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COLLECTIVE DECISION MAKING AS THE ACTUALIZATION OF DECISION POTENTIAL

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ABSTRACT

This paper presents some characteristics and dilemmas of collective decision making. Collective decision making could be presented as the process of successive crystallization of dominant alternatives under the influence of different decision contexts from primary given decision potentials. This process is presented as the many-phased process of the acting of contextually dependent "energizing factors" of the collective decision making on the "attractiveness matrix" of outcomes of collective decisions. The attractiveness matrix determines the attractiveness for each alternative of decision, and the most attractive alternative in the given situation presents the rational decision in the given situation. In the final phase of decision making holds a context which gets a simplified attractiveness matrix. It corresponds to the common decision for one of the alternatives.

KEY WORDS

collective decision making, rationality, decision potential, joint outcomes, energizing

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DECISION MAKING AND RATIONALITY

Decision making is understood here as the process and act of making a choice by agents (individuals, groups, institutions) among many possible courses of action, evaluation, feeling, and thinking in a given situation. Decision making as an act can be entirely "mental" or it may also be physical, i.e. expressed in the external environment. Decision making can help us reduce the complexity of a situation and bring down its associated doubts and uncertainties to a manageable level. It is an act which (usually) leads to another act, for example the execution of one of the alternative actions. Very few decisions can be made with maximal certainty. Thus the majority of decisions merely reduce the complexity of a situation or problem: the problem is not completely eliminated or fully resolved. This is because agents only rarely possess perfect knowledge about all alternatives and possible results, and likewise they also do not have entirely clear and uniform preferences (desires, interests, needs). For this reason decision making normally contains elements of uncertainty and risk. Experience as well as scientific research show that these uncertainties are fewer if our thoughts and decisions take place based on "sound reasons" and not *ad hoc*, by chance, under the pressure of circumstances, and so on. In this sense *rational decisions* are exceptionally important, i.e. decisions that are based on good, appropriate, and sufficient reasons. But what these reasons are and how we arrive at them and at rational decisions is a difficult and unresolved question.

1. In this text I take *rationality* to mean *the ability to think or act on the basis of reasons which can stand up to criticism.*[1]
2. Under "thinking" I include an extensive field of human cognitive processes to which we may give propositional content, i.e. content expressed in the form of propositions. Under "acting" I include behavior to which we can ascribe teleologicality.

Research on the rationality of decisions is important because it can improve the so-called intuitive decision making of individuals or groups. This is a process of searching for mental or practical options which evoke the optimal intellectual and emotional responses of agents in a decision making situation. Although intuitive decision making can frequently be rapid and it is accompanied by feelings of satisfaction and strong motivation for the realization of the decisions taken, it can also mislead, since agents may not take sufficiently into account all the alternatives and in this way may they may miss a better solution to the problem. Intuitive decision making frequently overlooks important factual information, and it is powerfully influenced by the prejudices, feelings, and desires of agents. Intuitive group decision making is particularly prone to numerous psychological pressures such as the pressure to achieve the greatest consensus in a group (the phenomenon of "groupthink"), overlooking critical information [3].

Evaluating the rationality of decision making is frequently quite complex, since we must take into account a whole range of cognitive and contextual factors. For this reason in practice we often simplify things by, for example, taking as the norm of rationality a certain idealized model of rational decision making. Among such models are, for example, logical models of problem solving, the classical model of rational choice, models from game theory and models of practical reasoning. These models contain some fundamental idealizations such as the assumption of logical coherence of the beliefs of agents, the assumption that in their decisions they always strive for the maximization of expected utilities, the assumption of the perfection of comparisons among possible choices (for any choice we can say that one is more attractive than another or that we do not give priority to any among them), the transitivity of choices (if an agent prefers choice A over choice B and prefers choice B over choice C, then she will prefer A over C), the assumption that rational agents follow the basic

principles of logic and the theory of probability, etc. [4, 5; p.261-277]. These models further assume that people make decisions based on the expected benefits offered by individual alternatives of action and with respect to preferences among choices, that they are capable of "calculating" the benefits (and costs) for each of the choices, and that in this way they maximize their benefit.

According to this model of decision making, among several alternative possibilities we select the alternative which has the greatest expected benefit with respect to the other alternatives, i.e. the greatest sum $u_1p_1 + u_2p_2 + ...+ u_mp_m$, where u_i is expected benefit (or utility) and p_i the expected probability of i-th outcome of decision making for the given alternative. I do not think this terminology is the most suitable, since the given sum represents more the *degree of attractiveness* (or simply *attractiveness*) of the alternative, not the expected benefit, since only individual outcomes can be beneficial in the light of the decision for the given alternative, and not the alternative itself. The product u_ip_i represents the *attractiveness of the outcome* for the agent in his decision making for the given alternative.

In seeking a rational decision we identify the expected benefits for all alternatives and then look for the alternative with the highest expected benefit. This represents the rational decision in the given circumstances. To the extent that this concerns a choice in social situations where our choice is dependent on the choices of other persons, we must then utilize the concept of *strategic game*, which is usually (though not always) a group situation in which participants on the basis of familiarity with their own preferences and assumptions about the preferences of their "co-players," and assuming the rationality and knowledge of co-players, select a strategy of action in such a way as to achieve with the greatest probability the maximization of the result for themselves (i.e. realizing the greatest number of their preferences and *eo ipso* minimizing possible "costs" or "losses.").

