Robert Nozick on Prisoner's Dilemma

Shahin Esmaeili, Mahdi HajiAliAkbari

I

Robert Nozick, in chapter two of the nature of rationality, proposes two famous problems in decision theory (i.e., Newcomb's problem and Prisoner Dilemma) and two main strategies toward these problems i.e. dominant strategy and dominated or cooperative one. He will try to give a formal principles to calculate the decision values in these situations. In this calculation he goes beyond the standard principle of maximizing expected utility and would try to put forth less ideal and more realistic principles that fit the decision situation in the real world. As he mentioned himself:

" The framework of decision-values, with its incorporated weights that can be altered over time, is one way that a fetting to the actual world can be accomplished." (Nozick, 1993, p 48).

He does not emphasize just strategies (joint or individual) but he does pay attention to the amount of the outcomes in each case and its effects on the decision-making process. He discusses three different modes of connection between action and outcomes which he calls causal, evidential, and symbolic modes. Finally, he concludes that a joint strategy is rational in some special cases and under some conditions. He presents his DV principles as a criterion of rationality including three kinds of outcomes and the Wight assigned to each of them.

1.1 One instance of prisoner's dilemma:

Nozick begins with a familiar instance of prisoner's dilemma:

"A sheriff offers each of two imprisoned persons awaiting trial the following options. If one prisoner confesses and the other does not, the first does not go to jail and the second will receive a twelve-year sentence; if both confess, each receives a ten-year prison sentence; if both do not confess, each receives a two-year sentence. Figure 2 represents the situation they face, where the entries in the matrix represent the number of years to be served in prison by the first and second prisoners, respectively." (Nozick, 1993, p 50)

		Prisoner II	
		Don't Confess	Confess
Prisoner I	Don't Confess	2, 2	12, 0
	Confess	0, 12	10, 10

FIGURE 2

Dominant vs. Cooperative (dominated)
In this instance, each party's selection of a (strongly) dominant action which is based on individual strategy leaves each of them worse off [10,10] than if each had chosen the more cooperative dominated action [2,2]. "The combination of (what appears to be) their individual rationalities leads them to forgo an attainable better situation and thus is Pareto-suboptimal. [equilibrium]" (Nozick, 1993, p 50)

II

2.1 Argument for dominance action.
First, He mentions the two familiar arguments for dominant and cooperative approaches and then he begins to present his new insights. For dominate strategy he states that:

> "Each prisoner reasons "If the other person confesses and I don't, I will receive twelve years in prison; whereas if I do confess, I will receive ten years. If the other person doesn't confess and I don't, I will receive two years in prison; whereas if I do, I will receive no years at all. In either case, whichever thing the other person does, I am better off confessing rather than not. Therefore, I will confess." (Nozick, 1993, p 50)

And for cooperation strategy he says:

> "Some people have argued that a rational person in this situation, knowing that the other also is a rational person who knows as much about the situation as he himself does, will realize that any reasoning convincing to himself will be convincing to the other as well. So if he concludes the dominant action is best, the other person will as well; if he concludes the cooperative action is best, the other person will as well. In this situation, then, it would be better to conclude the cooperative action is best and, realizing all this, he therefore (somehow) does so." [Both don't confess 2,2] (Nozick, 1993, p 51)

He assumes that all agents have some common knowledge that others are rational persons and they are roughly aware of their dispositions based on this common knowledge. It seems that this situation is more similar to translucent cases in Nozick articles.

In response to this question that "What should rational agents do?" Nozick respectively present three concepts referring to three kinds of relation between actions and outcomes, and concludes that each of them has some effects in our decision value.

