I would like to offer my apologies to the conference for the English in which my paper is written. I am not at all expert at writing English and I hope that the conference will not encounter as much difficulty in reading the paper as I did in writing it.

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Some Notes About the Operationalisation in Peace Researches

by

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Summary

The aim of this paper is to demonstrate the importance and the difficulties of the use of indicators in P.R.. They use today to mathematize our thinking and to speak in terms of numbers andformulas. But it is not easy to achieve this ideal because it is necessary before to introduce direct or indirect metrics. Hence the use of indicators. But as regards the Peace Research we must consider that this process of operationalisation of the theories is not so easy as in physics. Here the bridgmanian axiom "concept = set of operations which define it" is only approximatively possible to achieve. But in social researches this equivalence is not so easy and possible. In fact the concepts in social theories are not generally univocally defined and uniformly used. The common language has still a great importance. Therefore we speak about the dimensions of the concepts following the theory builded.

After defined the indicators, a simple conflictual model as example and the rôle of indicators introduced in this model, are discussed. It is useful to remember now that peace researches can be of two kinds. The first one considers the interaction among nations. The dimensions of this interaction are treated in our model and a discussion about the problem of the measure of this interaction is presented. Principal component analysis is remembered as useful tecnique for the syntesis of many indicators. Regarding the aspects of interaction among nations, the second kind of peace researches concerns public opinion polls. The problems of this kind of research are not treted into detail in this paper because public opinion surveyes are a common subject of analysis in sociological methodology.

The paper is completed by a brief discussion on the forecasting power of peace researches following what we have said about the choice of indicators as atoolof interpretation of the theories on the reality and as a meamns of validation.

Introduction

The aim of this paper is pointing some questions about the operationalization in Peace Research. As in physics also in social science the need of operationalizating some or all the concepts of a theory, is usually accepted by researching-workers in the context of validation, that is in validating some theory by a proper set of data, specifically collected and processed.

But there are some differences between physics and social sciences (Peace Research, as we shall subsequently show, is a branch of social sciences). We therefore cannot tout court assume the brigmanian concept of social research, as until now we know it. Hence we shall show these differences and how operationalisation is actually carried out. For this end we shall take into account an outline of a conflictual model under given hypothesis and we shall show the possible difficulties.

It is well-known that Peace Research endless stroves to theorize the several aspects of interaction among nations as war, diplomatic exchanges, commerce exchanges, and so on. Besides these questions, Peace Research also considers the public opinion about these above questions. Therefore we can find peace Research surveys designed following typical sociological techniques.

In order to summarize we must say that the Peace Researches are scientifically well established but they must pay attention to the validation techniques, particularly in the choice of indicators and in scaling techniques.

In the following pages we shall try to treat these questions.

1 - THE SCIENTIFIC SYSTEM AND PATTERNS OF RESEARCH

Before analysing the specific questions of conflictual model, it is necessary to spent a few words on the structure of a scientific system because the considerations about the operationalization are depending on the problems peculiar to the scientific modus operandi. In this brief note it is not possible to deep all the problems but we shall strove to make systematic our statements, as well as possible.

It is well-known that in the scientific modus operandi there are two distinct steps: the first one named the context of discovery and the second one named the context of validation. The first fase is not interesting for us as methodologist, but it is fairly interesting for the psychologist of the scientific discovery. Therefore we shall consider only the context of validation.

If we consider the work of a scientist we can observe that the main aim pursued is to ascertain a scientific law. A scientific law essentially consists in a rational ascertaining of the systematic appearance in space and time of a relation between two or more events or classes of events. This aim is difficult in achieving and chiefly it is impossible to reach the Truth. But if we are pragmatist in our thinking we must be ready to accept this trumbling condition. There are some fields of study as physics in which it is possible to ascertain a law. There are other fields as sociology in which it is difficult, if not impossible, to ascertain a law. Neverthless it is for me that a means of overcoming this essential difficulty is to introduce the concept of model. Now therefore we relenquish the hope of understanding the "secrets of nature". Hence the model is as regards the "scientific laws" in an inferior standing. We can say that a model is "suitable", indeed, or not, subduing it to a process of wasting away, because the experiences progressively compel the research-workers to neglet the previous models and then to build more suitable new ones. following the new observations.

