Equilibrium in Nash's mind

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Abstract

Donald Capps suggested the hypothesis that "the Nash equilibrium is descriptive of the normal brain, whereas the game theory formulated by John van Neumann, which Nash's theory challenges, is descriptive of the schizophrenic brain". The paper offers arguments in its favor. They are from psychiatry, game theory, set theory, philosophy and theology. The Nash equilibrium corresponds to wholeness, stable emergent properties as well as to representing actual infinity on a material, limited and finite organ as a human brain.

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Abstract

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Keywords: disintegration*,* game theory*,* information processing, Nash equilibrium, schizophrenia

1 INTRODUCTION

The philosophical relation of common sense and schizophrenia has a natural focus in the personality and creativity of John Nash (1928 – 2015), Nobel Prize in economics (1994), diagnosed with paranoid schizophrenia (1959).

One of his fundamental ideas refers to a new interpretation of equilibrium in game theory and philosophy of mathematics as noncompetitive in noncooperative games or even as a way for any competition of gamers or factors to be prevented. It is directly opposed to that of John von Neumann, one of the founders of mathematical game theory and its application in economics.

A few early papers of Nash (1950; 1950a; 1951) prove a generalization (Park, 2011) of Neumann's approach (Neumann, Morgenstern, 1953; Israel & Gasca, 2009; Nash et al., 1996). The quotability of "Nash equilibrium" grows exponentially (Mccain, & Mccain, 2010). Nash obtained the Nobel Prize in economics (Milnor, 1995).

The essence of Nash's equilibrium consists in the aims to be divided between the players disjunctively therefore achieving a more stable equilibrium (Marsili & Zhang, 1997). On the contrary, they share the aim(s) in Neumann's approach being always in direct competition conditioning instability and trends to disintegration. The Nash equilibrium can be seen as "strategic" (Crawford, 2002).

The prevention of rival is the best strategy of gamers who mean the strategies of all the rest for gain. If all gamers mean these strategies, they turn out to be in a stable state, that of Nash equilibrium. On the contrary, the gamers in Neumann's approach neglect the others' strategies therefore addressing one and the same purpose.

Thus, the collective gain of all gamers in Nash's approach is much bigger, but the individual gain of the single winner is bigger in Neumann's approach.

Furthermore, the Nash gamers should be gifted with the ability to know or forecast the strategies of all the rest. If the gamers are human beings as in economic models, this is natural and self-obvious. However, if they are not, the Neumann approach seems to be more relevant.

Nevertheless, all thermodynamic approaches, including quantum mechanics considered as a special kind of generalized thermodynamic theory, admit the option of Nash equilibrium though the agents have not consciousness and might not "know" or "mean" the strategies of the others. The condition sine qua non in statistic thermodynamics is their duality of agents and a whole, the system of all agents, which should be in equilibrium as far as the system exists.

One may conclude that Nash equilibrium is relevant to describe any ensemble if it is presupposed as a system. On the contrary, if it is a random collection existing as a whole occasionally destroyable or re-configurable at any time, the Neumann approach seems to be the relevant one.

The paper is organized as follows: Section II considers the link between the Nash equilibrium and schizophrenia in comparison with Neumann's approach to equilibrium. Section III discusses the connection between the concepts of information and Nash equilibrium addressing the schizophrenia models. The last section summarizes the research.

II THE NASH EQUILIBRIUM AND SCHIZOPHRENIA

Donald Capps (2009: 145) suggested the hypothesis that "the Nash equilibrium is descriptive of the normal brain, whereas the game theory formulated by John van Neumann, which Nash's theory challenges, is descriptive of the schizophrenic brain". The paper offers arguments in its favor. They are from psychiatry, game theory, set theory, philosophy and theology.

Indeed, the brain, mind and consciousness are natural to be considered as systems even as a system. Thus, equilibrium seems to be presupposed necessarily and the Nash equilibrium as well. One does not need their separated functions or parts to be considered as conscious gamers able to mean the others' strategies or cooperating with each other. Only the wholeness of both brain and mind seems to be enough to be postulated as usual.

Any violation of that wholeness would be a form of mental disorder, and the Neumann approach would be more relevant if that is the case.