It is well known that idealized models and methods of rational decision making are not sure, since empirical research on decision making shows that they set measures of rationality which are too high, and people frequently diverge from them, even in cases of relatively elementary forms of deduction or probability reasoning. Our preferences are rarely as coherent as that required by the classical model of rational decision making. Moreover, we usually do not act as "rational egoists", that is, as persons who maximize (only) their own benefit. Many researchers have drawn attention to these facts; hence these findings have become generally accepted in modern studies of rationality, [6 – 9].

In discussions of the connections between everyday thinking and rationality, concepts have been developed of bounded and embodied rationality, which attempt to determine the optimal (if not the ideally maximal) means of problem solving and decision making under certain conditions, in which our cognitive limitations, the characteristics of the environment, the problems which people try to solve, and the architecture of human cognition are taken into account, [10 – 13]. From this perspective criticism of certain thoughts, decisions, and acts is possible as to whether they are rational or not, or even irrational, but at the same time it is also possible to explain the action, which does not imply indirect justification of the action.

A somewhat different direction of thought is one that introduces two or more kinds of rationality or systems of thought in which not all errors in thinking and decision making can be explained by means of accidental errors in thinking or by means of computational limits to the human cognitive apparatus. It seems reasonable to infer systemic sources of these errors, though this does not eliminate rationality in general[2].

COLLLECTIVE DECISION MAKING

When I refer to collective decision making, I limit the discussion to relatively small, informal groups, and exclude a discussion of the rationality of large collectives or institutions. I accept this limitation first of all due to the limited scope of the discussion and secondly because an analysis of decision making in relatively small, informal groups is of crucial importance for all collective decision making, since many features of collective cognition in small groups are "inherited" in larger and more formally constituted groups. Similarly, I limit this paper to only those characteristics of cognitive processes in groups which can be captured in the repertory of modern cognitive science and for which we can for example find heuristic computer models.

At first glance we may assume that the interaction of individuals who strive towards rational decisions would as a rule lead to rational collective decisions. Although this is often the case (for example the operation of the market under conditions where there are no major disturbances in the flows of labor, goods, and money), we know from everyday practice as well as scientific observation of the functioning of groups that this is not always so. Some examples of this type are standard dilemmas of individual decision making in a collective context and they are often formally treated using game theory.

These problems belong in the wider set of *problems of collective action*. John Elster notes that a group encounters a problem of collective action when it is better for everyone if some of its members participate in an action than if no one participates, but it is better for each individual to not participate, [17; p.126]. It is interesting that people often solve these problems without excessive complications. Experiments with real people in real situations of a similar type have shown that people are more cooperative and more successful in cooperation than indicated by various theories of individual rationality. Strictly speaking, according to these theories cooperation among people is often not even possible simply because it is an irrational behavior. Experiments and computer simulations on strategic game behavior have shown that cooperation increases if the "games" continue (and it is not specified when the repetitions will end), or if the actors know their partners and have cooperated with them on other occasions, [18]. Roughly speaking, the following holds: the more cooperation there was in the past, the more we can expect in future.

In his well known work "The Logic of Collective Action" [19], Mancur Olson noted that people generally cooperate in order to provide some common good when *they work in relatively small groups and members can expect a clear benefit from cooperation*, or if *members are required to cooperate* or if there exist *particular incentives for cooperation*. The organization of a group can contribute to the greater cooperation of its members, but not necessarily. Organization is essential in large groups, where the contributions of individual members are not at all evident to others ("anonymity of cooperation"). Elster's view is that it is a mistake to assume that we cooperate purely due to our own interests, or that we are always driven by some particular motive. Different motivations of individuals, which may be rational or non-rational, are connected to one another in groups, and reinforce one another [17; p.397].

In many instances of cooperation there is a need to coordinate the actions of many individuals. For this reason decision making for cooperation takes place under the tacit or explicit assumption that others are prepared to coordinate their actions with other individuals. Such for example is decision making for a trip taken together, a dance with a partner, playing music in a band, cooperating in some group game, and even for such simple things as decision making for a walk together in the park. Here people rely on a *joint* assumption of all those involved in cooperating: that each among them will strive to fairly perform their part of the joint activity. All further decisions of the members of the group then take place alongside

this tacit assumption. If we tried to establish the thinking of the agents as some sort of practical conclusion, then we would have to make a *joint* practical conclusion for all participants with several premises which sum up their particular mutually coordinated aims and means of action and a *common rule of rationality*, which alongside the given premises would necessarily require the execution of the decision on the mutually coordinated action of all agents[3].

This would exceed the scope of so-called methodological individualism in explanations of collective actions and decisions.

THE CRYSTALLIZATION OF COLLECTIVE DECISIONS

It seems that we must assume a process of gradual or rapid crystallization of the mutually coordinated rational decisions of individual actors in collective decision making, which clashes with schemes of rational decision making by individuals (with either "perfect" or "limited" rationality). The concept of gradual crystallization of rational common solutions, rules, and norms is reminiscent of the concept of *focal points*, which is the topic of much discussion by game and rationality theorists. This is the explanation of the finding by Thomas Schelling: that people coordinate their behavior in such a way that all benefit, even though they do not have any explicit shared beliefs or perceptions which would lead them to coordination [21]. But there exist certain implicit guidelines for coordination, which in a given situation are salient. These guidelines are called "focal points of coordination."

