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ALCOHOLISM AND CONDITIONAL REASONING: DIFFICULTIES IN SPECIFIC MENTAL DOMAINS OR IN THE GENERAL USE OF HEURISTICS?

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A recent study states that alcoholics manifest conditional reasoning problems in certain specific mental domains, particularly in the domain of social interactions and in the domain in charge of precautions in hazardous situations. Nonetheless, given that the existence of such domains is questioned in different papers, a reinterpretation of the results of said study, in the light of a theoretical framework more widely accepted, might be needed. That is the aim of this paper, which will be based mainly on the dual-process theory and which will offer a critical review of both the Social contracts theory and the hazard management theory.

Introduction

The paper of Kornreich, Delle-Vigne, Knittel, Nerincx, Campanella, Noel, Hanak, Verbanck and Ermer (2011) states that alcoholism can be linked to certain difficulties for conditional reasoning in the context of social interaction and of precautions when facing hazardous situations. By trying to identify the cognitive areas that can present problems in people addicted to alcohol, the authors come to the conclusion that two specific domains of reasoning in the human mind, the one related to social interaction and the one related to appropriate behaviour in hazardous situations, do not work as they should in alcoholic people if compared to the way they work in the general population.

The idea of the existence of those specific domains comes from evolutionary psychology. In line with arguments such as those of Dawkins (1976, 1982), it has been stated that the process of evolution has created certain spe-

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cific domains of reasoning in order to improve the effectiveness of humans' performance in the environment. These domains of reasoning do not necessarily follow the rules or provisions of traditional logic but, instead, they are highly efficient in terms of evolution as they lead to more convenient conclusions in situations where the preservation of the individuals is threatened. The social contracts theory (Cosmides, 1989; Cosmides & Tooby, 1992; Gigerenzer & Hug, 1992; Fiddick, Cosmides, & Tooby, 2000; Fiddick, Spampinato, & Grafman, 2005; Fiddick & Erlich, 2010) suggests the existence of a specific domain of reasoning for the field of social relations and interactions. In turn, the hazard management theory (Fiddick et al., 2000; Fiddick, 2004; Fiddick et al., 2005; Boyer & Liénard, 2006) maintains the hypothesis that there is a specific domain of reasoning related to the situations that imply risks or danger.

Based in those studies, Kornreich et al. (2011) try to prove to which extent the operation of both specific domains is the appropriate in detoxified alcoholics and, as indicated before, they conclude that alcoholism is linked to difficulties in both domains. There are different alternatives to explain the results of the conditional reasoning tasks that have been employed to prove the existence of both domains and, provided that Kornreich et al. (2011) use similar tasks, it is possible to interpret their results from a different angle. Such is the object of this paper.

With that aim, this paper firstly explains in more detail both the social contracts theory and the hazard management theory, describing the reasoning tasks that they use to support their conjectures. Then, there is an analysis of the global characteristics of Kornreich et al. (2011)'s research and their use of similar tasks. Then follow some criticisms that have been made against the theories that defend the existence of specific domains of reasoning according to the results of tasks of the same kind. Finally, the results of Kornreich et al. (2011) are reinterpreted according to the dual process theory (Stanovich, 1999, 2012; Reyna, 2004; Evans, 2008), which, at present, is a widely accepted theory that can be considered to be consistent with several approaches that question both the social contracts theory and the hazard management theory.

Social contracts theory and hazard management theory

As mentioned before, the social contracts theory and the hazard management theory discuss specific domains of the human mind responsible of reasoning in certain circumstances. Specifically, the social contracts theory talks about the situations of social exchange in which, to obtain a benefit, the individual must meet a requirement. According to this theory, the rules that control the acquisition of benefits in exchange of requirements have to be rigorously

observed so individuals can last in time. It is because of this that nature, in virtue of the evolutionary process, has provided humans with certain mental algorithms which enable them to easily identify the subjects that do not follow such rules.