We must now consider the scientific system and the rôle of the models. A scientific system can be conceived, as a general rule, as a set of operations on symbols and objects. A sketch of the operational structure of a scientific system can be pictured as in the following table 1 (pag. 5)

A few words of explication are necessary now. As you can see we are in face of 6 steps in the process of the scientific procedure, 5 of which are validating steps. We shall call the set of these 5 steps a scientific' system. We call also 'theory', steps $A_1+A_2+A_3+A_4+A_5$; 'deductive system', we shall call steps

Sketch of the scientific procedure

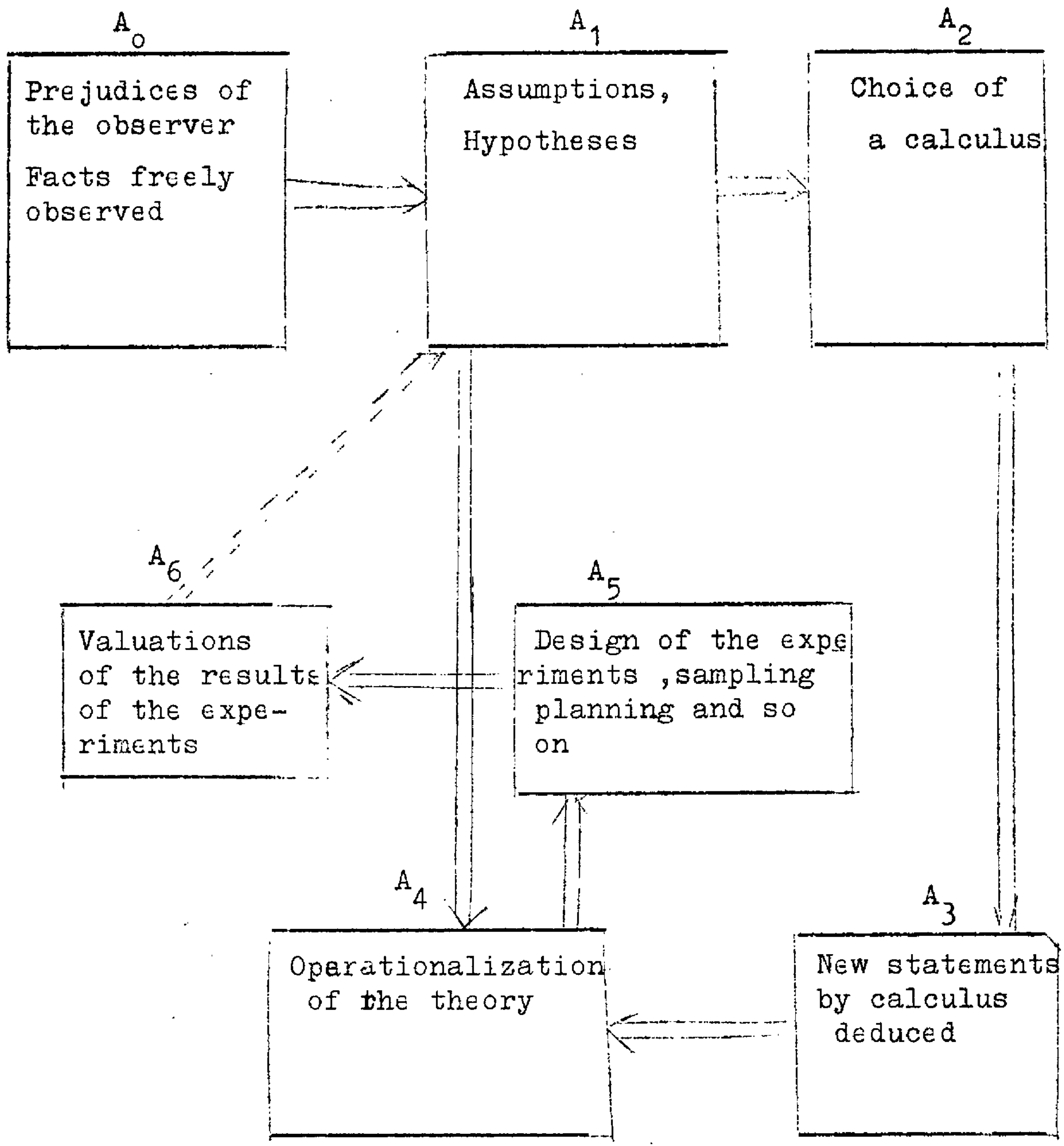


Fig. 1

$A_1+A_2+A_3$; we shall call 'model' steps A_1+A_2. Furthermore we shall call A_1 a 'basis for a theory', A_2 a 'calculus", A_3 as 'deduction' , A_4 as 'operationalization', A_5 as 'experiments', A_6 as the 'feed-back'. Therefore the procedure of a research-worker is the following one: being over the step '0' which is called the 'context of the discovery', the research-worker enunciates a set of hypotheses, internally structured, that is a set of statements formed by some theoretical concepts; these concepts are all primitive concepts that is concepts not further on analysable or definable in terms of other concepts. Besides the concepts and the hypothesis it is necessary to assume as true, statements which belong to previous theories, until now well accepted. In summary in step 1 we have:

1) Primitive concepts $C_1, C_2, \ldots C_n$
2) Not demonstrable assumptions or axioms for the theory, $(A_1, A_2, \ldots A_s)$
3) The terms of the logical vocabulary (and, not, or, and so on)
4) The hypotheses $(H_1, H_2, \ldots H_m)$

These bricks are not sufficient. It is necessary a motor for moving the whole. Indeed the scientist must adopt a calculus, that is a formal means which allows to combine primitive concepts, axioms and hypotheses. If we denote with K_i a particular calculus, then a new statement S_j can be conceived as a function of $(C_1, C_2 \ldots C_n; A_1 \ldots A_s; H_1 \ldots H_m)$ that is

(1-1) $$S_j = K_i \ (C; A; H; S_{j-1}, \ldots S_1;)$$

where $C = (C_1, C_2, \ldots C_n)$ or a proper subset of it;

$A = (A_1, A_2, \ldots A_s)$ or a proper subset of it;

$H = (H_1, H_2, \ldots H_m)$ or a proper subset of it;

$S_{j-1}, S_{j-2}, \ldots S_1$ are the previous statements by this means deduced.

Likewise for the new concepts. We shall denote the new concepts with

$$\bar{C} = (C_{n+1}, C_{n+2}, \ldots C_t)$$

Until now we are in face of a formal theory with none empirical relevance.

1 - 1 THE PROBLEM OF THE OPERATIONALISATION OF A THEORY

