, considering satisfaction as a random variable or considering prepotency as arbitrary for some criteria within equations of satisfaction and the consequences in terms of impediments to priorities determination is close to his suggestion about the powerlessness of African nations controlling their economic activities and deciding on resources (re)distribution in the context of cultural alienation.

The conditions of solvability of the satisfaction equations allow envisaging two main cases of cultural integrity default. On the one hand, the sole consideration of arbitrary prepotency in the case of negligible or absence of unpredictability of satisfaction may depict a case of a country

5. By construction of the equations of satisfaction, any equation of the system actually represents an identity between a sectorial satisfaction b_i and the weighted summation of its components b_{hi} , $h=1,2,\dots,n$. It is not about a dependency relationship, but a description. Thus, envisaging a dependency relationship in this case would be irrelevant.

with either strong or weak political leadership, but powerlessness to determine its future regarding priorities based on its satisfaction profile. On the other hand, the case of cultural integrity default allows envisaging random prepotency as a consequence of random satisfaction (sections 5.1 and 5.2). Envisaging random prepotencies in the context of non-random satisfaction would be close to the case of parametrical prepotency depicting the powerlessness to decide over resources redistribution.

The equations of satisfaction and the related conditions of solvability are not an exclusive representation of the case of cultural alienation. First, let us consider the case of parametrical prepotency and next an alternative perspective of the equations of satisfaction outside the context of cultural alienation. An exogenous prepotency practically envisaged as a prepotency set (by a decision maker) independently from the population's satisfaction profile might allow providing information about the strength or the weakness of political leadership, depending on whether this exogenous prepotency is set by local political leadership or, respectively influenced by a leadership emanating from the rest of the world.

Considering the case of local political leadership that sets exogenous priorities does not necessarily suggest there is cultural alienation. Second, parametrical prepotencies do not exclusively point to powerlessness to decide due to cultural alienation or economic alienation. Indeed, arbitrary prepotencies may emerge following the satisfaction profile of the considered population, independently of whether there is cultural alienation or not. Nevertheless, the approach in terms of random satisfaction inside the model of satisfaction seems to exclusively fit the case of cultural alienation or unaddressed societal crisis such as generalized anomie (section 5.2). That is to say, cultural alienation or an unaddressed societal crisis may manifest as an impediment to priorities determination but the impediment of priority determination does not necessarily indicate cultural alienation or an unaddressed societal crisis.

Appendix 3: The Satisfaction equations and the theory of human motivation

Aggregate satisfaction

The equations of satisfactions derive from 3MCD. But 3MCD method uses central trend statistics (mean and median) to summarize the levels of needs satisfaction and prepotencies for a group of people. Meanwhile, the aggregation of the levels of satisfaction is conceivable. More, the definition of bounds (threshold or upper bound) seems the only way to apprehend Maslow's (1943: pp. 388–389; 395) quantitative approach to the degree of satisfaction in terms of percentage. It follows that b_{hi} in the equations of satisfaction represented by both relations (2) and (3) may be considered as follows

$$b_{hi} = \frac{1}{r \times n} \sum_{j=1}^n g_{ilij} \quad (5)$$

Where $n \geq 2$ (population size) following the MMCM approach (Mean–Median Compromise Method) and r is the reference value (threshold or upper bound) of either the activity's satisfaction scores or overall satisfactions and $r \times n$ the aggregation reference. Let be r different from both unity and zero for convenience. Indeed, if $r=1$ this would lead outside the context of MMCM by dropping the median and if $r=0$ this would assign an undetermined value to b_{hi} . Consequently, if $r=1/n$, the relation (5) represents the case of aggregate satisfaction of an activity, otherwise it represents the case of referenced aggregate satisfaction of an activity. Similarly, the computation of the aggregate overall satisfaction can be provided by the following relation.

$$b_i = \frac{1}{r \times n} \sum_{j=1}^n \sum_{h=1}^s p_{hj} \times g_{ilij} \quad (6)$$

Where p_{hj} is the individual prepotency of person j relatively to the criterion h .