Assuming that Standard utility is the sum of the utilities of its (exclusive) possible outcomes, weighted by their probabilities, which sum to 1.
$EU(A) = \text{prob}(O1)\ u(O1) + \text{prob}(O2)\ u(O2) + \ldots + \text{prob}(On)\ u(On)$,

We can define the first two moods as follows:
Evidential expected utility(EEU):
refers the outcomes which are not probabilistically independent of the actions, and "specifies the expected utility as weighted not by the simple probabilities of the outcomes but by the conditional probabilities of the outcomes given the actions. "(Nozick, 1993, p 43)

$EEU(A) = \text{prob}(O1/A)\ .\ u(O1) + \text{prob}(O2/A)\ .\ u(O2) + \ldots + \text{prob}(On/A)\ u(On)$,

Causal expected utility(CEU):
Refers to the "causal decision theorists too use not simply the unconditional probability of the outcome but a probability relating the outcome to the action, this time not simply the conditional probability, prob($Oi/\ A$), but some causal-probabilistic relation indicating direct causal influence. "in CEU we still have conditional probability however we count just causal relation between actions and outcomes, not merely and evidential relation. The formula of utility calculating for CEU maximizer is the same of that of EEU, however, form CEU maximizer the probability of (O/A) in evidential cases is 0 – not defined.

So, "Causal decision theory recommends performing the dominant action; evidential decision theory recommends performing the cooperative action when you think the other party is relevantly similar to yourself." (Nozick, 1993, p 52)
According to Nozick, decision value of each action is not simply defined just with standard expected utility maximization principle, but with a more complicated formula which gives some weight to CEU and EEU as well.

$DV(A) = Wc\ .\ CEU(A) + We\ .\ EEU(A)$
Using two examples, Nozick shows that how the weight we give to CEU or EEU vary in different cases and how it has effective influence on DV.

Example 1 : CM is rational (Figure 4)
In Figure 4 where "the matrix entries are such utility numbers, we would think that cooperation is the rational choice. In general, when the cooperative solution payoffs [optimal] are very much higher than the dominance ones [suboptimal], and when payoffs for the nonmatching actions offer

only slight gains or losses over these two, then we strongly will think that cooperation is rational and will find that the dominance argument has little force." (Nozick, 1993, p 53)
In this case optimal outcome (1000) is much better than dominate outcome (1) and maximum outcome (1001) is just a little bit better than optimal one. So, an agent (whose is straightforward maximizer) prefer to follow EEU and would choose optimal outcomes which is no risky.
[optimal >> suboptimal]
[Maximum ~ optimal]

		II	
		C′	D′
I	C	1,000, 1,000	0, 1,001
	D	1,001, 0	1, 1

FIGURE 4

Example 2: dominant is rational (Figure 5)
However, in figure 5, "the cooperation solution is only slightly better than the dominant one, and the extreme values in the payoffs for the nonmatching actions diverge greatly. When we have no special ties to the other party or particular knowledge of the other party's probabilities of action, then we will think it is rational to perform the dominant action in the figure 5 situation, not running any risk that the other party will perform his dominant action, which he has a large incentive to do. (And if I go through this reasoning and think he also is very likely to be like me, then I may well settle upon the dominant action in this case, comfortable with the realization that he will also.) "(Nozick, 1993, p 53)
In this case, a maximum outcome (500) is much greater than the optimal (3) and the optimal one is just a little bit better than the dominant (2) outcome. So, in this cases the agent who gives more weight to CEU ignore any evidential utility just because the fact that from his point of view, the only acceptable probability is that of causal relation. So, form a CEU maximizer the value of EEU would be 0.

[Maximum >> optimal]
[optimal is just slightly better than suboptimal]
[Risk is low, for I gain either 500 or 2
And I lose just 1 by comparison to optimal]

		II	
		C′	D′
I	C	3, 3	–200, 500
	D	500, –200	2, 2

FIGURE 5

2.2. The Impact of the weight assigned to CEU and EEU

"These shifts in the decision one would make, which depend upon the (ratios of the differences in the) particular numerical utility entries in the matrix, are in accordance with the earlier principle of maximizing decision-value for people who give some weight to each of the particular principles *CEU* and *EEU*. At what precise point a person's decision will shift as the utilities are varied will depend upon how confident she is in each of these principles (that is, what weights she implicitly assigns to them) and also upon the probabilities she assigns to the other person's action being the same as her own." (Nozick, 1993, p 48)

2.3 The Third mode: Symbolic utility

Due to a more realistic theory for rationality, Nozick states that in the real world our actions have some symbolic value and it greatly effects on our relationship with others. He means that in addition to CEU and EEU there is still another relationship between action and outcome which is applied in a broader scope. Nozick states that "Yet the symbolic value of an act is not determined solely by *that* act. The act's meaning can depend upon what other acts are available with what payoffs and what acts also are available to the other party or parties. What the act symbolizes is something it symbolizes when done in *that* particular situation, in preference to *those* particular alternatives." (Nozick, 1993, p 48)