I assume that the *extent and quality of reasons and arguments* for various assertions or decisions which members of the group put into "circulation" and the mutual attachment of these reasons contribute significantly to the crystallization of collective decisions. Some arguments in the flow of discussion contribute more to guiding the discussion towards a possible solution of the problem, while others express the "mood" and give the discussion a special feeling of, for instance, "energizing" the discussion. For a successful decision or series of decisions that lead to the solution of a problem, both elements are needed: "the right direction" as well as adequate "energy".[4]

This can happen through a series of opposing viewpoints and arguments which continues until no one has anything more to add, or it comes to an end due to time limits, or it is an explicitly collaborative discussion in which each person strives to support a joint conclusion or finds the best possible answer to some question, but everyone avoids conflict within the group.

The process can be compared to the collapse of a wave function in quantum mechanics, which due to the influence of measuring the space of potential activations of the physical system is reduced to one of the possibilities. The structure of implicit values of different possibilities (alternatives) of functioning is adequate for the space of potentiality, but these alternatives do not appear as elements of logical disjunction but rather as some sort of "entanglement" of possibilities which is resolved only by the process of decision making or more precisely by the viewpoints and arguments in the discussion and the energizing of the discussion. According to this analogy, the decision plays a similar role to the effect of an experiment or observation in quantum physics: the dissolution of entanglement to a given "observable value". An important difference is that physical observation is usually a single and almost momentary intervention in the microprocess which in one step collapses the entanglement, while decision making is frequently the result of a discussion in a group, which is a process which takes place in different phases and in which a given choice is (usually) actualized gradually. There are some mathematical models of decision making based on the quantum mechanical model, but none are structured for collective decision making, [23 – 25]. However, the question arises as to what the possibilities are for their extension to an analysis

of collective decision making. I do not myself attempt to imitate the quantum mechanical formalism, but rather simply apply merely some general ideas which require a different formalism. I will illustrate my idea in a simple case of collective decision making.

JOINT OUTCOMES AND JOINT ATTRACTIVENESS OF OUTCOMES

Let us take the simple case of decision making between two alternative actions in a group of two $G = (a, b)$, who are deciding between just two alternatives A and B. In so doing they take into account just two significant outcomes or results of the action, e and f. Each of them evaluates these alternatives according to different measures, for example, according to how expected (probable) the outcomes appear to them. Let us assume that we have available the assessments of the conditional probability $p(A, e)$, $p(A, f)$, $p(T, e)$, $p(T, f)$ for both individuals and how beneficial or desires these outcomes appear to them $u(A, e)$, $u(B, e)$, $u(A, f)$, $u(B, f)$ for both alternatives. Let us assume that all benefits are normatised in the interval [–1, 1], and probabilities in the interval [0, 1]. The product of the probability assessments and the assessments of the beneficiality (utility) of the outcome of the person for the given alternative expresses the *attractiveness of this outcome* for that person in deciding in favour of the given alternative.

Let us take as a specific case of this collective decision making a husband (a) and wife (b) who are deciding where to go in the evening. Let us assume that there are only two possibilities which are of interest to them, that they go to the cinema (A) or to the theatre (B). In this they take into consideration two significant outcomes or results of the action, entertainment (e) and cultural enjoyment (f).

Let us assume that for them the following estimates of probability and beneficiality apply:

$p_a(A, e) = 0{,}7$	$p_a(B, e) = 0{,}5$	$u_a(A, e) = 0{,}7$	$u_a(B, e) = -0{,}2$
$p_a(A, f) = 0{,}4$	$p_a(B, f) = 0{,}6$	$u_a(A, f) = 0{,}6$	$u_a(B, f) = 0{,}5$
$p_b(A, e) = 0{,}6$	$p_b(B, e) = 0{,}6$	$u_b(A, e) = 0{,}5$	$u_b(B, e) = 0{,}6$
$p_b(A, f) = 0{,}4$	$p_b(B, f) = 0{,}7$	$u_b(A, f) = -0{,}1$	$u_b(B, f) = 0{,}8$

Thus for the husband and wife going to the cinema as well as going to the theatre bring a certain measure of entertainment and cultural enjoyment, but the husband and wife evaluate these two outcomes with differing conditional probabilities and differing degrees of beneficiality (usefulness)[5].

Under realistic conditions the assessments of probability and beneficiality of outcomes are dependent on how each individual assesses their partner, for example how competent and reliable they are, and how willing they are to cooperate. This means that for example the probability $p_a(A, e)$ is dependent on what a expects person b to do if he observes that a is leaning towards or deciding for A, and that a expects outcome e. Likewise for the beneficiality of expected outcomes. For the sake of simplicity I assume that at least at the beginning of the process of decision making these evaluations do not change much, hence the individual then in all combinations of decisions of members of the group for given alternatives calculates the same assessments of probability and beneficiality of outcome as they would be if he were deciding by himself. These assessments can later change under the influence of discussion between two personas and other interactional factors. In this case the assessments of probability and beneficiality of a given outcome for an individual in his decision for a given alternative can change with respect to how other members of the group decide or with respect to what the individual expects other members of the group to do[6].

