A definitial note on cooperation, conflict, and competition

By RUSSELL L. ACKOFF*

There are probably no concepts which currently occupy the reflective man as much as *cooperation, conflict,* and *competition.* Nevertheless the vast literature on these concepts is almost devoid of precise definitions. For example, more often than not "conflict" and "competition" are used interchangably. Furthermore, little attention has been given to measuring these relations. This note is directed toward reducing these deficiencies.

The definitions to be developed are based on the concept of the *purposeful state* of a decision maker (individual or group). I have used the "purposeful state" in other places as a basis for defining (1) *communication* and related concepts[1], and (2) *best decisions* in the context of decision theory[2]. It is not surprising that communication theory, decision theory, and a theory of cooperation-conflict can be built on a common conceptual foundation.

The definition of a purposeful state itself requires use of the following concepts:

I	= an individual or group whose behavior is observable.
N	= the individual's environment.
C_i $(1 \leqslant i \leqslant m)$	= the courses of action available to the individual, defined so as to be exclusice and exhaustive.

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O_j $(1 \leqslant j \leqslant n)$ = the possible outcomes of the courses of action, defined so as to be exclusive and exhaustive.

$P_i = P(C_i|I,N)$ = the probability that I will select C_i in N.

(Note that $\sum_{i=1}^{m} P_i = 1.0$.)

$E_{ij} = P(O_j|C_i,I,N)$ = the probability that O_j will occur if I selects C_i in N: the *efficiency* of I's use of C_i for O_j in N.

(Note that $\sum_{j=1}^{n} E_{ij} = 1.0$.)

V_j = the relative value of O_j to I in N.

An individual (or group) can be said to be in a purposeful state if the following conditions hold:

(1) There are at least two courses of action, C_1 and C_2, for which P_1 and P_2 are greater than zero: I has at least two potential courses of action in N.

(2) There is at least one outcome, O_1, for which $V_1 > 0$ for I.

(3) Relative to at least one outcome, O_j, for which $V_j > 0$, $E_{1j} > 0$, $E_{2j} > 0$, and $E_{1j} \neq E_{2j}$; that is, I's choice can "make a difference".

In ordinary English these conditions state that I is in a purposeful state if he wants something and if he can pursue it by alternative means which have some, but unequal, efficiency with respect to what he wants.

The expected value of a purposeful state (S), then, is

$$EV(S) = \sum_{i=1}^{m} \sum_{j=1}^{n} P_i E_{ij} V_j$$

if the V_j's are independent. If they not, the O_j's can be combined by a Boolean expansion into outcome-complexes whose values are independent.

If $\sum_j V_j = a$ (a is usually equal to 1.0), then

$$\max EV(S) = a$$

since $\sum_i P_i = 1.0$ and $\sum_j E_{ij} = 1.0$.

The concepts *cooperation, conflict,* and *competition,* involve interactions between individuals and/or groups. Therefore, we need the following expressions:

$EV_1(S|I_2)$ = The expected value of S to I_1 if I_2 is present in N.

$EV_1(S|I_2')$ = The expected value of S to I_1 if I_2 is not present in N.

The *degree of cooperation* of I_2 with I_1 (DC_{21}) can now be defined as

$$DC_{21} = EV_1(S|I_2) - EV_1(S|I_2')$$

and the degree of cooperation of I_1 with I_2 as

$$DC_{12} = EV_2(S|I_1) - EV_2(S|I_1').$$

These quantities measure the difference in the expected value of the state to one party with and without the other party present. DC_{21} and DC_{12} are not necessarily equal, a fact that I shall use below. If max $EV(S) = a$, the degree of cooperation also has a maximum value of a. Its minimum value is $-a$. Negative values of the degree of cooperation represent *degrees of conflict.* If this measure is equal to zero, say $DC_{21} = 0$, this means the value of the state to I_1 is independent of I_2.

Now let us consider the significance of $DC_{12} \neq DC_{21}$. Tris means that one of the parties is *exploiting* the other. If $DC_{12} > D_{21}$, then I_2 is exploiting I_1, if $DC_{21} < D_{21}$, then I_1 is exploiting I_2. The degree to which I_1 exploits I_2 is

$$DE_{12} = DC_{21} - DC_{12}$$

If this negative, then I_1 is being exploited by I_2. It is apparent that

$$DE_{12} = -DE_{21}.$$

If DC_{12} and DC_{12} are both positive quantities, but unequal, then the exploitation is called *benevolent,* since both parties benefit, though unequally. If DC_{12} and DC_{21} are both negative quantities, but unequal, then the exploitation is called *malevolent,* since both parties suffer. If one is positive and the other is negative we have what I suppose might be called *normal* exploitation.

If the minimum and maximum of the degree of cooperation are $-a$ and $+a$, respectively, then the minimum and maximum degree of exploitation are $-2a$ and $+2a$.

Now where does competition come in? The most useful suggestion I have found in the literature is that competition is conflict in accordance with rules; that is, *regulated* conflict[3]. On this basis, for example, we can distinguish between a prize fight (as competition) from a street brawl

(as conflict). What function do the rules have? Clearly, they must be intended to constrain the conflict to a type which serves some purpose. This suggests that competition involves both conflict and cooperation, but how?

Consider three individuals or groups – I_1, I_2, and I_3 – of whom two – I_1 and I_2 – are in conflict with each other. Now if this state of conflict increases I_3's expected value of his state, then I_1 and I_2 are competing relative to I_3. I_1 and I_2 may be "competing" business firms and I_3 their consumers; or I_1 and I_2 may be two prize fighters and I_3 the audience. Rules or laws control such conflicts to assure their service to the "third" party.

But clearly two people on a tennis court or on opposite sides of a chess board can compete without an audience. They can, but to see how they can we must look inside their states. Suppose I_1 and I_2 are in conflict with respect to two objectives ($O_1 = I_1$ wins, and $O_2 = I_2$ wins). Suppose further that both I_1 and I_2 pursue a third obpective (O_3 = recreation) which is efficiently served by the conflict relative to O_1 and O_2. Then I_1 and I_2 can be said to be competing *intensively*. Competition with respect to a "third" party is *extensive*. Of course, I_1 and I_2 may be competing both intensively and extensively.

This concept of competition cannot be represented by a single measure. The degree of competition between I_1 and I_2 clearly depends on DC_{12} and DC_{21} and would increase as these terms decrease (since negative values represent conflict), and hence as their sum decreases. It also depends on how "even" the conflict is, that is, the competition would be more "intense" as the difference between DC_{12} and DC_{21} decreases, and, hence, as the degree of exploitation decreases. Finally it also depends on how efficiently the conflict serves the "third" party or objective; that is, on the degree of cooperation with respect to this party or objective. I can see no way at present of conveniently combining these considerations into a single measure.

REFERENCES:

1. Russell L. Ackoff: Towards a Behavioral Theory of Communication. *Management Science*, Vol. 4, No. 3, April, 1958.
2. Russell L. Ackoff: *Scientific Method: Optimizing Applied Research Decisions*. John Wiley & Sons, New York, 1962.
3. Daniel Katz and R. L. Schanck: *Social Psychology*. John Wiley & Sons, New York, 1938.

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