About prepotencies, only a summary of prepotencies can be envisaged rather than an aggregation because it is basically about weights or proportions, that are different from the values of the component of satisfaction per se. Note that the table of overall satisfaction under 3MCD adaptation represents a summary profile of satisfaction or the satisfaction profile of the typical person representing the population. A table of aggregate overall satisfaction would rather represent the group profile of overall satisfaction. More, the equations of satisfaction constituting the summary profile of satisfaction are not equivalent to those of aggregate satisfaction. Indeed, from the summary profile to the aggregation of profiles, the elementary operations on rows (or equations) do not make the process for leading from one system of equations to another.

Consequently, prepotencies computed under the two different systems are not equivalent. Intuitively and to be consistent with the theory of motivation approach, the best way of computing prepotencies would be following the group profile because any summary necessarily drops some information. This raises the question to know which approach to use and/or how to find a compromise between the two approaches. Answering these two questions go beyond the purpose of the paper. Nevertheless, concerning the approach that can be used, it can be drawn from the approach in terms of the socio-economic agent size. On one hand, since the 3MCD approach provides the prepotency of the typical person representative of the population, this approach might fit an individualist context or atomistic socio-economic agents. On the other hand, since the whole population is embarked on the aggregate approach, it might be suitable for large sets socio-economic agents or communitarian context.

Motivation-based structure and Prepotency rule

a. Motivation-based structure of activities

Let be the case of the human motivation-oriented structure of activities as a way of social organization. Let be a set of five composite activities or basic activities according to the categories of basic needs in the theory of motivation. Each composite activity (with the associated composite basic need) may characterise a particular “development phase” following Itagaki (1963)’ approach, a particular need or a criterion. Let a_i denotes a composite activity, with $i=1,2,3,4,5$ representing in the same order: the subsistence, predictability, openness, authenticity and sovereignty, and actualization phases/ needs/ criteria. Following the relation (2), the equations of basic needs satisfaction can be summarized in 5 equations with 5 unknowns as follows:

$$b_i = \sum_{h=1}^5 p_h b_{hi} \quad (7)$$

Where b_{hi} is the average majority compromise or the aggregate satisfaction from the activity a_i relatively to the criterion c_h . In addition, with this adaptation, the notion of prepotency is still interchangeable with the ideas of priority, domination (Wicker, 1993), strength (Rauschenberger et al., 1980), high level (Hagerty, 1999; Taormina and Gao, 2013) or emergent ordering (Tay and Diener, 2011). Indeed, these notions may replace the notion of prepotency in the following Maslow (1943: p. 394)’ propositions without changing their meanings: “These basic goals [or basic needs] are related to each other, being arranged in a hierarchy of prepotency. This means that the most prepotent goal will monopolize consciousness and will tend of itself to organize the recruitment of the various capacities of the organism.” In the equations of satisfaction, the hierarchy of prepotency is the hierarchy of computed prepotency using either 3MCD or aggregate approaches.

b. The prepotency rule

The notion of prepotency is essential for testing the ability of the equations of satisfaction to address the Maslow’s theory of motivation. The main propositions about prepotency in this theory concern the relationship between prepotency and satisfaction. The rule is that the most prepotent need be the less satisfied, the exception constituting the reversal of the rule. Various empirical tests using different approaches tend to confirm the rule (e.g. Wicker and al., 1993; Hagerty, 1999; Taormina and Gao, 2013), to nuance it (e.g. Tay and Diener, 2011) or to reject it indirectly (e.g. Rauschenberger et al., 1980). Hence, since Maslow’s theory of motivation admits both the rule and the exception, it is required to demonstrate that the equations of satisfaction can represent the two situations; that is the most prepotent need is not necessarily the less satisfied.

The proof of this proposition requires studying the solution set behaviour concerning all satisfaction components and overall satisfactions. One can identify at least two possible ways for approaching this behaviour. It is about an analytical or numerical survey of the prepotency variation with regard to satisfaction. The results of the analytical survey are succinctly presented below. More developments may interest another study. For the moment, the problem is only to provide support to the ability of satisfaction equations to represent the prepotency rule and thus their ability for social priorities determination.

The analytical way to approach prepotency behaviour with regard to satisfaction may consist of the sign study of the total or the partial derivative of a given prepotency. The independent variable for the derivation may be all overall satisfactions or all satisfaction components. Total derivative might include either all these partial derivatives or some selections of these partial derivatives. In these circumstances, a monotonous sign (always positive or always negative) of the partial derivatives would challenge the possibility of equations of satisfaction to represent the prepotency notion under the theory of motivation. If the sign of the total derivative is monotonous this would imply that

there is a simple relationship between satisfaction and prepotency in the sense of the monotonous determined sign; which is not the case.