In the case of collective decisions we must observe *assessments of possibility* that actors simultaneously decide in favour of different alternatives and count on (in general) different

outcomes of their decisions. It is essential that these decisions occur simultaneously and in mutual association. I am referring to "joint decisions" and "joint outcomes". In order to assess the attractiveness of these possibilities we must take into account *the average of the probabilities* of the expected outcomes and the *average* of the assessments of *beneficiality or desiredness of outcomes*. The joint outcome of decision making of *k* members of a group can be presented in a series of *k* pairs (selected alternative, expected outcome), where each pair suits the possible outcome of the decision in favour of a selected alternative for a given member of the group. Each member of the group assesses the conditional probability of the occurrence of an outcome (given the decision in favour of a given alternative). The assessment of the conditional probability of a joint outcome is equal to the average of the probability assessments of all particular outcomes which appear in the joint outcome, and similarly the assessment of beneficiality of a joint outcome is equal to the average of the assessments of beneficiality of all particular outcomes which occur in a joint outcome. The product of the assessments of conditional probability and assessments of beneficiality of the joint outcome express the *attractiveness of the joint outcome*, while the sum of attractiveness of all such joint outcomes in which all members of the group decide in favour of the same alternative expresses the *attractiveness of this alternative*[7].

To the extent that all members of the group simultaneously decide in favour of the same alternative, it is a *coordinated* or *collective decision*. In this respect members of the group in general count on different possible outcomes of their individual decisions. I refer to "coordinated (joint) outcomes."

In my model of collective decision making I assume that members of the group weigh their alternatives for action from the perspective of the group, i.e. they implicitly assess the *attractiveness* of the joint outcomes and alternatives and compare them to one another. In this it is not necessarily the case that they make a decision *only on the basis of these comparisons.* Other factors also influence the actual decision, but this does not necessarily mean that the group is irrational. Among some of the most important factors are changes in the attractiveness of outcomes of decision making for particular alternatives due to the assumptions of actors involved in the decision making, the extent to which other members of the group are interested in or committed to the alternatives given, and how they assess the individual joint outcomes. The group of actors decides rationally if it decides in favour of the choice of alternatives which in the given circumstances has the highest degree of attractiveness.

The decision making situation in the group of actors can be illustrated using different formal methods, for example with the help of appropriate vectors or matrices of joint outcomes. We can specially design a matrix of probability estimates and a matrix of beneficiality estimates of joint outcomes. For our purposes the most suitable is the *outcomes attractiveness matrix* $\boldsymbol{At}_{\mathrm{G}}$ for group *G* (in general this is a more than two dimensional matrix), which merges both matrices mentioned into one. Such a matrix illustrates the mutual implicit complexity of the alternatives of action in the space of common action (in our case the space of joint action by a pair). It represents a kind of *potential for decision making* of the group.

In the case of two people (*a, b*), two alternatives (*A, B*) and two possible outcomes which are important for decision making (*e, f*), we can create the following table or initial outcome attractiveness matrix:

e *f*	*A, e*	*A, f*	*B, e*	*B, f*
A, e	$(p_a(A, e) + p_b(A, e))/2$ $(u_a(A, e) + u_b(A, e))/2$	$(p_a(A, e) + p_b(A, f))/2$ $(u_a(A, e) + u_b(A, f))/2$	$(p_a(A, e) + p_b(B, e))/2$ $(u_a(A, e) + u_b(B, e))/2$	$(p_a(A, e) + p_b(B, f))/2$ $(u_a(A, e) + u_b(B, f))/2$
A, f	$(p_a(A, f) + p_b(A, e))/2$ $(u_a(A, f) + u_b(A, e))/2$	$(p_a(A, f)\, p_b(A, f))/2$ $(u_a(A, f) + u_b(A, f))/2$	$(p_a(A, f) + p_b(B, e))/2$ $(u_a(A, f) + u_b(B, e))/2$	$(p_a(A, f) + p_b(B, f))/2$ $(u_a(A, f) + u_b(B, f))/2$
B, e	$(p_a(B, e) + p_b(A, e))/2$ $(u_a(B, e) + u_b(A, e))/2$	$(p_a(B, e) + p_b(A, f))/2$ $(u_d(B, e) + u_b(A, f))/2$	$(p_a(B, e) + p_b(B, e))/2$ $(u_a(B, e) + u_b(B, e))/2$	$(p_a(B, e)\, p_b(B, f))/2$ $(u_a(B, e) + u_b(B, f))/2$
B, f	$(p_a(B, f) + p_b(A, e))/2$ $(u_a(B, f) + u_b(A, e))/2$	$(p_a(B, f) + p_b(A, f))/2$ $(u_a(B, f) + u_b(A, f))/2$	$(p_a(B, f) + p_b(B, e))/2$ $(u_a(B, f) + u_b(B, e))/2$	$(p_a(B, f) + p_b(B, f))/2$ $(u_a(B, f) + u_b(B, e))/2$

