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EMOTION AND DECISION MAKING *

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Anyone whose interests lie in real-life decision processes is bound to note the oft times disturbing role that emotions play in such processes, particularly in the areas of assessment of information and long-range planning. Instead of simply dismissing emotions as noisome, irrational agents in the decision making process, one needs to obtain an understanding of their nature and how they influence the decision making process in order to acquire better control of them. This paper proposes a model of emotions based primarily on the following assumptions: (1) The whole set of emotions forms a system that is evolutionally developed and generically programmed – a system that serves the purpose of making decisions that are appropriate to the kinds of environments that can be characterized as primitive and wild. (2) The non-emotional, more analytical decision system is a product of a much later period in evolution which, along with other higher cognitive-analytical functions, developed primarily to supplement, but not to replace, the emotion system by covering its shortcomings. Thus, even though these two systems are often in conflict, the cognitive decision system does not operate without the help of the emotion system; without desires, loves, and hates there hardly would be utilities. (3) The first assumption gives rise to the possibility of studying the emotion system as a purposeful, rational decision system in its own right.

Whatever the philosophers claimed, the main use of logic was to justify your emotions.
From a novel by Philip Jose Farmer

Emotion and value

Imagine a boy at the breakfast table on a merry Sunday morning contemplating whether he could get away with not eating the detestable spinach on his plate. He looks surreptitiously toward his mother. Noting that she already appears to be a bit irritated by his hesitation to

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eat his spinach and that any more delay in eating it may result in a spanking, he resignedly stuffs all the spinach in his mouth and tries to swallow it in one gulp in order to shorten the loathsome act. While he is not particularly afraid of the pain of being spanked, he feels a spanking would be very humiliating and would certainly spoil his expansive Sunday morning mood.

It is basically a decision process that the boy is involved in. All that is described above in emotion-relevant terms can be transcribed into such decision theoretical expressions as utility, subjective probability, and information. For example, it is the information obtained through the boy's observation of his mother's apparent state of mind that caused an increase in the subjective probability of the worst outcome contingent upon the alternative course of action of not eating the spinach. This increase results in the other alternative, that of eating the spinach as quickly as possible, as having the highest expected utility and therefore this alternative is chosen by the boy.

I began this paper with this simple family scene in order to make a few points. What the boy has undergone is a very common kind of decision process (the reader may observe how touches of various emotions guided the process in a decision-theoretically proper way), and he has hardly been 'emotional' in carrying out the process. One may argue that this is just a 'description' of a decision process making heavy use of emotional terms which could be far removed from the boy's actual decision process. Admitting this, let me point out the fact that this 'emotional' description is a natural one which anyone can understand without difficulty. It is also musch richer in content than the more decision theoretical description of the same process that followed. That is, the emotional terms used seem to tell us far more than just the decision process itself; they convey information about the characters of the boy and his mother, about the family atmosphere, and about the things the boy might do after breakfast. This richness in content, as well as the implications underlying emotional concepts, must be the reason why fiction writers use such concepts almost exclusively in telling the reader how the characters in a story went about making their 'decisions'.

So there seems no doubt that every one of us has, as a major component of our 'common sense', a cognitive framework, or a system of schemata, consisting primarily of emotional notions for describing, comprehending, and predicting human behavior and human relations. Let us call this cognitive system *common-sense psychology*, and I am an

admirer of its efficacy. It may not be an overstatement to say that it is only with its assistance that we are able to cope with the complicated interpersonal relationships we are confronted with in modern society.

Perhaps this common-sense psychology is no more efficient than the common-sense physics we use for dealing with familiar objects in our surroundings: the type of physics which tells us, for example, that heavy objects will fall faster than light objects. In physical issues, however, we can resort to the real, nearly infallible laws of scientific physics whenever the issues become complex, as when building a builiding, constructing a dam, or designing a rocket. With the complex issues of human relations, however, we have nothing even remotely comparable to modern physics. Thus we depend exclusively on common-sense psychology whether the issue at hand is simple (*e.g.*, a little family strife) or complex (*e.g.*, diplomatic negotiations between nations). In case of the more complex issues, politicians and diplomates are expected (besides having other qualifications) to be expert common-sense psychologists, particularly in the manipulation of other people's emotions. It is easy to demand that these persons who are responsible for the safety of millions of lives behave in a very rational manner. They are rational in their own ways. They try to manipulate the emotions of their constituency or of their opponents because such a strategy pays off; this is part of the game they play, and the emotion-based nature of the rules of the game has hardly been brought out into the open for the more rational mind to scrutinize. So, if one really wants to realize a world in which rationality prevails over emotions, we should, first of all, *externalize* (Toda 1976) the nature of emotions. Dismissing emotions as just noisome irrationality and pretending that we are beyond the sway of emotions are both sure ways of making ourselves susceptible to emotional manipulations.