Similarly, the hazard management theory suggests that another fundamental aspect for the survival of individuals is that they should know how to easily identify situations in which people put themselves at risk. Consequently, when facing rules that impose the fulfillment of a requirement to perform a dangerous action, individuals are capable of easily identifying people that unnecessarily risk their physical integrity.

It is important to indicate that these theories do not refer to the same specific mental domains. In fact, their supporters have presented researches in which they try to prove that such theories describe different mechanisms. Papers such as those of Fiddick et al. (2000), Fiddick (2004) or Fiddick et al. (2005) can be relevant in this way, because it can be drawn from them, for example, that certain variables that influence the versions with social contracts do not influence the versions with hazardous situations (including the adopted perspective or the described intentions), that anger is not equally activated by the rules with social contracts and the rules with hazardous situations, that brain damage may affect only one of these mechanisms (not necessarily both), and that it has been noted, by means of functional Magnetic Resonance Imaging (fMRI) examinations, that such mechanisms are related to different brain areas of activity.

Nevertheless, given that both theories are based on the idea that their specific domains are the result of the human being's adaptation to the environment, they both believe that, when an individual thinks about a situation that can be included in said domains, he comes to the correct conclusion even if he does not follow the provisions of traditional logic. Thus, to prove their thesis, they usually appeal to versions of the well-known Wason selection task (Wason, 1966, 1968). This task is a conditional reasoning exercise in which four cards are presented to the subject. In early versions, the subject knows that each card has a letter on one of its sides and a number on the other, but he can only see one side of each card. He is shown a vowel on the first card, a consonant on the second, an even number on the third and an odd number on the fourth card. The idea is to choose which card or cards should be turned over in order to make sure that the following rule is true:

> *If a card shows a vowel on one side, then it should have an even number on its back.*

According to propositional logic, as it is a statement with the form *if P, then Q,* it can only be false if there is a case *P and not-Q*, in other words, if one card has a vowel on one of its sides and an odd number on the other. There-

fore, the cards that must be chosen are the card with the vowel (corresponding to *P*) and the card with the odd number (corresponding to *not-Q)*. Note that the card with the consonant (corresponding to *not-P*) is not needed because it is just the vowel that needs an even number on its back – the consonant can have either an even or an odd number on the other side – and that the card with the even number (corresponding to *Q*) is not required because the rule does not state that cards with an even number must have a vowel on its back – but that cards with a vowel must have an even number on the other side – and, therefore, although the rule is confirmed if a vowel appears on its back, such a rule is not false if that card has a consonant on its other side.

The complexity of this task resides in the fact that, usually, subjects do not choose the right cards. Nevertheless, this changes when the setting describes a situation of risk or of social exchange. It is the case of versions presented in the form of social contracts. These versions are usually properly solved by a high percentage of subjects. In an example taken from the paper of Kornreich et al. (2011) which is widely used by other authors, the task consists of a family rule for teenagers that want to use the car, in which the cards represent teenagers and their actions towards the car. Specifically, the rule of this version is:

> *If you borrow the car, then you must fill up the tank with gas* (Kornreich et al., 2011, p. 954).

This version's cards show if the car was used or not and if the tank was filled up or not. The visible sides of the cards show a teenager that used the car (*P*), a teenager that did not use it (*not-P*), a teenager that filled up the tank (*Q*) and a teenager that did not fill it up (*not-Q*).

The frequency in which the subjects chose the right cards, that is the pair *P and not-Q*, in this type of versions has made the supporters of the social contracts theory to state that these versions are correctly solved because they reflect situations of social exchange in which, to obtain a benefit, it is necessary to meet a requirement. Therefore, these versions trigger the evolutionary mental algorithms to detect cheats and allow the subject to give the right answer. According to supporters of the social contracts theory, in abstract versions, those that use numbers and letters, subjects are wrong because they can only appeal to their general logical reasoning abilities.

There are similar results when the task is related to a situation in which the individuals can be exposed to risk. Another example of the paper of Kornkreich et al. (2011) and similar to other widely used versions, shows a hospital's rule to treat patients with tuberculosis and in which the cards represent doctors and reflect their actions with regard to patients. In this version the rule is:

> *If you work with TB patients, then you must wear a surgical mask* (Kornreich et al., 2011, p. 954).