Indeed, the sign of any derivative of prepotency with respect to overall satisfaction or satisfaction components depends on the signs of the involved matrices determinants from Cramer's rule. Since the sign of a matrix determinant is not generally knowable a priori, neither is the direction of variation of a given prepotency following variation of overall satisfaction or satisfaction' components. The determination of the sign of the determinant of a matrix relies on the arithmetic approach, which is numerical computation. Let us consider the following coefficients of the equations of satisfaction from the relation (7).

$$\begin{pmatrix} b_{11} & b_{21} & b_{31} & b_{41} & b_{51} & b_1 \\ b_{12} & b_{22} & b_{32} & b_{42} & b_{52} & b_2 \\ b_{13} & b_{23} & b_{33} & b_{43} & b_{53} & b_3 \\ b_{14} & b_{24} & b_{34} & b_{44} & b_{54} & b_4 \\ b_{15} & b_{25} & b_{35} & b_{45} & b_{55} & b_5 \end{pmatrix}$$

To demonstrate that the derivative of a prepotency with respect to satisfaction has not a predetermined sign, it would be necessary to show that the sign of this derivative depends on the sign of the concerned determinant(s) from the Cramer's rule, and sufficient to show that the remaining part of the derivative has not a predetermined sign. Let be p_3 (from activity/ need 3), the dependent variable for the derivative. The highlighted satisfaction components and overall satisfaction are chosen as independent variables of the prepotency derivative. The choice is made to have a sample that would inform about the general behaviour of prepotency derivative with respect to satisfaction.

Relatively to the prepotency of need 3, the chosen independent variables are thus: a principal component b_{11} from an overall satisfaction of an activity other than activity 3, a principal component b_{33} from an overall satisfaction of the same activity 3, the satisfaction of need 3 as a component b_{32} of the overall satisfaction of a different activity (activity 2), the satisfaction b_{53} of another need as a component of need 3, overall satisfaction b_3 of the same need, the satisfaction b_{24} of a need other than need 3, as a component of the overall satisfaction other than that of need 3, and finally the overall satisfaction b_5 from another need than that of need 3. The following relations (8) show that the sign of the partial derivatives is not knowable a priori.

$$\frac{\partial p_3}{\partial b_{11}} = \frac{(b_{22}b_3b_{44}b_{55} - b_{25}b_4b_{43}b_{52})\Delta - \Delta_3(b_{22}b_{33}b_{44}b_{55} - b_{25}b_{34}b_{43}b_{52})}{\Delta^2} \quad (8)$$

$$\frac{\partial p_3}{\partial b_{33}} = -\frac{\Delta_3}{\Delta^2}(b_{11}b_{22}b_{44}b_{55} - b_{15}b_{24}b_{42}b_{51})$$

$$\frac{\partial p_3}{\partial b_{32}} = -\frac{\Delta_3}{\Delta^2}(b_{21}b_{43}b_{54}b_{15} - b_{55}b_{14}b_{23}b_{41})$$

$$\frac{\partial p_3}{\partial b_{53}} = \frac{(b_1b_{42}b_{14}b_{25} - b_5b_{44}b_{12}b_{21})\Delta - \Delta_3(b_{31}b_{42}b_{14}b_{25} - b_{35}b_{44}b_{12}b_{21})}{\Delta^2}$$

$$\frac{\partial p_3}{\partial b_3} = \frac{1}{\Delta}(b_{11}b_{22}b_{44}b_{55} - b_{15}b_{24}b_{42}b_{51})$$

$$\frac{\partial p_3}{\partial b_{24}} = \frac{(b_{41}b_{52}b_{13}b_5 - b_{15}b_3b_{42}b_{51})\Delta - \Delta_3(b_{41}b_{52}b_{13}b_{35} - b_{15}b_{33}b_{42}b_{51})}{\Delta^2}$$

$$\frac{\partial p_3}{\partial b_5} = \frac{1}{\Delta}(b_{41}b_{52}b_{13}b_{24} - b_{44}b_{53}b_{12}b_{21})$$

Where $\Delta = \det[b_{hi}]$ and $\Delta_i = \det[b_{\Delta hi}]$;