As known, a theory without concrete validation, that is without those links between theoretical concepts and propositions and the reality of the concrete events, is an empty box. On the contrary a theory is a means for explicating the reality and therefore for forecasting new events.

Therefore, considering the new propositions well deduced, for validating a theory or, it is the same, for testing the original hypothesis, it is sufficent to control the forecasts. Strickly speaking it is necessary to remember that usually it is not possible to control the original hypothesis. We shall debate this question as regards the social researches and more particularly as regards the peace researches in subsequent paragraphs.

Considering the application of a calculus K_i we arrive, for instance, at a statement $S_j \rightarrow S_1$. The form of this statement may be whichever you want. We can have a mathematical formula

$$Y = f(X_1, X_2, \ldots X_s)$$

in which the form of the f can be or not specified, or we can have a formal implication

$$\forall x \; (Px \rightarrow Qx)$$

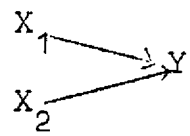
where P and Q stand for a given Property and $\forall$ is "for all"

Moreover this statement can be deterministic or probabilistic, in terms of words or in terms of mathemathical symbols. However it is not interesting for us, the form of these statements. What it is interesting for us is the fact that we have at our disposal one or more controlable statements.

1 - 1 - 1 - THE USE OF INDICATORS

Let us consider now that we have a statement which links a given class of events to other classes of other events. We can summarize this fact in this manner:

(1-1-1-) 1



where X_1 and X_2 are "factors" or "causes" and Y is the "effect" or the "consequences". Today mathematics is a usual tool for every scientist.Not only physics make use of mathematics but also biology,psychology and other sciences as sociology,and so on. Now mathematical models in social research, as for instance in Peace Researches,are actually used.These models can be deterministic or stokhastic.Therefore it is usual to speack of variables or of variates.The possibility of using mathematical or statistical techniques allows indeed to benefit by the powerful tools furnished by these doctrines.We cannot obviously remember in this paper all the mathematical and statistical tools at our disposal and we put off interested students to the suitable books of mathematics and statistics.Of course the use of mathematics in social sciences is neither more nor less then only a powerful tool.Therefore it is only for this reason that we use mathematics or statistics.In summary it is necessary to think in terms of " as if....."