In this type of version, in which most of the subjects can also answer correctly, the cards make reference to a situation where doctors work with a patient with TB or not and if they use a surgical mask or not. Specifically, the cards show a patient with TB (*P*), a patient without TB (*not-P*), a doctor using a surgical mask (*Q*) and a doctor not using it (*not-Q*). As shown above, given that a higher percentage of subjects significantly tends to choose cards *P* and *not-Q*, supporters of the hazard management theory maintain that these versions are solved in an optimal way because they describe situations in which the subject can be exposed to risk, thus he activates the corresponding evolutionary mental algorithms. According to supporters of the hazard management theory, in this case, it is not the general logical reasoning abilities that operate, but the specific mental domain related to hazardous situations.

Kornreich et al. (2011)'s paper seems to be based on these conjectures and tries to show that the specific capacities to detect social offenders and individuals that put themselves at risk can be somehow or to some extent limited in alcoholic people. The next section of this paper shows more details of their investigation.

The possible negative impact of alcoholism in social interactions and in hazardous situations

Alcoholic people manifest everyday difficulties in social interactions and in circumstances where certain precautions are needed. This has lead Kornreich et al. (2011) to suggest that these people may present problems related to the specific domains of reasoning linked to such fields. In reality, their study is far more comprehensive, as they also try to establish relations with abilities such as emotional intelligence and to control variables like depression or anxiety. Nonetheless, the next pages will only show what is relevant to this paper, that is, their findings related to the already mentioned specific domains of reasoning.

Their group of alcoholic subjects was composed of 25 people (17 men and 8 women), all of them at their final phase of detoxification and without precedents of bipolar disorder, schizophrenia or dementia. The control group was also composed of 25 people (also 17 men and 8 women), without psychiatric precedents or records of alcoholism. The subjects were carefully chosen so that the groups coincide in sex, but also in age and educational level. Other aspects were also considered, for example, the regular use of drugs.

But the relevant part for this study is linked to the versions of the Wason selection task that they used. The subjects were shown eight different versions with the social interaction rule, eight with the rule reflecting a hazardous situation and eight with a rule that was neither related to the field of social interactions, nor to the field of hazardous situations. These are the results:

In the versions with a social contract related to social exchanges, the alcoholic subjects gave a significantly inferior number of correct answers than the control group. Likewise, the number of correct answers was significantly inferior in the case of versions with rules related to hazardous situations. On the versions not related to any of the two specific domains, the answers of alcoholic subjects were also significantly inferior. Nevertheless, it was observed that the performance of alcoholic subjects improved in the social contracts and hazardous situations versions more than the performance of the control group. This could be explained because, for the eight versions not linked to a specific mental domain, the answers of the alcoholic subjects were made almost at random.

From this data, Kornreich et al. (2011) deduced that, in spite of being able to observe severe difficulties for logical reasoning in alcoholic subjects (as derived from their answers in the versions not related with social contracts or hazardous situations), their reasoning ability when facing evolutionary relevant situations and linked to specific domains is in a relatively better condition. According to the authors, detecting internal factors in social interactions and taking the necessary precautions to avoid danger are evolutionary problems from a long time in the history of humanity. Nevertheless, the general domain of logical reasoning and the intellectual abilities, which is what underlies the versions of the selection task not linked to any specific mental domain, are probably from a later period according to an evolutionary point of view.

Thus, without excluding the possibility that, instead of being its result, the difficulties in conditional reasoning could precede and, in some level, cause the development of alcoholism, the authors state that, besides of what is mentioned in the paragraph above, it is evident that alcoholics, compared to the general population, also manifest certain difficulties for reasoning about social interactions, which can have a negative impact in circumstances where cooperation is needed, and for reasoning about hazardous situations, which can lead to self-destructive acts.