If we use our case of the husband and wife who are deciding where to go in the evening, we obtain this initial outcome attractiveness matrix[8]:

e *f*	*A, e*	*A, f*	*B, e*	*B, f*
A, e	0,390	0,165	0,423	0,525
A, f	0,275	0,100	0,300	0,385
B, e	0,083	-0,038	0,110	0,180
B, f	0,300	0,110	0,330	0,423

So long as no decision is made, then the two people remain at the implicit entanglement of different possibilities. If they decide on one, then each of them "chooses" the appropriate alternative (*A* or *B*) and expects a certain outcome (*e, f*). It is not necessarily the case that both persons decide for the same alternative or they expect the same outcomes. Only when the persons choose the same alternative can we refer to their *common decision*. In the case where they choose different alternatives in their mutual interaction we can refer only to their *individual decisions under the influence of the group*.

The outcome attractiveness matrix expresses the *implicit entanglement of possible choices,* similar to the quantum entanglement of the states of several mutually interacting subatomic particles. The aggregate quantum state of particles which are connected by for example, common origin, can be shown mathematically by means of the so-called direct (or tensor) product of the vector spaces of the states of particles which participate in the collective state. In simple cases this is the direct product of two vectors[9].

This product is illustrated by a matrix which expresses the quantum entanglement of possible associated states of the particles. Some of the possible associated quantum states represent the possible outcomes of observations or interactions of the system with the environment. As is known from quantum physics, the interaction of such a system of particles with a measuring apparatus can collapse the wave function of the system in such a way that one of the possible outcomes is actualized as the "measured result." Metaphorically we could say that the quantum system "decides" in favour of a certain possibility [26; pp.255-262]. Here we can predict only the probability of the system "deciding" for that possibility, we cannot predict with any certainty.

Similarly we can say that the influence of the context of collective decision making operates on the fact that the group chooses one among the possible collective decisions. In the case of our couple who is deciding whether to go to the cinema or to the theatre, based on the given attractiveness matrix, the (initial) attractiveness of alternative *A* amounts to 0.930, and the attractiveness of alternative *B* to[10] 1.043.

If we take into consideration only those two values, it is rational for both to go to the theatre. In the example given there also appear nonzero degrees of attractiveness for non-coordinated outcomes, and thus we must take into account in the assessment of the rationality of decisions the attractiveness of non-coordinated decisions, i.e. the situation in which *a* chooses *A*, and *b* chooses *B*, and the situation in which *a* chooses *B*, and *b* chooses *A*. The attractiveness $At((A)_a(B)_b)$ of the first situation is 1.633, and the attractiveness $At((B)_a(A)_b)$ of the second situation is[11] 0.455.

If we consider all four possibilities for the joint decision making of two people, we see that the non-coordinated decision in which *a* chooses *A* and *b* chooses *B* predominates. If there is no additional motive for a *common* decision, then the husband decides to go to the cinema and the wife decides to go to the theatre. But there is a problem, which may inhibit their common decision in favour of the same alternative. In the case given, the difference between $At_{ab}(A)$ and $At_{ab}(B)$ is relatively small. Even if the two people gave priority to a coordinated decision over a non-coordinated decision, it is not clear in advance whether our couple would decide based on the initial attractiveness of the alternatives. If the difference between the (initial) attractiveness of *A* and of *B* is large, then it is quite probable that our couple would decide to go to the theatre. But it is more probable that the discussion between them would continue further. They might seek additional information about both alternatives and all this would change the context of decision making, in particular their commitment to the given alternative. They could also form some further alternative, such as "let's stay home", which changes the decision making situation and along with it the matrix of attractiveness of outcomes. Decision making then takes place on a new level. If even then they do not arrive at a decision, the two continue to discuss and seek additional information and arguments in favour of or against the relevant alternatives. This takes place until such time that the actors arrive at a final decision. This can be a common decision for one of the alternatives or a junction of two different decisions (for example, the husband goes to the cinema and the wife goes to the theatre)[12].

Even then, if individuals aspire to a common decision, the matrix of attractiveness of outcomes does not entirely determine the decision of the group. We may speak only of a certain probability of a decision in the given context of decision making. An important role is played by the *context of decision making*, for example the emotional commitment of the cooperating individuals to a common decision and the power of arguments provided in the discussion. This context changes the matrix of attractiveness of outcomes, which is set up for the initial or previous phase of decision making. I say that the context of decision making creates different *energizing shares of the group for particular joint outcomes* and indirectly for deciding on particular alternatives. This context can change the attractiveness of joint outcomes in such a way that the attractiveness of a given alternative is increased while the attractiveness of other alternatives (and in general, joint outcomes) is reduced. This is a systemic factor of the context of decision making which is dependent on the entire group of actors and the context of decision making. Each joint outcome corresponds to a particular energizing share of the group for that outcome. To the extent that we can observe the energizing of the group for coordinated outcomes which belong to the common decision in favour of the same alternative, we obtain a *degree of energizing of the group for decision making by the group regarding that alternative.*

The simplest formal determination of the energizing shares of the group for different joint outcomes is for them to appear as a group of factors which increase or decrease the attractiveness of joint outcomes. To the extent that this is a group which strives for coordinated action and common decisions, the energizing shares for non-coordinated joint outcomes can be simply ignored (they have a value of 0). It is reasonable to expect that in groups which strive for common action and decision making, the energizing shares of the group for various coordinated outcomes in decision making regarding the same alternative can be made uniform in the final phase of decision making. This suits the greater homogeneity of the group in the final phase of decision making and the unwillingness of members to engage in mutually clashing decision making. A more complex determination of the energizing shares would be if specific factors of the energizing of decision making corresponded to each possible decision of two persons (for example, both go to the cinema, both go the theatre, the first goes to the cinema and the second to the theatre, the first goes to the theatre and the second goes to the cinema). These factors can be in mutual associations which are listed by certain functional associations.