Before going into the issue of rationality, which I will do in the next section, let us take a brief look at the relationship between emotions and values (utilities). As in the case of the spinach-hating boy, when we say someone fears something bad might happen if he does a certain thing, the person himself is often not in a state of fear; rather he is *anticipating* a fear he might feel as a consequence of an act he may perform. De Rivera quotes from Truman's Memoirs to demonstrate how such an anticipatory emotion might influence important political decisions: "In deliberating whether or not to resist the invasion of South Korea, President Truman reports considering how he would feel

about himself if he, as President, failed to resist the aggressive action of another nation" (de Rivera 1977). This example is hardly likely to be an exceptional one nor one limited to important political decisions. In considering alternative resorts for a vacation, one would probably try to imagine some typical situations one would experience at each of the resorts. The emotional feelings accompanying these images, such as joy, relaxation, irritation, and so on, would probably be taken into account, along with monetary expenses, in determing the total worth of each resort. Thus anticipatory emotions could well play a critical role in a person's non-emotional cognitive decision system.

Does this imply that emotions are the ultimate source of all personal values? Some emotion theorists appear, in effect, to believe so when they identify emotion with motivation. Tomkins (1970), for example, assumes that a person is maximizing positive affect and minimizing negative affect. James (1902) suggests that his reader imagine a person who is entirely devoid of emotion, no joy, no fear, no greed, no amibition, no anger, nothing. Is there anything left for the person that is worth making a decision about? So there is a possibility that the supposition holds. Nevertheless, one should not make a rash identification of positive and negative emotional feelings with personal values. One may have anticipatory fears about some bad consequence; this, however, does not necessarily mean that the consequence is bad *because* it arouses the expectation of fear. If an emotional feeling itself is a direct value indicator, no one would be able to *enjoy* a *horror* movie. So for the moment it seems a much sounder position to suppose, along with Ortega y Gasset (1957), that emotions reveal values, and that we do evaluate, very often, the utility of a state by the emotions it may arouse. This supposition opens up a very interesting possibility; instead of simply accepting a person's value system as something sacrosanct, as is customarily done in decision theory, we may now question its rationality. A considerable advancement will be obtained only by revealing how emotions influence the development of personal value systems.

The issue of the rationality of a personal value system acquires further significance when it is considered in the context of corporate decision making, where the decision maker has great power and his decision may influence the welfare of many people, as in the example of President Truman described earlier. Such a decision maker is assumed to operate under the value system of the corporate body, but

Truman, as we have seen, allowed his decision to be guided by his personal values. Few people, however, would blame Truman for having done this. Indeed, decision theory claims that an individual makes decisions exclusively on the basis of his own utilities, or his personal values, and corporate decision makers should be no exception. Many social planners, including decision analysts, must have suffered the frustrating experience of having their 'flawless' plan rejected by the decision maker to whom the plan was submitted – rejection based on no reason at all, an irrelevant reason, a twisted rationalization, or even an honest reason. For example, the legislator who admits a plan is good but rejects it because it will cause him to lose votes. (Incidentally, while this constituency feedback mechanism is important in making politicians fulfill their roles properly, it is far from sufficient since it involves patent biases such as favoring 'popular' policies too much and too often.) Even without this mechanism, human societies, democratic or not, are generally equipped with socially accepted and socially enforced rules that function to make corporate decision makers identify their personal values with those of the public. If a corporate decision maker does a good job, he will be praised, honored, get promoted, become famous, and so on. On the other hand, if he does his job poorly, or if he pursues private values which are in disagreement with those of the public, he will be blamed, punished, humiliated, and lose his job (look what happened to President Nixon). Note that a substantial portion of these social rules are non-material, emotional ones, and at the critical moment they often play far more important roles than do material rewards and punishments.

Thus emotions fill important social functions, as will be emphasized again later. But, of course, this is not the whole story of the role of emotions in society; the effectiveness of emotions can backfire and cause great damage, too. Since a corporate decision maker is also an individual, he is under the sway of his own emotions, and when he is, his cognitive field, or decision scope, tends to center around the target of his emotion, thus obliterating important long-range considerations. Rash actions and hasty decisions under the influence of a strong emotion are easy to check, however. Far greater damage is done by those decisions whose emotion-based character passes unnoticed even by the decision maker himself because he rationalizes.

In our contemporary society, everyone has learned to rationalize his or her emotional actions since society survives, in part, on the basis of

its members' suppression of asocial emotions. If everyone tried to physically hurt anyone who aroused his or her anger, our cooperative society would immediately collapse. So, if one succumbs to an impulse, one needs to provide a plausible reason to extricate oneself not only from external punishment and blame but also from internal guilt for falling below one's own standard. The fact that Sjöberg and Johnson (1978) found people made twisted rationalizations when they broke their pledge to give up smoking may be evidence in point. Perhaps this habit of rationalization is the reason we tend to believe ourselves to be less emotional and more rational than we really are.

There is essentially nothing wrong with the fact that our values are largely determined by emotions such as love, joy, pride, and so on as long as we are aware that they also are determined by greed, hate, fear and the like. By becoming aware of this, our cognitive system may finally be able to come up with a solution for how to live harmoniously with emotions. For the moment, however, the situation is not that way. Interestingly enough, our ignorance about emotions is guarded by the emotions themselves. In any culture there are objects (material objects or beliefs or symbolic objects or whatever) that social mores and institutions insist should be valued highly, often for no rational reason. It becomes quite touchy to talk about these things because we often are deeply indoctrinated to respond to them with emotion. Let me mention one such example: history reveals beyond doubt that countless intercommunity or international bloody strifes have occurred because of some dispute over border territory, and in many cases the disputed areas were nothing but narrow strips of barren land that were useful to nobody. Nevertheless such a piece of land has often been the cause of all kinds of belligerent emotions experienced by the members of the two communities or nations. Countless rationalizations are made to account for the importance of claiming sovereignty over the disputed piece of land and if someone proposes a rational solution to resolve the dispute, he finds all ears closed.