Nevertheless, the interpretation offered by Kornreich et al. (2011), would probably not be accepted by other authors that have used other perspectives when dealing with conditional reasoning, in general, and with the problematic of the Wason selection task, in particular. From such perspectives, it may be possible that the same results have a different meaning. Without aspiring to

an exhaustive analysis, because the approaches to the Wason selection task are numerous, the following part presents some significant and relevant ideas that can lead to a different understanding of the behaviour of the alcoholic participants in the experiment raised by Kornreich et al. (2011).

Alternative theories for the hypothesis of the existence of specific domains of reasoning

Certainly, there are many alternative approaches to the social contracts theory and to the hazard management theory that try to explain why certain versions of the selection task offer, usually, a higher number of correct answers than the others. There are, for example, approaches such as the one of Griggs (1983) or the one of Pollard (1981, 1982), that point to the fact that some versions are better answered because their contents relate to the subject's previous experiences; the one of Yachanin and Tweney (1982), which states that in the versions with more optimal results there are certain circumstances – in them, generally, the rule is established and one must look for offenders (and not prove if the rule is established or not) and, in many occasions, the subject has to take on the role of an authority that must check if the rule is fulfilled or not – which cannot be appreciated in those that show an inferior performance; the one from the deontic logic (Cheng & Holyoak, 1985, 1989; Fodor, 2000), that supports the theory that certain tasks have higher percentages of valid selection because they have rules related to permissions, obligations or prohibitions that make reference to a general domain of deontic reasoning (and not to specific domains); or the one of the mental models theory (Johnson-Laird, 1983, 2001, 2006; Johnson-Laird & Byrne, 1995, 2002; Johnson-Laird, Byrne, & Schaeken, 1992; Johnson-Laird & Hasson, 2003; Byrne & Johnson-Laird, 2009), which suggests that the content of the propositions have an influence on the possibilities that can be anticipated for them and in their pre-constructed models which, in the selection task, can conduct to certain cards and not others.

Of course, it must be acknowledged that the social contracts theory and the hazard management theory can raise arguments against some of those approaches. For example, it can be said that Cosmides (1989) proved that the fact that the content of a version is linked to familiar experiences does not lead, by itself, to a valid selection of cards, and that the selection task can be correctly executed even if its content does not refer to familiar experiences. Equally, it can also be stated that supporters of the approach related to the deontic logic need to explain results such as, for example, those of Giggerenzer and Hug (1992), which seem to show that, if a version refers to a benefit that can be acquired, the percentage of correct selection increases, regardless of the logical form of the rule.

However, given that the alternative approaches are varied, the mere existence of such approaches can cast doubt into the social contracts theory, the hazard management theory, and, in consequence, the interpretation that Kornreich et al. (2011) give to their results. It is evident that, starting from different preconceptions, there can be different conclusions about the cognitive fields or the reasoning abilities that, according to the same results, can present problems in alcoholic people. Besides, there are some other particularly interesting papers such as the ones of Beller (2010) and of Beller and Spada (2003), from which it is inferred that, even if it can be proved that the specific domains of reasoning exist, as those suggested by the social contracts theory and the hazard management theory, it could never be proven that those domains have been developed in virtue of the human process of adaptation to the environment because there is always a chance that they were acquired by the educational process of every individual. Another relevant study is the one of Girotto and Tentori (2008), in which it was observed that it is very difficult to find a subject that correctly solves a version of the selection task with a rule that does not express a relation of social exchange and incorrectly solves a version where the rule expresses such relation, which means that, in some way, the general reasoning ability is also implied in the execution of versions with rules in terms of social exchange.

Nevertheless, a theory emerged the last few decades in the field of cognitive science which has been already mentioned, the dual-process theory, and here it will be used to reinterpret the results of Kornreich et al. (2011). This theory has been chosen because, to a large extent, it is consistent with most of the approaches just described and, besides, it is widely accepted at the moment. The next part of this paper will give a short description of the dual-process theory and it will explain how to understand the results of Kornreich et al. (2011) based on the main thesis of the dual-process theory.