But it is not easy to change all the concepts in measurable concepts.This fact is particularly true in social researches. Therefore the effort is tewards the measure tools because in this case it is possible to make use of mathematics and statistics.If we must verify,for instance,the model M_1 (formula (1-1-1)-1)we can write a system of equations of this type:

$$(1-1-1)-2 \quad \begin{cases} X_1 = e_1 \\ X_2 = C_{21} X_1 + e_2 \\ Y = a X_1 + b X_2 + e_3 \end{cases}$$

where e_i (i = 1,2,3) is a random variable and X_i is expressed in terms of deviation from the expected value,that is $X_i = x_i - E(x_i)$,where x_i is the actual variable; C_{21} ,a , b are the partial regression coefficients.

In this case it is necessary to verify that $C_{21} = 0$, that is the simple correlation coefficient R_{x_1,x_2} should be zero.Therefore we must calculate this correlation coefficient and verify it on empirical data.

In any case it is necessary to collect suitable data ,in terms of number expressed and therefore it is necessary to measure y-concept,x_1-concept and x_2- concept.

Having accepted the necessity of the transformation of the empirical concepts into measurable concepts,it is necessary to spend some words about the problem of measure operation.We have seen that when new statements are deduced and new concepts are introduced it is necessary another step,that is the binding of these empirical concepts with the observable events. We consider a measure operation as this bond.Now as you can see,it is necessary to speak about measure operation.We distinguish:

1) Direct Measure : a measure is direct if it is possible to find an instrument which associates in a suitable manner to the empirical observable event a number that we can read on a suitable scale.Conditions for direct measure:
   a) The scale really measures what we like to measure
   b) The instrument does not affect the event
   c) there is only a manner for associating event and instrument
   d) If the observer repeats the association ,obtains the same number
   e) If two observers measure the same event with the same instrument, they should obtain the same number.

2) Indirect Measure: a measure Y is indirect if it is not possible to find an instrument which possesses properties a),b),c),d),e), but if it is possible to bind Y with the direct measure of other observable events($x_1,x_2 \dots x_k$) and we can write :

$$Y = f(x_1, x_2, \dots x_k)$$

In this case we must know the form of the function or we must assume it. In some cases it is possible to know the form of the function,for instance when the theory gives explicitely indications. In other cases principal component analysis is a useful technique for knowing the new variable Y . In these cases we are in front of a linear combination of the variables ($x_1 \dots x_n$) with suitable coefficients. It is necessary to pay a great attention when we adopt these technique.Effectively the new variable could not be suitable for the concept that we will measure indirectly.Obviously if the variables $x_1 \dots x_n$ are not measurable directly,it is necessary to solve the same problem just now discussed.Therefore we have:

$$Y = f\ (x_1, \ldots\ldots x_n)$$

$$x_i = g_i\ (x'_1 \ldots\ldots x'_m)$$

$$x'_j = g_j\ (x''_1 \ldots\ldots x''_k)$$

$$\vdots \qquad \vdots \qquad \vdots$$

and so on until we can reach a set of indicators $(h_1 \ldots\ldots h_.)$ directly mesurable. This procedure is obviously always possible. A problem of direct measure must be solved for instance when we are in front of a concept with many dimensions.In this case it is necessary to synthetize many dimensions in only one dimension.Useful technique is in this case partial correlation coefficient.We shall not deep in this paper these technical problems, as previously indicated. It is sufficient for our pourpose to arrange only the whole matter.

It is time now to explain how these abstract considerations are actually valid in problems of peace research.In subsequent paragraph we shall discuss a simple example ,that is a conflictual model.We shall discuss the problem of forecast of a possible conflict under particular conditions and we shall show how it is possible to operationalize an abstract model . The model consider firstly a decisional aspect under optimal behaviour and subsequently the operational aspect of measure effectively on the reality the parameters.of the model. If we shall encounter the values of the parameters as we have assumed in the model,then we can forecast something with a given probability.