There are numerous cases of this sort, enough to make one ostracized ten times over if one voiced doubts about the high values assigned to all of them. This, however, is a fool's errand. The important thing is to help people understand how much we humans are under the control of emotions, and how often we use what Osgood (1978) calls 'Neanderthal thinking', though I am sure that Neanderthals lived in far more harmony with their emotions than we do today.

Emotion and rationality

Perhaps I have overemphasized the irrational aspects of emotions in the foregoing section. Now, to restore a balanced view, let me turn to the rational side of emotions. Here, however, I will not be discussing anticipatory emotions or emotions as values, but rather will be referring to emotion in the more proper sense of the world – the emotion implied when we say someone is emotional, the emotion that generates its own characteristic decision process. Consider the spinach-hating boy again. Assume that he has suddenly remembered, before eating the spinach, an incident that happened the previous evening when he was *unjustly* scolded by his mother for a mischief he did not commit. This memory revives his anger and results in the following sequence: he feels defiant, forgets the spinach completely, is spanked, runs out of the house in a rage, and thus completely spoils his Sunday.

I am not going to attempt to demonstrate the rationality of this anger-driven chain of behavior. Individual cases are irrelevant to the issue of rationality. Even the most deliberate, well thought-out decision may result in disaster. In my opinion, 'rational' is an adjective meaningfully applicable only to the *principles or rules* under which a purposive system operates. A principle or rule is rational if and only if it makes the system function (almost) optimally for a given context and under given constraints. The reason I am particularly concerned about demonstrating rationality in the system of emotions, which many may think is the most improbable place to find it, is because of the great deductive merit the assumption of rationality provides. Assume that emotions provide some animal with principles for making decisions rationally. What is the purpose of the system called 'some animal'? Survival as a species. Constraints? Limited information processing capacity. Context? A rather primitive, but stable, wild environment. "OK", says the computer, and it will hesitate only a fraction of a second before it spews out a list of necessary characteristics that the rational emotions should have. How nice. But perhaps I must go a little more slowly to convince anyone besides myself.

Take normative decision theory, for example. It is obviously a rationality-oriented approach characterized by a maximization procedure, and the major methodology underlying its rationality belongs to the class of *analysis-synthesis.* In the analysis phase a decision tree is decomposed into component elements (states and transitions) so that

their numerical characteristics (utilities and subjective probabilities) can be evaluated *independently* of each other. In the synthesis phase these independent evaluations are then combined according to a certain formula (usually expected utility) to produce to overall worth of each alternative. Let us call this type of rationality *decompositional* or *analytical* rationality; it is, no doubt, the most typical paradigm among all possible types of rationality.

The decompositional rationality of normative decision theory has been handed down to contemporary descriptive decision theory which has recently become more cognitively-oriented. In taking a more cognitively-oriented view one must pay strong attention to the fact that human cognitive operations are limited. An information processing system with a finite capacity cannot base its rationality on fineness of its analyses alone, but must base on efficient allocation of its analytical resources. The rational allocation principle should be stated as: analyze finely where there is information, but combine elements together as a *chunk* where there is redundancy (Miller 1956). Therefore under limiting conditions of any kind, one should consider *compositional* rationality as well as decompositional rationality.

The need for compositional rationality is not restricted to the domain of information processing since a decision making system engages in more than just information processing. The oprations of a cognitive decision system begin with detecting a decision problem, that is, a situation calling for an action. The system then gathers information relevant to solving the problem, generates alternative plans of action, conducts analysis-synthesis within an appropriate decision scope for each of the alternatives, chooses the best alternative, and then executes it (Toda 1976). (Of course, this description is no more than a schematic tabulation of the basic features of the decision process.)

Now, applying the principle of compositional rationality, when there is redundancy some of the phases of this decision process could be condensed or skipped entirely. When it is sufficiently understood that the decision problems of a certain class always lead to the same course of action after going through deliberate information processing, the deliberate information processing part might be dispensed with since one's decision making capability is limited either by cost, time, or ability. This is, however, an extreme case. Most often this redundancy-skipping procedure will result in a routinized, simplified decision process: whenever the decision problem is identified as belonging to a certain familiar

class, it will be followed by routinized information processing and the activation of stereotypical alternatives to be evaluated in a more or less small, fixed decision scope. So we form habits through learning – a certain class of cognition automatically elicits a certain class of response. Let me call any such simplified, habitual way of making decisions a *decision routine.* We cope with most of our familiar decision problems, those we encounter in routine business transactions or in household chores, by resorting to decision routines which we have learned through experience. Whether it is the decision routine or the cognitive chunking, its compositional rationality is an exact parallel to Shannon's coding theorems (Shannon and Weaver 1949). This implies the existence of an indispensable assumption for any type of compositional rationality to hold, *i.e.*, the environment of the system utilizing compositional rationality must remain stationary so that the redundancy stays where it has been in the past.