If factors of energizing of the group for particular joint outcomes are determined in this way, these factors operate simultaneously on the probability assessments and the assessments of the beneficiality of outcomes, in which we cannot precisely determine on what it operates to a greater extent and to a lesser extent. The energizing shares describe the system effects of the changes of the context and the internal interactional structure of the group on members of the group. Different energizing shares with respect to different joint outcomes also imply changing the probability assessments and the assessments of the beneficiality of individual outcomes with respect to which joint outcome an individual outcome belongs.

I assume that collective decision making takes place in several phases, and in each one the energizing of the group changes, i.e. the energizing shares for individual joint outcomes change. In each phase of decision making we may provide an assessment of the rationality of the decision making, namely, that it is rational for the group of actors involved in the decision making that they decide commonly for the alternative which has at that the highest degree of (common) attractiveness.

The energizing share of group $E_G(I)$ of group G for the joint outcome I increases or decreases the attractiveness of that outcome $At_G(I)$ achieved in the previous phase of decision making. Formally presented, the energizing share can be expressed as a real number $0 \leq E_G(I) \leq (At_G(I))^{-1}$. The new attractiveness $At'_G(I))$ is then equal to the product $At_G(I)E_G(I)$. The energizing of different joint outcomes operates in such a way that we obtain a new matrix of attractiveness $\boldsymbol{At'}_G$ of outcomes, in which the product of previous degrees of attractiveness and corresponding shares of energizing appear in individual fields.

It holds that decision making is all the more rational the more that the energizing shares of the group for coordinated outcomes (outcomes of collective decision making on equal alternatives) are mutually coordinated. Then a clear structure for the attractiveness of alternatives is formed, in which the commitment of members in favour of one of them corresponds to the "lack of commitment" to all the other alternatives. The homogeneity of the group means that members negotiate with one another as equal partners and do not form minority subgroups which oppose one another.

In the case that we have a group G consisting of two persons (a, b) who are deciding between two alternatives and count on two possible outcomes and there exists a high motivation of the group for common decision making, we obtain the following *matrix of energizing of group*[13] $\boldsymbol{E}_G$:

$E_{ab}(A, e,e)$	$E_{ab}(A, e, f)$	0	0
$E_{ab}(A, f, e)$	$E_{ab}(A, f, f)$	0	0
0	0	$E_{ab}(B, e, e)$	$E_{ab}(B, e, f)$
0	0	$E_{ab}(B, f, e)$	$E_{ab}(B, f, f)$

In this matrix we find the energizing shares of groups for different joint outcomes, in which those shares in the fields which belong to "mixed" selections of alternatives are equal to 0. This corresponds to the absence of motivation for different decisions by individual members. Both submatrixes which lie along the diagonal of the main matrix correspond to all possible joint outcomes in common decision making by two persons for *A* or for *B*. I call such a matrix a "polarized" matrix of energizing. If we apply this matrix to the previous matrix of outcomes, we obtain a new polarized matrix of attractiveness.

If in the process of decision making the energizing shares of the group become even more uniform, we obtain uniform shares of energizing in decision making by the group about individual alternatives, independent of the joint outcomes. Then we obtain (two) constant values: one ($E_{ab}(A)$) represents the degree of energizing of the group in deciding in favour of *A*, and the other ($E_{ab}(B)$) the degree of energizing of the group in deciding in favour of *B*.

In the case that the group is itself the context for decision making and it is willing to make only common decisions, we may take as the degree of energizing of the group in deciding for a certain alternative the *reciprocal value of the average of the common attractiveness of all other alternatives*[14].

This is of course an idealization of the conditions, which is acceptable if we assume that the group is homogenous and that its members decide rationally on the basis of implicit or explicit assessments of the outcomes of decision making. Then in the group there exists a correspondingly greater (or smaller) share of energizing in deciding about a given alternative according to the smaller (or greater) average common attractiveness of all other alternatives.