1-1-2 An example of forecast of conflict. The model.

Let us consider now a country C which can choice between two alternative courses of actions, A and B, for instance to choice war or to choice peace, with suit ble strategy. We shall develop our model formally in advance. We shall put events A and B with $Pr(A) + Pr(B) = 1$, where $Pr(A)$ and $Pr(B)$ are the probability of the choice of A or B, mutually exclusive events. Now we have: if C choice A then obtains x_1 $(0 \leq x_1 \leq \infty)$ or x_2 $(0 \leq x_2 \leq \infty)$ with probability respectively $Pr(x_1)$ and $Pr(x_2)$. Since x_1 and x_2 are conditional events it is more clean to write respectively $Pr(x_1/A)$ and $Pr(x_2/A)$. Of course we have $Pr(x_1/A) + Pr(x_2/A) = 1$. If C choice B then obtains y_1 and y_2 $(0 \leq y_1 \leq \infty$ and $0 \leq y_2 \leq \infty)$ with probability respectively $Pr(y_1/B)$ and $Pr(y_2/B)$ so that $Pr(y_1/B) + Pr(y_2/B) = 1$.
We can represent this situation with the following graph:

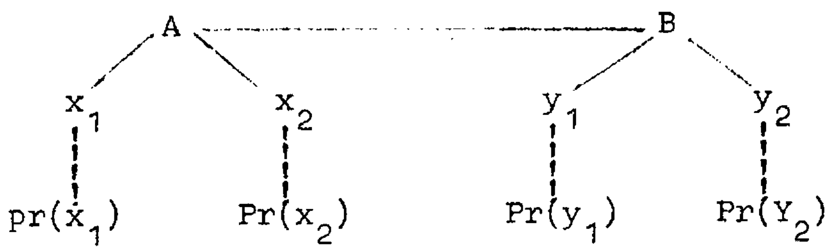


fig. 2

Obviously we have

$$Pr(x_2) = 1 - Pr(x_1)$$
$$Pr(y_2) = 1 - Pr(y_1)$$

If we calculate $E(x)$ and $E(y)$, where E stands for the expected value of the variable x and y, we shall obtain

1-1-2)-1
$$x_1 \cdot Pr(x_1) + x_2 \cdot Pr(x_2) = X$$
$$y_1 \cdot Pr(y_1) + y_2 \cdot Pr(y_2) = Y$$

Now if $Y \succ X \implies B \succ A$, where $\succ$ stands for "is preferred". Obviuusly Y and X are $E(y)$ and $E(x)$ and it is easy to see that we are in face of a typical decision criterion. Consider now

$Pr(x_1) = a = \text{costant}$
$Pr(x_2) = b =$ "
$Pr(y_1) = a' =$ "
$Pr(y_2) = b' =$ "
$X = c = \text{costant}$
$Y = c' = \text{costant}$

and consider that x_1, x_2, y_1, y_2, are now variables. Then we have a system of two linear equations .We also put in this case $x_1 = y_1$ and $x_2 = y_2$. Therefore we obtain

1-1-2)-2
$$\begin{cases} a\,x_1 + b\,x_2 = c \\ a'x_1 + b'x_2 = c' \end{cases}$$

where obviously we have $a + b = 1$
$a' + b' = 1$

Therefore we can deduce that

1-1-2)-3
$$\begin{cases} a\,x_1 + (1 - a)\,x_2 = c & \text{(straight line } r_1) \\ a'x_1 + (1 - a')\,x_2 = c' & \text{(straight line } r_2) \end{cases}$$

and then in reduced form :

1-1-2)-4
$$\begin{cases} x_1 = -\left(\frac{1-a}{a}\right) x_2 + \frac{c}{a} & (r_1) \\ x_1 = -\left(\frac{1-a'}{a'}\right) x_2 + \frac{c'}{a'} & (r_2) \end{cases}$$

In order of giving a graphical representation we put (r_1) and (r_2) in canonical form:

1-1-2)-5

$$\frac{x_1}{\frac{c}{a}} + \frac{x_2}{\frac{c}{1-a}} = 1 \qquad (r_1)$$

$$\frac{x_1}{\frac{c'}{a'}} + \frac{x_2}{\frac{c'}{1-a'}} = 1 \qquad (r_2)$$

£-1-2)-5'