Now let us turn to emotion. First, let me demonstrate that each emotion is a decision routine. Consider 'anger' for example. The emotion of anger is aroused when a certain type of cognitive appraisal of a given situation is made. Though the nature of anger-arousing cognitions will not be discussed until the end of the next section, it is doubtlessly the type of cognition that creates a decision problem; that is, it calls for an action with or without an emotion. Once an anger emotion is aroused, the individual feels an urge to engage in aggressive behavior directed toward the object arousing the anger. Note, however, that the emotion itself does not necessarily specify the particular form of aggressive behavior to be taken. So we may say that anger generates a specific *class* of alternative actions called aggressive behaviors. Unless one of the actions is impulsively executed, the choice of an action often requires intensive cognitive operations; that is, evaluating the pros and cons (subjective probabilities and utilities) of each alternative aggressive action including, of course, no action at all and then choosing an action. One of the well-known characteristics of such information processing under emotions is that it operates within a relatively narrow scope, centering primarily around the immediate situation. The stronger the emotion, the more difficult it becomes to consider the long-range consequences of actions and anything else that is not directly related to the immediate situation. As described earlier, the preselection of alternative actions, the stereotyped way of information processing, and the narrowness of the decision scope are all characteristics of a decision

routine. Thus emotions can be considered as decision routines.

While non-emotional decision routines are learned through experience, emotional decision routines are not. The essential structure of emotions undoubtedly lies in genetically inherited programs which are modifiable only in specific details. Tracing back along the phylogenetic evolution tree for the origin of emotions, we will find that we can go quite far, at least with the basic emotions, and recent developments in ethology have discovered more and more counterparts of human emotions in other primates (see, for example, Eibl-Eibesfeldt 1970). Thus we can think of emotions as decision routines learned on the gene-level through the evolutionary process. Even though such 'learning' probably takes a tremendous amount of time, time is not a crucial factor when it is the species rather than the individual who learns.

No matter at what level learning takes place, when a system learns, it should, on the whole, improve its performance, and thus, by definition, increase its level of rationality. However, when improvement depends a great deal on an increase in compositional rationality, such improvement may fall apart with the occurrence of environmental nonstationarity. Note how drastically human civilization has caused our environment to change within such a short time, a time too short to allow any significant species learning to take place for readaption. Thus we are left with a well developed emotion system preserved almost intact with its wild-life rationality being greatly impaired by nonstationarity but not yet completely lost. Who says our society is no longer wild?

As a result, we find ourselves in a dilemma today. It is our large brain with its accompanying capacity for elaborate information processing that has created the powerful new methodology of analytical rationality, an element that is entirely foreign to species-learning which apparently depended only on compositional rationality [1]. This analytical rationality that human beings have acquired has come to

[1] I should also point out here that the basic process of evolution has resulted, at a level more fundamental than that of species-learning, in acquisition of greater decompositional rationality as organisms' internal and motor organs evolved in the direction of finer separation of the functions they performed and created new functions as well. But here I encounter a definitional problem. Since this process takes place not on the species level, what is the 'system' that acquired a greater rationality by this? The mysterious 'life' may be the only candidate. What, then, is the 'purpose' of life in view of how we think about rationality? These are, of course, old questions which continue to be asked almost rhetorically. But perhaps, there is some profit in repeating the same questions with a slightly different terminology each time.

cause, among other things, the emergence of non-emotional, analytical decision making, which unfortunately often finds itself in conflict with emotional decision making. At the same time, the emergence of sciences and technologies as other products of the analytical mind have degraded the rationality of emotions by introducing drastic changes in our environment. In my opinion, all the grave social problems we observe in our comtemporary world appear to have roots in this dilemma. It is easy to simply blame emotions as the cause of problems and insist that we control our emotions through willpower. I regard this attitude as our emotional reaction to the problems of emotions. The only rational alternative to this attitude is to respond to the problems of emotions analytically, and it seems to me that the best strategy for doing so is to analyze the system of emotions in the right context, *i.e.*, in a wild, primitive environment where the system's rationality can be high.

Arousal, expression, and other attributes of emotion

At this point I would like to consider a few important attributes of emotion upon which I have not yet touched. However, I will do it in a rather special way – I will try to interpret each attribute of emotion in terms of hypothesis that was put forward at the end of the last section, namely that emotion is a rational system for animals, including Genus Homo, living in a wild environment. I am afraid that I might sometimes overdo it with insufficient evidence, but my purpose for the moment is to see if the above hypothesis can act as a useful heuristic for providing more concrete hypotheses.

The relationship between emotion and motivation has long been debated among the investigators of emotions. (See Strongman 1978, for a review of the history of the investigation of emotion.) Consider, for example, the usually non-emotional motivational state called hunger. Once an animal finds itself in a state of hunger, it will start one of the class of behaviors characterized as food-seeking. In this respect, hunger operates in a fashion similar to anger, the latter leading to an aggressive behavior. Furthermore, the emergence of a hunger state hardly appears to be strictly a physiological event. As Tomkins (1970) argues strongly for and Schachter (1967), based on his experiments with obese subjects, testifies, to feel hunger is very likely a cognitive event caused jointly by appropriate internal and external signals. Thus, all told,

hunger appears to operate exactly as a decision routine. If so, this hunger routine is obviously one of the oldest outcomes of evolutionary learning (I believe that a creature that always eats whatever food is available will not feel hunger as it does not need such routine). The question, then, is why do we regard hunger as non-emotional and anger as emotional?