Schizophrenia is featured by a series of instabilities and trends to disintegration in:

– "Common sense" (McEvoy et al., 1996; Stanghellini, 2000; Blankenburg & Mishara, 2001; Stanghellini & Ballerini, 2007; Revsbech, Sass & Parnas, 2012)

– Imagination and perception (Sheiner, 1968; Frith, 1987; Simons et al., 2006; Brébion et al., 2008; Gawęda, Moritz & Kokoszka, 2012; Giacobbe, Stukas & Farhall, 2013)

– The self (Hemsley, 1998; Stanghellini & Ballerini 2007).

– The perception of the others (Sheiner, 1968; Stanghellini & Ballerini, 2007; Benedetti, 2009; Giacobbe, Stukas & Farhall, 2013)

– Time perception (Lyon, Lyon & Magnusson, 1994; Bonnot et al., 2011; Parsons et al., 2013; Peterburs, 2013; Gómez, 2014)

– Choice and rationality (Cromwell et al., 1961; Frith, 1987; Haggard et al., 2004; Revsbech, Sass & Parnas, 2012)

– Understanding metaphors (Kircher et al., 2007; Mo, 2008; Elvevåg, 2011)

The enumeration can be continued, but all those cases can be described as the severe competition of mental functions with a single winner and the suppression of the defeating functions too important for integrity and psychic health.

The Japanese psychiatrists even renamed schizophrenia (Sato, 2006; Sartorius et al., 2014) to "Togo Shitcho Sho" ("Integration dysregulation disorder").

III INFORMATION MODELS OF SCHIZOPHRENIA AND THE NASH EQUILIBRIUM

Choice, mental time, and information processing (Usher & McClelland, 2001; Wittmann & Paulus, 2008; Takahashi, 2009) are unified in Hick's law (Hick, 1952; Hyman, 1953; Beh, Roberts & Prichard-Levy, 1994) Fitt's law (Fitts, 1954; Fitts & Peterson, 1964) and their generalizations (Krinchik, 1969; Beggs et al., 1972; Kirkby, 1974; Gignac & Vernon, 2004; Seow, 2005). The model of brain based on computer has been suggested yet by John von Neumann (1958). There exist even computer models of schizophrenic patients (Hoffman et al., 2011). Turing machines (i.e. usual computers), which number is bigger than modeled mental, functions can represent a normal brain in the Nash equilibrium vs only a single one, or which number is less than the number of modeled mental functions, in Neumann's approach.

The difference between Nash's approach and Neumann's might be visualized even on a single bit, which is the elementary unit of information, after one adds the concept or even quantity about the relation or "game" between the two alternatives of a bit. Then each of the two alternatives "searches" for that strategy, which would increase the probability to be chosen. Then the result would hesitate arbitrarily about the equal probability (i.e. 50% for each alternative) in Neumann's approach. One can say that both alternatives share a single dimension. On the contrary, the result would be just the equal probability (i.e. the standard definition of a bit) in Nash's approach, and as if the two alternatives are separated in dimensions therefore implying their unity as the whole of a bit.

In fact, the concept of information interpreted as the measure of wholeness or completeness corresponds to the latter. The former does not need an absolutely different of wholeness: that of a non-cooperative and thus competitive game, in which both alternatives ("players") are involved one-time or randomly and the same refers to their "wholeness" existing only during the time of the game.

On the contrary, the healthy brain, mind, and consciousness should have stable wholeness, and the Nash model would be more relevant. The relevance of the other model, that of Neumann would witness to disintegration as schizophrenia would be defined in general.

IV CONCLUSIONS

The Nash equilibrium corresponds to wholeness, stable emergent properties as well as to representing actual infinity on a material, limited and finite organ as a human brain. Though the concept was introduced by Nash in relation to game theory therefore presupposing the players as human beings able to choose consciously their strategies in competition, it can be easily generalized to any theory allowing for thermodynamic approach. The main requirement is for the investigated ensemble to be consider as a system rather than as occasional collection existing only for the game and thus constituted *ad hock*. The brain, mind, and consciousness satisfy obviously that condition and consequently the application of the 'Nash equilibrium' to both "normal" and schizophrenic brain. Furthermore, the trends to disintegration of the latter might be represented as decreasing relevance as to Nash's approach to equilibrium on behalf that of Neumann. Thus the thesis of Donald Capps that the Nash equilibrium describes the "normal" brain while that of Neumann, the schizophrenic brain can be supported by a series of arguments.

The concept of information even the level of its unit, a single bit, unifies both approaches. A bit "in tension" might be introduced to demonstrated a dynamic and unstable equilibrium corresponding to Neumann's approach. Then the standard definition of a bit supposing a gap and thus stability between the two alternatives refers to that of Nash.

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