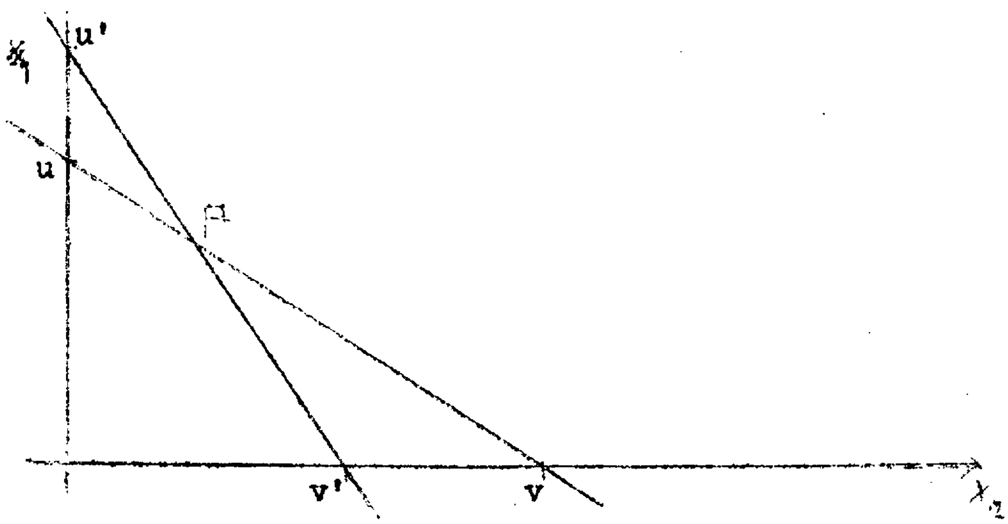
$$\frac{x_1}{u} + \frac{x_2}{v} = 1$$

$$\frac{x_1}{u'} + \frac{x_2}{v'} = 1$$

where $u = \frac{c}{a}$; $v = \frac{c}{1-a} = u \cdot \frac{a}{1-a}$

$u' = \frac{c'}{a'}$; $v' = \frac{c'}{1-a'} = u' \cdot \frac{a'}{1-a'}$

and graphically we have the two straight lines r_1 and r_2 whose point of intersection is indicated as P.



Graphic 1

We shall call P as point of " indifference ". It is easy to deduce the coordinates of P. We have :