I think the major distinction between these two categories corresponds to the absence and the presence of marked physiological arousal. By this, however, I do not mean that hunger creates no arousal. All the so-called basic drives like hunger have the attribute of *strength* like any emotion, and the stronger the drive, the more its operational mode resembles that of emotions. For example, a very hungry individual may hardly be able to think of anything but hunger and food, and I believe this concentration of cognitive operations upon the immediate issues is caused by a mechanism very similar to that used by emotion-based central arousal on information processing. Therefore these so-called basic drives or need-states do not appear to be essentially different from emotions, albeit they play more fundamental roles than most emotions in the overall survival program of animals and as a result are more resistant to degradation of their rationality by environmental instability, *i.e.*, they are more robust programs. The fact that some of them show little apparent somatic arousal, at least when their intensities are relatively low, may be simply because such arousal is not needed. Hunting for food may either be a routine business requiring no special discharge of bodily energy or this energy may be needed only when prey is discovered.

Arguing in this manner, I would now be expected to explain why emotions require arousal. I think this is not too difficult a task to accomplish. Consider the role of the 'suddenness' of an event in determining the initial strength of the emotional arousal it creates. Suppose that you are walking down a dimly-lit street at night sensing danger. Suddenly, without warning, a hand touches your shoulder from behind. You are *startled!* You are not sure whether the person touching you is a mugger or a friend. This situation is an emergency. There is not much time to contemplate upon the best action to take in case the hand belongs to a mugger. Fear, along with the adrenalin discharge in your blood stream caused by arousal, will make the choice for you. As soon as you identify the person as a stranger, or even before that, you will run with a speed so fast as to surprise even yourself.

Note that danger is ubiquitous in a wild environment, but if it is an expected danger, one will have had time to prepare to meet it or avoid it. When the emergence of danger is sudden, however, life and death depend upon whether or not one can take appropriate action with the shortest delay and the maximum efficiency, and nothing but a well established decision routine will do the job properly. In fact, the repertoire of alternative actions that emotion of fear provides one with is rather rich, and a minimal amount of information processing will be needed to decide among the actions. Fleeing is the appropriate action when there is hope of outdistancing the enemy. Screaming at the top of one's voice may be another if help is near by. One may put up a desperate fight if fleeing is impossible since there is a chance, however slight, that one will win the fight or scare the enemy away. One also may adopt submissive behavior, putting oneself at the mercy of the enemy by displaying an expression of abject terror, which hopefully may create an emotion of pity in the mind of the powerful opponent. This last action can be effective only if the opponent is a member of one's own group or at least of one's own species. I will discuss this social aspect of emotional interplays in the next section.

The appropriateness of all these courses of action when one confronts a fear-arousing imminent danger in a wild environment is obvious. But there is one more alternative action, and it poses a puzzle. A fear-stricken individual sometimes becomes immobile, frozen stiff. Is this just the response to hopelessness or is it something akin to sham death, which may, though it actually seldom does, avert the attention of the predator whose brain is so simple that it is attracted only by objects that move? Note that 'playing possum' is often the best strategy when the potential victim has discovered the enemy but not *vice versa*. The mystery is that this course of action is taken so often when the victim is face to face with the source of danger.

So the decision routine of fear provides, on the whole, a good collection of actions effective in the wild. But even the best decision routines used in the wild can bring about disasters when used in an artificial environment. Note that panic represents an extreme fear response. There is no need to tell the reader how panic multiplies the magnitude of a disaster when, for example, fire breaks out in a building that is teeming with people. Nothing similar to a building on fire happens in the wild, yet animals may panic to survive (unless there are also human hunters who deliberately make them panic which is, however, an artificial situation).

Thus the role of arousal is quite clear in the case of fear. It is the preparation for an immediate execution of whatever action is chosen. Without a doubt, this interpretation can be generalized to anger, to anxiety, and to several other emotions. But all of these aforementioned emotions belong to the class of negative emotions. Let us now consider a positive emotion, 'joy' for example. Joy certainly causes arousal, but why, since joy does not seem to have a typical repertoire of actions to be executed immediately like that of fear.

In the case of joy, the lack of characteristic behavior patterns is not too surprising. Since joy is the result of a significant improvement in one's state, it is a decision problem only in the sense that any significant change in one's state calls for changes in one's plans, although such changes need not be carried out immediately. Notice that the strength of joy is positively correlated with the unexpectedness of the positive event. Consider, for example, which situation will give an individual greater joy: receiving a desired but expected promotion or receiving a desired unexpected promotion? The answer is obvious. Now let us return to the prehistoric wilderness. A hungry savage is wandering across a barren terrain quickly losing all hope of finding food. He suddenly comes across a chunk of fresh meat left, perhaps, by some predator. Such luck will, of course, give him great joy. But this savage is also in an emergency situation. He must protect himself and the food while he consumes it; in order to do so he must stay alert and be prepared to fight off any other hungry animals which may appear.