Conditional reasoning in alcoholics and the dual-process theory

The dual-process theory comes from the idea that, in the human mind, there are two different types of cognitive processes. On the one hand, according to the terminology recently introduced by Stanovich (2012), there are Type 1 processes (from now on, T1), that are the ones related to intuition or heuristics; and on the other hand, there are Type 2 processes (from now on, T2), that are the ones related to analytic, abstract and logical reasoning. Stanovich (2012) also suggests a tripartite extension of this theory, which mainly consists of dividing T2 in two different fields, one related to purely algorithmic intellectual activities and one related to dispositions of thought such as the need to repeatedly check every possibility before making a conclusion or the tendency to value opinions depending on every piece of evidence available.

This second field of T2, the one related to dispositions of thought, is the one that can explain, according to Stanovich (2012), the individual differences and the fact that in exercises as the Wason selection task, subjects rarely, not to say almost never, offer the same answer.

An important aspect of T1, according to this theory, is that it is different because, in many cases, it is unconscious. Although some of the heuristics with which it counts can be innate, it seems that most of them come from experience, which means that, when a logical and analytical activity of T2 is repeated a considerable amount of times, it can be automated, it can become a heuristic and be realised in a relatively quick way. If it is considered that Stanovich (2012) seems to place in T1 the cause of the versions of the selection task with rules in terms of social interaction or hazardous situation to be adequately answered by arguing that individuals respond to them according to their heuristics, this is not absolutely incompatible with proposals as those of Griggs (1983), Pollard (1981, 1982), Beller and Spada (2003) or Beller (2010), which refer to the subject's previous experiences.

Another important aspect of T1 is that its action can be stopped or corrected by T2 and, according to Stanovich (2012), this happens in virtue of the individual's dispositions of thought. Such idea allows, as expressed by Stanovich (2012), the link between the dual-theory and the mental models theory, because the possibilities or models that the individual could have created for a proposition or concrete situation can cause the interruption or revision of T1. This relation between T1 and T2 could explain, in the same way, results as those of Girotto and Tentori (2008), according to which a subject that correctly solves a version without social contract and without hazardous situation can also solve correctly a version with social contract. It has to be noted that, definitely, a subject that adequately answers a version without social contract and without hazardous situation needs to do it by appealing to his general logical reasoning abilities and not to his heuristics. If people had efficient heuristics to solve these versions, the results would probably not be so negative, because what seems to happen is that most of the subjects carry out these versions because they try to respond to them appealing to T1 when, actually, they should appeal to T2. This can lead to think that the individual that is capable of solving a task without social contract and without hazardous situation is someone with a disposition of thought that leads him to turn to T2 in very diverse situations, even when he faces versions of the selection task related to social contracts and thus that he also uses his logical reasoning to solve these last versions. And, evidently, the versions related to social contracts can be correctly solved in terms of heuristics, but also, of course, thanks to rigorous logical inferences.

On its part, it is evident that the deontic logic theory supposes the existence of a special logic that operates in deontic situations and there is no doubt

that such special logic can also be linked to the action of the heuristics of T1. Such heuristics can be related to situations of permissions, prohibitions or obligations with the same structure of those experienced daily by the subject, which, evidently, can trigger its action. The same can be said of arguments such as those of Yachanin and Tweney (1982), because previous experience in situations in which it must be proven if a rule is followed, be it by one's own action or by observation, can also lead to the activation of T1's heuristics.

Of course, some other criticisms against the social contracts theory and the hazard management theory could be considered in order to appreciate to which extent they are compatible with the ideas of the dual theory. Nonetheless, a more systematic revision, besides exceeding the purposes of this paper, would make it unnecessarily long, as it only intends to offer an alternative interpretation of the results of Kornreich et al (2011) under the light of the dual theory's thesis. In any case, the paper maintains that the already mentioned criticisms against the theories that support the existence of specific reasoning domains in the human mind are sufficiently representative of the contemporary theoretical landscape in the field of cognitive science. Besides, such criticisms are also enough to understand that the ideas of the social contracts theory and of the hazard management theory are, at least until now, hypothesis that are not unanimously accepted and that such ideas have not been conclusively proven.