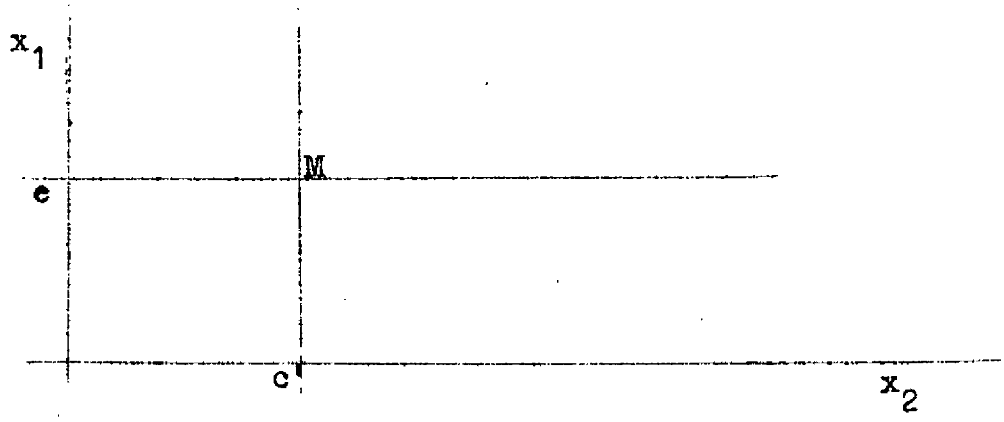
1-1-2)-6

$$x_1 = \frac{-(1-a)\,c' + (1-a')\,c}{a\,(1-a') - a'(1-a)}$$

$$x_2 = \frac{c'\,a - c\,a'}{a\,(1-a') - a'(1-a)}$$

now if we put a = 1 and a' = 0 we shall have

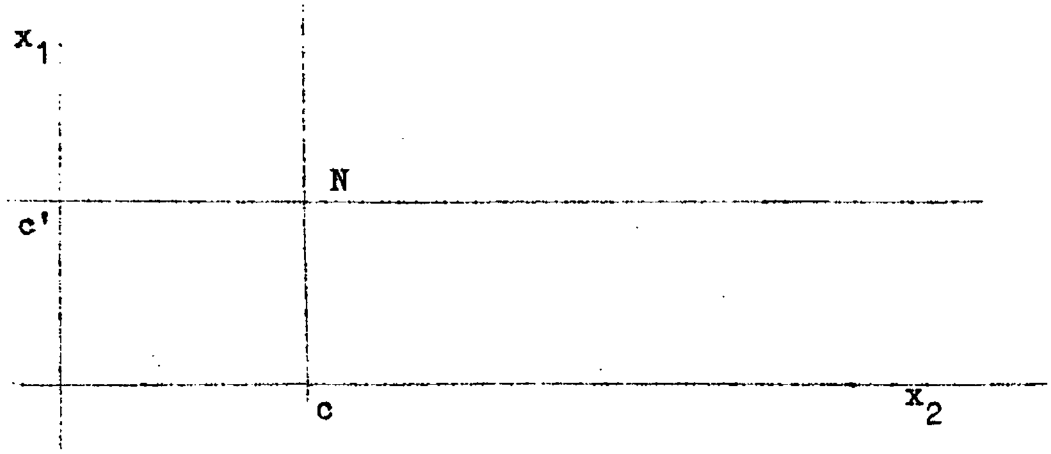
1-1-2)-7 $x_1 = c$ and $x_2 = c'$ (see graph.2)



Graphic 2

If we put a = 0 and a' = 1 we shall have

1-1-2)-8 $x_1 = c'$ and $x_2 = c$ (see graph.3)



Graphic 3

If we consider $a = 1$ and $a' = 1$, then we shall have

$$x_1 = \frac{0}{0} = \text{indeterminate form;} \quad x_2 = \frac{c - c'}{0} = \infty$$

If we consider $a = 0$ and $a' = 0$, then we shall have

$$x_1 = \frac{c - c'}{a - a'} = \infty \quad ; \quad x_2 = \frac{0}{0} = \text{indeterminate form.}$$

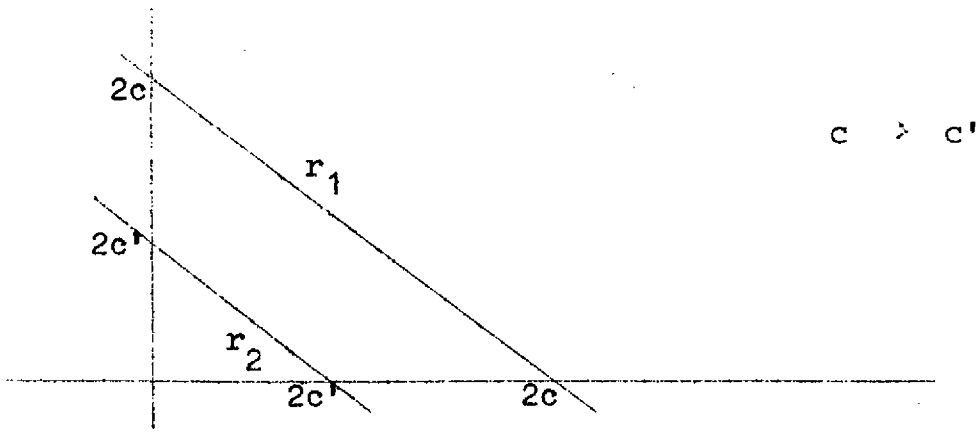
Obviously we can consider the two straight lines r_1 and r_2 for all the possible values of a and a', in the plane (x_1, x_2).

For instance : $a = a' = 0,5$, we shall have

$$u = 2c \qquad u' = 2c'$$

$$v = 2c \qquad v' = 2c'$$

and graphically we can see:



Graphic 4

that is two parallel lines. If $c = c'$, then we shall have $r_1 = r_2$, the two straight lines are overlaping and the choice of A or of B is obviously indifferent.

In subsequent paragraph we shall consider a particular value of a and a' following the interpretation of the model. Now we must only remember that $u, u', v,$ and v' are dependent from a and a'. and that the two lines represent the two choices.