I am not ready to claim that this *is* the cause of arousal in joy. However, as long as suddenness or unexpectedness play a critical role in arousing emotions, I think it is reasonable to assume that the physiological arousal accompanying emotion is a preparatory reaction to cope with emergencies since any sudden event in the wild may be a potential emergency. Note also that central emotional arousal results in concentration of information processing upon only the immediate issues. This is adaptive in a wild environment since no organism, when it is fleeing or fighting, should be distracted by something not immediately relevant. Such concentration of information processing becomes maladaptive in modern society in which important (and thus emotion-arousing) issues tend to have long-range consequences and in which immediate actions become less important than deliberate cognitive information processing.

As a prelude to the subject of the social significance of emotions

which will be introduced in the next section, I would like to turn my attention to the important emotion of anger. The origin of anger can be seen in the instinctual defensive aggression of lower animals, a type of behavior perhaps as old in the evolutionary process as the instinctual withdrawal or escape behavior that is seen as the origin of fear. Imagine stimulating a lobster. It will either draw back into a safe hiding place or take the *pose* of attacking with distended claws. No one can be sure if this lobster's posture is intended to display threat, but if one considers species more advanced than the lobster the threatening aspect of pre-attack postures becomes more obvious. One of the characteristic features of these threatening postures is that they make the threatening individual look bigger. Note the obvious rationale underlying such behavior. In defensive or provoked aggression, fighting may not be the intention of the provoked organism and, if possible, it should be avoided in order to prevent the organism from being harmed in the act of fighting. Obviously, the best way to prevent fighting is to make oneself look powerful since estimation of the *power* of a potential fighting opponent is the indispensable cognitive faculty of a surviving organism whether it survives in the wild or in modern society. And the 'size' of an opponent apparently is one of the major information sources for this estimation. If the result of this estimation turns out to imply greater power on the part of the provoked organism than the provoker, it will act as a releaser of fear in the provoker which, in turn, will urge the provoker to flee or at least give up trying to initiate a fight. Even though all this may look obvious, it unequivocally tells us about the role that emotional *expression* plays in inter-organismic interactions. Emotional expression as a powerful form of communication may sometimes have greater survival merit than the emotional action itself, even though this power of expression comes primarily from what it appears to indicate about forthcoming actions. This leads to another obvious point: the behaviors of any animal species advanced enough to possess emotions are regulated in an anticipatory fashion, whether or not the underlying mechanism (which, by definition, is a simulator) involves a conscious operation.

Since the distinction between expression and action can sometimes become tenuous, let me employ the following definitions. An action is a behavior whose major effect lies in the specific result that that behavior has while an expression is a display whose major effect lies in communication. Even with this definition, the distinction is not always

easy when applied to human beings. A verbal accusation, for example, may work both as a threat (an expression of anger) and as an actual attack intended to hurt the opponent (an action of anger). Moreover, humans are good actors; an experienced 'emotion manipulator' can easily dissemble an emotion or non-emotion. But such a ramification is only of secondary importance and is not of immediate concern.

Let us now consider the broader *class* of anger-arousing cognitions since such cognitions need not be restricted solely to anticipated direct physical attacks. In the animal kingdom well-known instigator of threat and aggression consists of infringement of an animal's *territory*, particularly by a conspecific. The territory of an animal may best be described as the *sphere of control* the animal has. The survival merit for a species to have such a system of individualized territories is easy to see since it is one of the simplest means of avoiding interference between the various activities of conspecifics. Such an intra-species regulation system works, of course, only when the rules of the system are respected; the display of threat by the holder of a territory is a challenge to a trespasser, forcing the latter to choose between obeying the rule by withdrawing or not obeying the rule and fighting.

The notion of sphere of control is particularly useful when one considers anger-arousing conditions for humans. Consider, for example, possession of an object. When we say that a person owns an object, it usually means that the person has *exclusive right* of control over the object. Thus when the person finds that someone else has tampered with, damaged, or stolen the object, his or her right is infringed upon and the person may become angry. The rationale underlying such anger is exactly the same as that underlying territorial encroachment. In the wild, or anywhere else, one's rights may go to someone else if one does not protect them, although human groups (including modern society) usually have ways of protecting some important rights of their members collectively. The interplay of these group functions and emotions will be discussed in the next section.

One's sphere of control is not restricted to material objects; it may cover one's fellow group members as well. Suppose that someone throws an apple in between the Japanese monkeys. Usually it will be observed that the higher-ranking monkey will take the apple without receiving any protest from the lower-ranking one. Occasionally, however, particularly if the apple lands near the foot of the lower-ranking monkey, the lower-ranking monkey will show signs of picking the apple

up and in doing so will invite the rage of the other monkey. Perceiving this rage, the lower-ranking monkey will cringe and usually take the submissive posture of presentation. The higher-ranking monkey will usually be appeased by this show of submission and will consummate the ritual by taking the pose of mounting and leaving peacefully with the apple. A similar exchange is also common in human society, with differences lying only in the variety and sophistication of culture-dependent human rituals. The lack of display of appropriate courtesies by a lower-status person to a higher-status one is regarded in many cultures as a severe breach of social code, giving the offended the right to punish.