In our case of the husband and wife who are deciding about whether to go to the cinema or to the theatre, and who are determined to go together and the external context of decision making does not influence them, we may assume that in the phase of decision making which follows the initial situation (given by the original matrix of outcomes $\boldsymbol{At}_{ab}$), the share of energizing $E_{ab}(A)$ is equal to the reciprocal values from $At_{ab}(B)$, and the share of energizing $E_{ab}(B)$ is equal to the reciprocal value from $At_{ab}(A)$. This means that $E_{ab}(A) = 0.958$, $E_{ab}(B) = 1.075$. This gives us a new polarized matrix of attractiveness $\boldsymbol{At'}_{ab}$:

0.374	0.158	0	0
0.263	0.096	0	0
0	0	0.118	0.194
0	0	0.355	0.455

If we now calculate the common attractiveness of both alternatives, we obtain $At_{ab}(A) = 0.891$ and $At_{ab}(B) = 1.122$. Here too *B* is a more attractive alternative than *A*, but the difference between them has increased. If at the beginning the difference between alternatives *B* and *A* amounted to 0.113, it is now 0. 231, which may mean that our couple would commonly decide for *B*, that is, for going together to the theatre. We see that in the *situation* where the group is itself the context for decision making and it is motivated for common decisions, the advantage of those alternatives which had a slight advantage at the beginning increases gradually. This corresponds to the well known phenomenon from group dynamics, the

already mentioned *groupthink*. This phenomenon can shift the group from the truly rational decisions that critical and frank discussion among members of the group would lead to. Such discussion can change the inventory of arguments for and against particular alternatives and along with this the energizing shares of the group in deciding on particular alternatives. In this case the energizing shares change in the flow of discussion in such a way that the alternative which has been backed by the best arguments gains in attractiveness[15].

In the case that some external contextual factor has entered into this phase of decision making, the energizing of the group can be completely changed and turned around. Our couple may receive the information that the theatre performance has been moved up an hour and as a result they find themselves short of time. In that case it is probable that their somewhat greater commitment to go to the theatre is reduced in a moment and going to the cinema will gain in attractiveness.

The desire for coherence among the assessments of possible outcomes of decision making of members in common decision making for the same alternative probably has a strong influence on the dynamics of collective decision making. This tendency leads to members of the group having the same assessments of conditional probability and beneficiality (usefulness) of anticipated outcomes of decision making.

It is important that we determine how the context of the decision, in particular the commitment of the participants to making a decision, the intensity of the discussion, and the arguments provided combine to turn the potential for decision making into an actual decision. Viewed mathematically, the influence of the context is such that in the *final phase* it reduces the matrix of attractiveness $\boldsymbol{At}_G$ to a polarized matrix of attractiveness, in which one of the diagonals is located in the non-zero submatrix which corresponds to the joint decisions for individual alternatives, and the other fields acquire the value of 0.

On the basis of the finding that for a given group $G = (a_1, ..., a_k)$ and a particular alternative A_i**,** the attractiveness $At_G(A_i)$ is maximal, we can formulate a practical conclusion which illustrates a rational decision for this choice in a *certain phase* of decision making:

1. members of group G are deciding between A_i and other $(n\text{-}1)$ alternatives,
2. they are trying to achieve the most attractive results possible through their decision,
3. in a given phase of decision making there exist two polarized matrices, the matrix of energizing $\boldsymbol{E}_G$ and the matrix of attractiveness $\boldsymbol{At}_G$,
4. for members of G the attractiveness $At_G(A_i)$ is maximal with respect to all other possibilities of decision making.

Members of G *commonly* decide in favour of A_i.

It is interesting that here it is not necessary to add the complicated explicit assumptions of *common knowledge* or *common belief*[16] of the members of a group, for example the demand that the members of the group have common knowledge about how they assess the conditional probabilities and beneficiality of possible outcomes. However, these assumptions are present implicitly in the premises given. The practical conclusion cited does not determine the common decision of members of the group, but only illustrates in another way our (and perhaps their own) assessment of rationality of the given collective decision: it contains rational reasons for the given decision.

A formal presentation of the potential for decision making requires increasingly complex and mutlidimensional matrices of choices (if there are k actors, n alternatives and m possible results, we obtain a k-dimensional square matrix of attractiveness of results with $n \times m$ columns and rows)[17], but in principle we can present the collective decision for one of the

alternatives as a reduction of the original matrix of attractiveness to the corresponding polarized matrix of attractiveness.

To the factors of attractiveness of some alternative we could add some new conditions, for example, "starting constraints" of decision making. These are actions or states of things which must be realized for particular alternatives to be realized (and for certain outcomes to follow). We could also add (emotional, ethical) valuations of these conditions for particular actors.

My view is that these and similar additions to the principle would not change the essence of things. Decision making is formally presented as in general a multi-phase process of the actualization of collective potential for decision making. In the final phase of decision making there emerges a context in which we obtain a simplified and possibly polarized matrix of attractiveness of outcomes which corresponds to the common decision making in favour of one of the alternatives. For each phase of the decision making we may formulate the corresponding matrix of attractiveness and matrix of energizing of the group and assess what we can expect assuming that the actors decide rationally. Collective decision making can thus be presented as a process of gradual crystallization of the dominant alternatives under the influence of different contexts of decision making as represented by the initial matrix of attractiveness. Contexts of decision making are represented by the corresponding matrices of the energizing of the group for all possible joint outcomes.

REMARKS

[1]This definition is close to that of Toulmin's definition of the rationality of belief "open to argument" [1; p.13] and Habermas's definition of rationality as the capability of a belief, statement, or action (*Äusserung*) to be subjected to a trans-subjective process of justification and critique [2; p.27], but it implicates neither Toulmin's theory of argumentation nor Habermas's theory of discourse as the medium of communicative rationality.