Thus, based on the dual theory, that has been proven to possess a higher level of compatibility with other approaches than the specific domains theories, it can be said that the fact that the alcoholic participants have a worse performance than the control group in the versions with social interactions and with hazardous situations mainly shows that they present difficulties in T1, either because it is hard for them to acquire heuristics by automation of the logical-analytical processes of T2 or because they have come to a point where they cannot turn to heuristics that had been acquired in the past (maybe this is an interesting aspect for future research in this problematic). In the same way, and close to the conclusions of Kornreich et al. (2011), it would be unwise to reject the possibility that the difficulties in T1 are not the result of alcoholism, but a condition that, in some level, precedes it (which can also be an important topic for future research).

However, it is important to remember that the performance of the alcoholic participants in versions without social exchange and without hazardous situations was considerably worse than that of the general population, which shows that the general abilities of logical inference and analysis, this is, T2, can also be conditioned by the consequences of alcoholism. In fact, it must be kept in mind that the alcoholic participants, in spite of their percentages of correct answers being always significantly inferior to those of the control

group, improved to a greater extent their performance when facing versions with social exchanges and hazardous situations, compared to the versions that did not relate to any social or hazardous situation. This means, in agreement with the conclusions of Kornreich et al. (2011) in this specific point, that it is general reasoning the one that can be affected in a deeper way in the case of alcoholism. At any rate, T2 is also responsible, according to the tripartite division of Stanovich (2012), of deciding when and in which circumstances the action of the heuristics of T1 cease to operate in terms of analytic and logical abilities.

Conclusion

As it can be appreciated in this paper, the results of Kornreich et al. (2011) are valuable even if one does not accept their thesis that there are specific domains of reasoning in the human mind. The only consequence of not accepting the existence of such domains is that their results have a different meaning. In this paper their results were interpreted based on the ideas of the dual-process theory because, as explained before, it is considered that this approach is not necessarily exclusive in respect to most of the theoretical approaches that have emerged to explain the problems involved in the selection task of the four cards. This seems to be one of its greatest advantages in comparison with other theories.

Of course, there is no doubt of the importance of constantly studying the difficulties associated to alcoholism to have a deeper comprehension of the problematic of this addiction. Nonetheless, it is also convenient to keep in mind that, by thoroughly studying in the field of cognition, it is possible to work based on different theoretical frameworks and, depending on the chosen framework, the conclusions can be very diverse, even if, as this paper shows, the same experimental data is being interpreted.

Therefore the studies must consider that the Wason selection task is one of the more polemical reasoning exercises (not to say the most polemical) that have emerged for the study of cognition. More than forty-five years after being created by Wason, a definitive solution for its problems is unfortunately still missing and it seems that some more years should pass before having signs of such a solution. It is because of this that it is necessary to be cautious when using this exercise in a study, because, depending on the explanation chosen to interpret the strange results of its initial versions and the improvement that can be observed in its versions with some kind of content, the studies can lead to different results or be dealt with from different perspectives. Obviously, for the progress of science, it could be appropriate to work based on a conjecture. Which does not seem so appropriate is to forget that the work comes from an idea and not from a mature theory. In this way, it is conven-

ient, when using this task, to be conscious of the fact that not all the mysteries associated to this task have been solved and that, until they are clear, no result can be accepted as conclusive.

Either way, the paper of Kornreich et al. (2011) does prove that conditional reasoning finds difficulties in alcoholics. It is not clear if that which is altered in these subjects is related to the specific domains of social activity and of hazardous situations or to the heuristic processes. According to the social contracts theory and the hazard management theory, the correct theoretical position for this discussion seems clear but, as shown in this paper, according to the dual-process theory, a theory that manifests important potentialities and with a considerable reach that can give room to very opposite approaches, it also seems to be clear which thesis is valid for this debate, and that should not be forgotten.

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