Now let us consider the implications of the above statements. First note that the sphere of control, or, if one prefers, the *system of perceived rights* in the case of human beings, does not mean an absolute territory or domain in the objective world. The monkey who took the apple had rights over the apple only because he happened to be of higher rank than the other monkey present. Thus among human beings and higher primates, at least, many rights are determined *on the spot* by applying certain *rules* to the issues at hand. The effectiveness of such rules can be maintained only when they are shared by all members of the groups within which the interactions will take place. The chances are high that the underlying principles of such rules as hierarchical rank-order or status systems are genetically based. The fact that subsequent to Schjelderup-Ebbe's discovery of the peck-order in chickens, many more species have been added to the list of animals which spontaneously develop a rank-order system when a new group is formed (Eibl-Eibesfeldt 1970) supports this notion. The actual content of these rules, such as who assumes which rank, is determined on a local basis; it usually depends upon the individual's physical strength, intelligence, coalition membership (discussed in the next section), and the outcomes of contest fighting. Therefore any specific rank-order is modifiable by new events. It seems appropriate, however, particularly in the case of human beings, that each group member be characterized not only by a rank but also by a more sensitive 'status' variable, a variable which may change even when the member remains in the same rank.

Obviously status is one of the most delicate issues in human and animal social behavior and no short argument, such as that which follows, will do justice to its importance. However, since it appears to be one of the most critical determiners of human emotions, let me just

summarize some hypotheses I consider relevant. Each person is characterized by a variable which may be called the person's *power.* This power is somehow represented by the 'size' of the person's sphere of control, which may or may not include control over the person's own group members. The person's status is the *socially recognized* power of the person. Therefore there is usually a time lag between the change in one's power and a corresponding change in one's status. Note that various more or less institutionalized hierarchical systems usually exist in human societal structures. Since many of the social rules operating in our societies apply directly to the positions and ranks people assume in these institutionalized systems, these positions and ranks are often important determiners of one's power and therefore determiners of one's status as well. Nevertheless, they should not be identified either as one's power or as one's status since it might very well happen that a person in a low position (or of no position at all) could have high power and/or high status. Remember also that these variables should be considered as multi-dimensional; a person's power and status may be high in one aspect but low in another – they are context-dependent, even though there is a definite tendency for generalization across contexts. For the sake of simplicity, however, power and status will be dealt with in the following section as if they are unidimensional variables.

In the next section I will attempt to elucidate the importance of the status variable on the basis of very simple assumptions concerning the rationality of groups, and then discuss how the characteristics of various emotions can be meaningfully linked to these assumptions via the notions of power and status.

Groups and coalitions

When von Neumann and Morgenstern (1944) introduced the notion of *coalitions,* where a coalition is a subgroup of players who cooperate as a team, in their discussion of n-person games, they considered the following two conditions concerning the rationality of a coalition. Let x_i be the final gain of the i-th coalition member. Also let $v(i)$ be the maximum gain that i can obtain alone without being a coalition member, and $V(C)$ the maximum gain the coalition C can obtain. Then, the two conditions are: (1) $x_i \geqslant v(i)$ and (2) $\Sigma_i x_i = v(C)$. The meaning of the first condition, the condition of *individual rationality,* is obvious: if

this condition is not met, it would make no sense for the player i to stay in the coalition. The second condition, *group rationality,* is equivalent to the Pareto optimality conditions and simply means that the total gain of a coalition should be as much as potentially possible.

In however a weak sense of the word, any group may be regarded as a coalition as long as membership is voluntary, since the voluntariness of membership implies that the condition of individual rationality is satisfied. Few real groups would satisfy the condition of group rationality in the strict sense. However, we may at least generally assume that the higher the group's rationality, the greater the group's chances for survival. And, with greater total gain, the easier it becomes to satisfy individual rationality. So, viable groups tend to be those that strive to increase their level of group rationality, which is tantamount to increasing the level of cooperation among group members primarily by reducing internal conflicts. Obviously the most common type of internal conflict arises from the problem of how to divide group gain into individual shares without violating individual rationality. This implies, particularly when the group gain is not very high, that members with high power, that is, high values of $v(i)$, should get more than those with low power because they are, in general, better off individually than others in the group.

Still, the gain allocation cannot be left to an unrestricted display of raw power since it may lead to unlimited extortion of the weaker members by the stronger resulting in violation of the weaker members' individual rationality. Since weak members also will be contributing to group gain, a viable group should have social rules *that protect its weak members whenever necessary.*

Note that group rationality also implies inhibition of direct display of powers since there is nothing more effective in degrading group rationality than a constant internal struggle to demonstrate each member's relative superiority in power. Such problems, however, could be solved simply by assigning each group member a value representing the member's *estimated* power. The estimation process should be open, *i.e.*, done either through direct observation by other members of the group or through open communication, and every piece of evidence that can potentially demonstrate an increase or decrease in a member's power must be considered within this socialized information processing channel. This socially sanctioned estimate of a group member's power is his or her status, and the problem is to develop social rules that allocate

group gain relative to each member's status. If such rules are adequate, they should assure high group rationality by resolving most, though probably not all, internal conflicts by peaceful means.

While in reality human societies must operate with far more complex mechanisms than those just described, let us return to a rather primitive group culture equipped with little more than the above principles and see what kind of motivations one would develop in such a group and how various emotions could incorporate these motivations.