Nozick defines SU as follows:

> "The symbolic utility of an action *A* is determined by *A*'s having symbolic connections to outcomes (and perhaps to other actions) that themselves have the standard kind of utility, just as the *CEU* of *A* is determined by *A*'s causal-probabilistic connections to outcomes with the standard utility." (Nozick, 1993, p 48)

Taking SU into account, Nozick final DV formula would be as follows:

$DV(A) = Wc \,.\, CEU(A) + We \,.\, EEU(A) + Ws \,.\, SU(A)$.

SU is the utility of the various out-comes and actions *symbolized* by the act, with its own associated weight *Ws*.

He believes that SU is a utility applied to an action rather than an outcome. And SU, like CEU and EEU, is not a different kind of utility, but it is just a third relationship between action and outcomes. "Symbolic utility is not a different kind of utility, standing to standard utility in something like the way that metaphorical meaning stands to literal. Rather, symbolic utility is a different kind of *connection*—symbolic—to the familiar kind of utility. It stands alongside the already familiar connections, the causal and the evidential." (Nozick, 1993, p 48)

Contextualism aims at a rational decision based on the relevant items in the context (Afroogh 2019; Afroogh 2021), and Nozick will follow a version of this approach. According to Nozick , SU can be the value of cooperative action is some cases However, it doesn't mean that SU equals to the value of cooperation strategy. The SU might be the value of acting individually in a decision situation, and it completely relevant to contexts and agents character. As Nozick mention in the las part of his clarification on SU:

> "To say all this about symbolic utility is to say that our responses to the Prisoner's Dilemma are governed, in part, by our view of the kind of person we wish to be and the kinds of ways we wish to relate to others. What we do in a particular Prisoner's Dilemma situation will involve all this and invoke it to different degrees depending upon the precise (ratios of differences among) utility entries in the matrix and also upon the particular factual circumstances that give rise to that matrix, circumstances in which an action may come to have its own symbolic meanings, not simply because of the structure of the matrix." (Nozick, 1993, p 57)

2.4 Decision value formula by Nozick

So, the decision-value of the act for him will depend upon all three of these things—its *SU*, *CEU*, and *EEU*—and upon the weights he gives to these. Thus,

$DV(A) = Wc \,.\, CEU(A) + We \,.\, EEU(A) + Ws \,.\, SU(A)$.

(Nozick, 1993, p 56-57)

So, cooperative action is not always the rational decision. The cooperative action will be performed if the causal, evidential, and symbolic utilities interact so as to lead to this.

So, "The framework of decision-values, with its incorporated weights that can be altered over time, is one way that a fetting to the actual world can be accomplished." (Nozick, 1993, p 48)

III

Conclusion

In contrary, Nozick is not a cooperation fan and he defends of cooperation strategy only if his DV formula leads us to it. he presents very effective insights and helpful suggestion to make a more realistic theory on rationality in these cases. Proposing three causal, evidential and symbolic items, his theory would explain more commonsensical extensions and it shows that it has more explanatory power.

Two reflections

1.It seems to that if we want to have a more realist theory on rationality, we need to consider some more items including morality.

Hobbes believes that it is not reasonable to be unjust, because it is not reasonable to believe that doing so you can maximize your utility; And Gauthier (1990) and Nozick agree that the most important way to prove the rationality of a strategy is to calculate EU for the agent, however, they disagree about different items that are involved in this calculation. So, it seems that all of them presuppose very strong link between rationality and *egoism*. A strategy is rational if and only if you can maximize ***your*** expected utility. The only difference between Nozick and Gauthier is that he is a smarter egoist person who, in addition to straight EU, pay attention to three other important item to maximize his utility.

However, in the real world, sometimes we see that a rational person decides in a way that maximize just the expected utility of her partner. Assume a prisoner (B) who is very good and moral person, and based on his altruistic belief, he wants to take a strategy which maximize her partner's utility. And imaging that her partner is an orphan kid which is not a very rational person and high probably will do based on individual strategy. So, the kid will get no year sentence, and B will get 12 years sentence. It would be exactly against the outcomes proposed by the principle of maximizing expected utility.