$[b_{\Delta hi}]$ is the matrix obtained by replacing the i^{th} column with the vector $[b_i]$

$$[b_{\Delta hi}] = \begin{cases} b_{hi} & \text{if } h \neq i \\ b_i & \text{if } h = i \end{cases}$$

The only partial derivative which may have a monotonous sign is the partial derivative of a given prepotency with respect to another prepotency considering satisfaction and components of satisfaction to be represented by positive or zero real numbers. This sign is always negative as shown by the relation (9), which is trivial and consistent with the prepotency notion per se: the more a need is prepotent, the less so is another need, *ceteris paribus*.

$$\frac{\partial p_i}{\partial p_h} = -\frac{b_{hi}}{b_{ii}} \quad (9)$$

Where $h \neq i$, b_{ii} is the principal component of the overall satisfaction b_i , b_{hi} is the coefficient of the prepotency p_h in the formulation of p_i obtained from equation i. Thus, relations (9) and (8) are sufficient arguments for not ruling out the possibility for satisfaction equations to be consistent with the prepotency rule.

Appendix 4: The Equations of satisfaction and some practical considerations

Measuring range

a. The Satisfaction measuring range

Practical considerations about satisfaction measurement are about the unicity of measuring scale on all categories of basic needs (or satisfaction components and overall satisfactions). The unicity of the measuring scale may traduce into the unicity of the measuring range. Taormina and Gao (2013) and Tay and Diener (2011) use the same measuring scales (5-point Likert scale and respectively dichotomous yes-no scale) for all categories of needs they considered; in addition, they use the same measuring scales to approach both life satisfaction (considered as an indicator of overall well-being) and respectively positive and negative feelings (contributing to well-being).

Consequently, the considered measuring ranges in these studies are respectively from 1 to 5 and respectively from 0 to 1. Wicker et al. (1993) approach deprivation through the measurement of 30 goals attainment (broken down into Maslow's five categories of basic needs) assessed by a 9-point numerical scale; the considered measuring range is then from 1 to 9. Hagerty (1999) uses 12 variables (with different measuring scales) broken down into five Maslow's categories of basic needs; compared to the aforementioned studies, these variables such as life expectancy, gross domestic product, available calories of foods per person, primary education enrolment, etc. are designed "independently" from Maslow's categories of basic needs.

b. The Measuring range of priorities

The unicity of the measuring range of prepotency is trivial following the equations of satisfaction. However, practical consideration envisaged for satisfaction measurement holds indirectly and only through the paper approach of satisfaction since the considered studies test the idea of needs hierarchy but do not measure prepotency per se. By the way, a given value of prepotency measurement has no meaning in itself. It has meaning only when associated with a defined phenomenon such as an economic or a financial crisis, for example, that some "excessively" high and/or low prepotency values might point to. That is similar to water temperatures values that only have meaning when associated with a phenomenon such as evaporation or glaciation.

Concerning prepotency values and the evoked crises, let be the unicity of satisfaction measuring range (per equation). The consideration of prepotency as a weight tends to assign, by computation, values to prepotency that range most frequently within an interval, let be the usual interval. For some singular profiles of satisfaction, some prepotency values may range outside the usual interval while the satisfaction measuring range is respected. Indeed, a small variation of a satisfaction component may traduce into a more than proportional and more rapid inflation (or deflation) of some prepotencies values up to a relatively very great (or, respectively small) numbers, depicting highly excessive (feelings of) deprivations (satisfaction) comparatively to the usual interval, other things equal. This would be more likely in the case of deterministic deprivation/satisfaction (section 5.1); otherwise, the excessive deprivation (satisfaction) would be probabilistic for an already rare phenomenon...

An example for a deterministic situation is provided below. Consider the tables 3 and 4. When other components of satisfaction are fixed, an increase of one unit on the satisfaction component $b_{13} = 74$, leads to an atypical increase for the prepotencies p_1, p_2, p_3 and p_4 to large numbers. From the initial satisfaction profile (table 3), the variations of other satisfaction components but b_{13} do not lead to similar excessive prepotencies variation.