First note that as long as higher status implies a higher share, one would seek to increase one's status, and the most natural way to do so would be to increase one's own power. Though the term 'power' may sound a little too grandiose in this context, remember that increasing one's power means nothing more than expanding one's sphere of control which can be accomplished by various means, *e.g.*, by acquiring a new object, by obtaining a new skill, by joining a coalition, *etc.* Joining a coalition means formation of an intra-group coalition, and one will gain extra power by joining one since one of the benefits will be support from coalition partners in case of conflict.

Now let me emphasize the following point: an increase in power does not automatically produce an increase in status so the former must be advertized to the person's group members in order to make it reflect on his or her status. Suppose that a person has obtained a desired object and thus increased his or her power. This is an obvious cause for joy. As previously mentioned, joy appears to have no characteristic pattern of action (aiming at some direct effect) since a joyful situation does not require it. Instead, joy is characterized by a rather rich variety of expressions intended for communication of the joyful state. For example, the person who has acquired a desired object will most likely invite friends over to show it off. Children invariably do a boasting act when they are given a valuable gift. Certainly it is most natural to interpret these communicative acts as the necessary social recognition procedures which turn acquired power into status. Granting that this may be the most crucial function of the expression of joy, it appears that there is an additional function of expressing joy. Note that a joyful person often feels an urge toward conviviality, to gather friends and relatives (namely, the person's coalition partners) to treat them, to share with them a pleasant mood of joy and to distribute gifts among them. Obviously this is a coalition event – a coalition member has a duty to share with his partners whatever gain he has obtained. By shirking this

duty, one may risk not only reducing one's power by losing the support of one's partners but also may invite these partners' envy. Envy is a dangerous emotion to ignite. It is a subclass of anger and is caused by the cognition that someone else has gained in status. Note that status is a relative measure. If someone's status goes up, someone else's status will go down, *unless both persons are coalition partners whose status levels are linked.* A typical form of aggression by an envious person is to put a verbal label of 'shame' on the target person in order to impair the status of the latter. Of interest here is the fact that Bushmen are so afraid of inviting envy that whenever one of them obtains a valuable object (*e.g.*, a sharp knife) not only will that person part with it very quickly but the object also will be passed around within the tribe until it loses its value (Service 1966).

Since it is impossible to discuss all of the emotions in this way, let me finish this paper by giving an annotated list of emotions that appear to be relevant under those aspects of group functions discussed above:

Protection of weak members

(1) Parental love – see Love which is discussed below. (2) Pity –caused by recognition of the helplessness of a weak member. It will urge a strong person to give away a part of the person's power. (3) Sorrow, grief – caused by a loss in power or status which usually is not attributable to the fault of another. For example, a child (a legitimate weak member) may cry, which is an obvious distress call invoking the protect-the-weak rule. An adult on the other hand, particularly a male, cannot cry without admitting that he is weak and thereby degrading his status. (4) Submission – this typical expression of fear is listed here because it displays a person's weakness, which, in turn, may restore a proper status difference between the person and his offended opponent and may make the latter feel pity and reduce his anger.

Conversion of power into status

(1) Pride – hiding a loss of power to preserve status, especially when the loss is believed to not be readily observable by the public. It often produces a haughty demeanor in an attempt to signal high status or foolhardy bravery to compensate for loss in power. (2) Shame–caused by a publicly observable loss in power and therefore a loss in status. It usually occurs as a result of one's own blunder which leads to impairment of other group members' powers. It therefore creates an urge to

make oneself inconspicuous. (3) Honor – though not an emotion it is mentioned here because it implies a social procedure for rewarding a person who has contributed to the group by directly elevating the status of this person (sometimes without an accompanying material power increase). The person's power will be increased because his or her elevated status will attract potential coalition partners (supporters). Note that shaming is often employed as a social procedure for the opposite purpose.

Coalitions

(1) Love – no one can discuss love in a few words. The essential role played by love in forming and maintaining closely knit coalitions is undeniable. Note that love leads to devotion and expects reciprocity. These are assurances against the worst enemy of coalitions, *i.e.*, defection. (2) Jealousy – defection of one's coalition partner is often fatal because the greatest benefit of joining a coalition arises from the mutual trust among coalition partners. Closely knit coalitions are further guarded by jealousy against potential defection. Jealousy operates by first arousing suspicion when the evidence for defection is not decisive. When the defection becomes clear, anger is evoked and aggressive behavior will be directed toward either the defector or the person who tempted the defector or both.

Conclusion

The short descriptions given above neither cover all of the important emotions nor are sufficiently elaborate to give justice to those that are listed. However, they may suffice, for the moment, to convey to the reader a notion of the approach I am taking. I would like to conclude by summarizing the major points I have attempted to make in this paper. Emotions are decision making programs developed through evolution; they seem to have been particularly elaborated in human beings. They may have emerged first for the purpose of survival of the species, but those that particularly enrich human experience seem to be directed toward increasing the level of rationality of human groups. Human beings, however, have greatly enlarged their information processing capacity, giving rise to an analytical, non-emotional way of making decisions. Because of the interference of emotional processes in

the latter, emotions are often blamed for being the source of senseless irrationality. This blame has some truth to it, even more truth than we customarily believe there is because we are often misled by rationalizations. However, emotions still play a vital role in our everyday thoughts and behaviors, and in our analytical decision making as well, because they typically influence value cognitions. Emotion-based problems cannot be solved only by blaming emotions. Their characteristics should be understood analytically and there appear to be ways of doing this.

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