Reply:

What is meant by "utility" is not just monitory or material values. You can consider the moral value as the utility which you expect to maximize through doing some action. Utility would be defined based on your believes and desires whatsoever. So, for B the utility of being 12 years in prison would be the maximized utility.

2. Given that constrained maximization proposed by Gauthier is a theory of rationality and is a *criterion for rationality*, and that would be the best answer for the main questions in prisoner's dilemma i.e. "Which of them is *rational* decision maker, SM or CM?"

"What should *rational* agents do? SM or CM"

Then, what definition of rationality Is presupposed in these questions? Isn't it circular?

Reply:

It seems that it would be circular discussion on rationality, however it is not a vicious circularity. It seems that what is happening here is analogous to *reflective equilibrium* method in conceptual analysis of knowledge by epistemologists. The reflective equilibrium method in epistemology is used to give the best theory which explains the most commonsensical extensions of 'knowledge' in the ordinary language, however, here it seems that this method is used here to explain some intuitive extensions of rationality, but just in the context of economy, statistic or decision theory.

References:

Axelrod, Robert and Douglas Dion, 1988, "The Further Evolution of Cooperation," *Science*, 242 (December 9): 1385–1390.

Aumann, Robert, 1995, "Backward Induction and Common Knowledge of Rationality," *Games and Economic Behavior*, 8: 97–105.

Afroogh, Saleh, (2021) A Contextualist Decision Theory.10.13140/RG.2.2.24234.24005

Afroogh, Saleh. "A Contextualist Decision Theory." *arXiv preprint arXiv:2101.08914* (2021).

Afroogh, Saleh, (2019). Contextual Reason and Rationality. Master's thesis, Texas A&M University. Available electronically from http : / /hdl .handle .net /1969 .1 /186349.

10.13140/RG.2.2.21462.06726

Afroogh, Saleh. "De Dicto Cognitive Reason Contextualism."(2020)

Batali, John and Philip Kitcher, 1995, "Evolution of Altruism in Optional and Compulsory Games," *Journal of Theoretical Biology*, 178: 161–171.

Bendor, Jonathan, 1987, "In Good Times and Bad: Reciprocity in an Uncertain World," *American Journal of Political Science*, 31: 531–558.

Carroll, J.W., 1987, "Indefinite Terminating Points and the Iterated Prisoner's Dilemma," *Theory and Decision*, 22: 247–256.

Farrell, Joseph, and Roger Ware, 1989, "Evolutionary Stability in the Repeated Prisoner's Dilemma," *Theoretical Population Biology*, 36: 161–167.

Gauthier, David, 1986, *Morals By Agreement*, Oxford: Oxford University Press.

Howard, J.V., 1988, "Cooperation in the Prisoner's Dilemma," *Theory and Decision*, 24: 203–213.

Kraines, David and Vivian Kraines, 1989, "Pavlov and the Prisoner's Dilemma," *Theory and Decision*, 26: 47–79.

Kreps, David, Paul Milgrom, John Roberts and Robert Wilson, 1982, "Rational Cooperation in the Finitely Repeated Prisoner's Dilemma," *Journal of Economic Theory*, 27: 245–252.

Kendall, Graham, Xin Yao and Siang Yew Chong, 2007, *The Iterated Prisoners' Dilemma: 20 Years On*, Singapore: World Scientific Publishing Co.

Lewis, David, 1979, "Prisoner's Dilemma Is a Newcomb Problem," *Philosophy and Public Affairs* 8: 235–240.

Nozick, R. 1993. *The Nature of Rationality*. Princeton, NJ: Princeton University Press, 50-59

Nozick, Robert, 1969, "Newcomb's Problem and Two Principles of Choice", in N. Resher (ed.), *Essays in Honor of Carl G. Hempel*, Dordrecht: D. Reidel, 114–146; reprinted in Cambell and Snowden 1985, 107–132.

Poundstone, William, 1992, *Prisoner's Dilemma* New York: Doubleday.

Segal, Nancy and Scott Hershberger, 1999, "Cooperation and Competition Between Twins: Findings from a Prisoner's Dilemma Game," *Evolution and Human Behavior*, 20: 29–51