Since prepotency is envisaged as a weight following the 3MCD application, different measuring scales for prepotencies (weights) associated with satisfaction components of the same overall satisfaction would not make sense. In addition, since prepotencies are envisaged as coefficients of satisfaction equations, their measuring range depends on the satisfaction measuring range. Rauschenberger et al. (1980) measure needs strength/hierarchy using a Markov chain form on individuals' states of satisfaction while Wicker et al. (1993) approach needs strength/domination using between-goals

Table 3. Example 1

Prepotencies		0,72	-0,10	-0,76	1,14	0,00	b_i
		p_1	p_2	p_3	p_4	p_5	
Activity	a_1	14,00	17,00	19,00	22,00	24,00	19,00
	a_2	33,00	36,00	38,00	41,00	45,00	38,00
	a_3	74,00	77,00	82,00	84,00	88,00	79,00
	a_4	166,00	171,00	184,00	189,00	193,00	178,00
	a_5	1 000 397,00	1 000 407,00	1 000 413,00	1 000 415,00	1 000 429,00	1 000 408,56

Table 4. Example 1'

Prepotencies		7 956,41	-7 954,82	-7 957,98	7 958,06	-0,60	b_i
		p_1	p_2	p_3	p_4	p_5	
Activity	a_1	14,00	17,00	19,00	24,00	24,00	19,00
	a_2	33,00	36,00	38,00	45,00	45,00	38,00
	a_3	74,00	77,00	82,00	88,00	88,00	79,00
	a_4	166,00	171,00	184,00	189,00	193,00	178,00
	a_5	1 000 397,00	1 000 407,00	1 000 413,00	1 000 415,00	1 000 429,00	1 000 408,56

(or between-intentions to satisfy) correlations and partial correlations, Hagerty (1999) tests nations' sequence of needs achievement using the correlation between years of fastest growth achievement of needs and the predicted sequences of achievement following Maslow's needs hierarchy. Tay and Diener (2011) use the item response theory to test the emergent ordering between needs through the comparison of the probabilities of these needs to be fulfilled. Taormina and Gao (2013) test the ability of the satisfaction level of a need to statistically predict the satisfaction level of the next higher-level need.

The consideration of the unicity of satisfaction measuring range along with conditions of solvability in the case of infinitely many activities (appendix 2) suggests the reconsideration of the notion of satisfaction per se within the equations of satisfaction.

Realized satisfaction, satisfaction reserve and cumulative satisfaction

The equations of satisfaction seem no longer accurate to exclusively represent satisfaction per se in the case of infinitely many activities or unlimited population. They better represent what can be called realized and/or cumulative satisfaction, and the potential or reserve of satisfaction (or privileges of the largest accumulation of transformed wealth/ resources). Concerning the notion of reserve of satisfaction, the main reason supporting this notion is that the unicity of measurement range for all satisfaction components and overall satisfactions is somewhat incompatible with the second condition of solvability of satisfaction equations in the case of infinitely many activities. Indeed, the existence of layers of increasing satisfaction for prepotencies to be computed suggests there exist different measurement ranges following these layers of increasing satisfaction.

Since this reason excludes the possibility for equations of satisfaction to represent satisfaction in the case of infinitely many activities, the equations of satisfaction have meaning only within the reconciliation between the case of infinitely many activities and social hierarchy as a principal component of social complexity. Indeed, consider the relation $\lim_{h \rightarrow \infty} \frac{b_{hi,i-1}}{b_{hi}} = 0 (i = 1, 2, 3, \dots)$ in appendix 2; it is practically uneasy to find a meaning to a satisfaction level at for example a billion units of satisfaction for a person relatively to fifty units of satisfaction for another one; unless considering a reserve or a potential of satisfaction plus real satisfaction about the billion units minus the realized

satisfaction (e.g. forty units) for the first person and realized satisfaction for the fifty units of the second one...

Concerning the notion of cumulative satisfaction, this is suggested by the negligible values of both satisfaction components and overall satisfaction that do not concern the principal activity of the considered people (appendix 2). Concerning the difference between cumulative satisfaction and reserve of satisfaction, this rests on the realization. If cumulative satisfaction can be considered as the addition of realized satisfactions over some time, the reserve of satisfaction is simply the possibility of satisfaction above cumulative satisfaction. Realized satisfaction can be simply considered as an element of satisfaction experienced during a relatively short time and/or for a single or situational experience. However, both cumulative satisfaction and reserve of satisfaction may be concomitantly envisaged in either the short or long run without coinciding.