[2]Various authors have proposed a division of ways of thinking into more automatic, fluid, spontaneous, implicit, unconscious thinking of people in interactional situations and more conscious, reflective, normatively guided explicit thinking and similar for two types of rationality [8, 14 – 16].

[3]I write more about this in [20; pp.262-268].

[4]Here I rely on the theory of collective rationality and collective reasoning developed by C. McMahon in his book *Collective Rationality and Collective Reasoning* [22]. In his view collective thinking and decision making essentially contain a kind of "pooling" of the reasons provided [22; p.109]. McMahon emphasizes that there is mutual coordination of beliefs and collective decision making only when members of the group mutually coordinate on the "scheme of cooperation", i.e. that they interpret their situation in the same way and in so doing a given combination of their actions gains priority over noncooperation.

[5]In this example I allow for the possibility that for the individual both outcomes can be conjunctive, i.e. they can occur simultaneously, but with a different measure of beneficiality (desiredness). In theories of decision making disjunctive outcomes are frequently assumed. This of course simplifies the analysis of decision making, but the assumption is not necessary. But I make some other assumptions which simplify the further analysis: rationality as the maximization of attractiveness of alternatives, mutual independence of probability assessments and assessments of beneficiality. In addition I assume linearity of the attractiveness of alternatives with respect to the attractiveness of particular outcomes. These assumptions allow me to provide a relatively simple account of my basic idea; in the continuation of the discussion we may replace them with more realistic ones.

[6]If we were to do an empirical study, we would ask the following questions for each combination of decisions of member of the group in favour of a particular alternative and for each possible outcome *i* of a decision in favour of alternative *A:* "How do you assess the probability and beneficiality of outcome *i* of your possible decision for *A* in the event that the other members of the group decide in favour of a given combination of decisions?" Answers to these questions would give us for each outcome and alternative information on how each member of the group assesses the conditional probability and beneficiality (usefulness) of this outcome of decision making in favour of the given alternative in the given group of actors involved in decision making.

[7]The attractiveness of an alternative can be normatized to values between –1 and 1 if the sum of attractiveness of all relevant joint outcomes is divided by the number of all those outcomes. For the sake of simplicity I do not consider this possibility.

[8]Results are rounded to three decimal points.

[9]I leave aside for now a more precise determination of this direct product. The matrix of joint expectations can also be presented as the direct product of the corresponding "vectors of expectations of outcomes" for individual members of the group, and the matrix of joint beneficiality can be presented with a similar pseudo-direct sum of "vectors of the beneficiality of outcomes", but I leave aside for now this presentation.

[10]Their normalized values are 0.233 and 0.358.

[11]Their normalized references are 0,408 and 0,114.

[12]This outcome is of course closer to or further from the "anticipated" rational collective decision in the given circumstances.

[13]Here and in the following tables I omit the row and column with the references to the given joint outcomes.

[14]This is only one possibility for the determination of the energizing factors which works well if the products of attractiveness and the respective energizing factors are less than 1. A somewhat more sophisticated determination would be if we took the ratio of the attractiveness of the given alternative and the average of the common attractiveness of all other alternatives.

[15]D. Moshman and M. Geil presented an interesting experiment on deductive reasoning in which groups of students showed a greater degree of rationality in deductive reasoning than (on average) their members. The increase in the rationality of the group relative to individuals was clearly connected with the quality of the discussion and arguments [27].

[16]Common belief is a minimal assumption which can in some circumstances (for example in the case that there is a rational discussion based on correct information and facts and good mutual familiarity on the part of both persons) become strengthened to common knowledge. Some authors refer to "mutual knowledge" or "mutual belief". This is a situation in which all members of the group have some knowledge (or belief) and they know (or believe) that all members of the group know (or believe) that they know (or believe) and so on to infinity. It turns out that each coordination of the action of multiple actors or cooperation among them assumes by them a kind of common knowledge or common belief (see [20, 28, 29]).

[17]The multidimensional matrix cited can by means of appropriate mathematical "tricks" be translated into a two-dimensional matrix, for example by the appearance of different combinations of four in the rows and columns *(person, alternative, outcome)*.

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KOLEKTIVNO ODLUČIVANJE I AKTUALIZACIJA POTENCIJALA ODLUČIVANJA

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SAŽETAK

Rad predstavlja karakteristike i dileme kolektivnog odlučivanja. Kolektivno odlučivanje može se prikazati kao proces uzastopnih kristalizacija dominantnih mogućnosti pod utjecajem različitih konteksta odlučivanja proizašlih iz primarnih, zadanih potencijalâ odlučivanja. Takav proces je prikazan kao višefazni proces djelovanja kontekstualno ovisnih "faktora energiziranja" kolektivnog odlučivanja na "matricu privlačnosti" ishoda kolektivnih odluka. Matrica privlačnosti određuje privlačnost svake od mogućnost odlučivanja. Najprivlačnija mogućnost u danoj situaciji predstavlja racionalnu odluku u toj situaciji. Zaključna faza odlučivanja odvija se u kontekstu u kojemu je matrica privlačnosti pojednostavljena. To odgovara uobičajenom odlučivanju za jednu od mogućnosti.

KLJUČNE RIJEČI

kolektivno odlučivanje, racionalnost, potencijal odlučivanja, zajednički ishodi, energiziranje