It is now time to introduce some axioms

1) $A > B$ if and only if $c > c'$

2) $A \quad B$ if and only if $Pr(A) > Pr(B)$

3) $A \approx B$ if and only if $Pr(A) = Pr(B)$

where ' $\approx$ ' means that the choice is indifferent.

<u>Theorem</u> : If $A > B$ then $Pr(A) > \frac{1}{2}$.

indeed	if $A > B$ then	$Pr(A) > Pr(B)$
but		$Pr(A) = 1 - Pr(B)$
then		$Pr(A) > 1 - Pr(A)$

$$Pr\ (A) + Pr\ (A) \geq 1$$

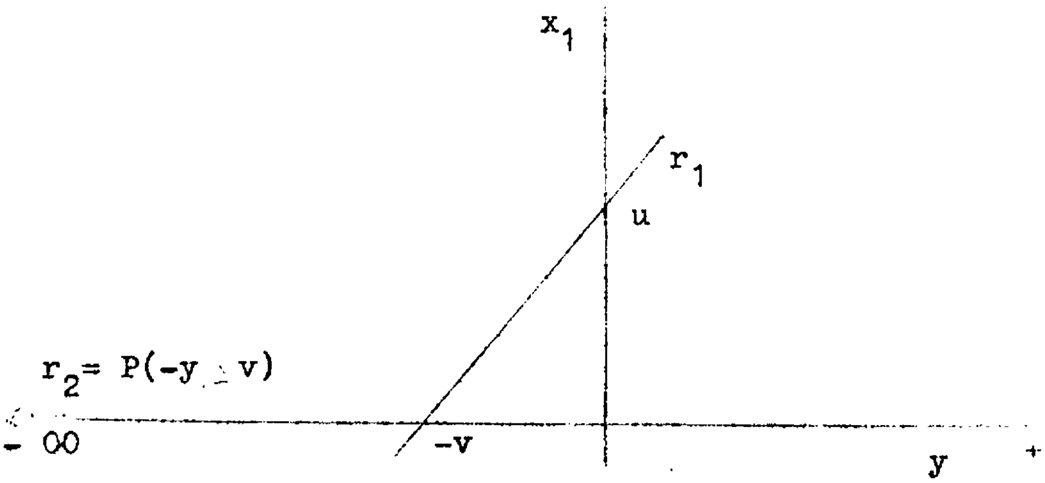
therefore $\quad 2\ Pr\ (A) \geq 1$

endly $\quad Pr\ (A) \geq 0,5.$

Let us consider now the values x_2 e r_2 > x_2 e r_1 and x_1 e r_1 > x_1 e r_2 then , for $a' = 0$ (and therefore $1 - a'=1$) and overall $a > a'$, then we shall have a very particular situation on the plane (x_1,x_2). In fact the two straight lines are:

1-1-2)-9
$$r_1)\quad a\ x_1 + b\ x_2 = C$$
$$r_2)\quad x_2 = c'$$

and if we consider $x_2 = -y$, as a loss, we have that $c < c'$ and ttherefore ,considering theorem previously demonstrated, we have $A > B$ and $Pr\ (A) > 0,5$. It is important to consider that we . take into account only the probability, that is the values of a and a'. Graphically we have:



Graphic 5

As you can see $x_2 = c' = P\ (-y)$ is always at the left,on the $-y$ axis ,of the intercepting point of r_1 on y-axis.

1-1-2-1 Interpretation of the formal model.

Let us consider now an interpretation of this model so abstract. Let us consider:

A = Peace Choice with given political strategy
B = War choice with given military strategy
x_1 (A) = Profit from peace or happiness or gain
x_2 (A) = Sufference or loss from peace choice
x_1 (B) = Profit from War (nuclear)
x_2 (B) = Loss from nuclear war

Empirical situation :

1) They use the nuclear weapons and I C B M
2) Deterrent menace ,that is second strike is as much destroying as the first one.

subcondition 2') There are not technical solutions against I C B M that is the reliability of an A B M system is near zero.

Consequences : 1) It is possible to destroy wholly the enemy
2) Country C can wholly destroied considered
3) Therefore the loss is 00,if @ choice B.
4) The loss or the gain in a strategy of peace is never a priori 00
5) The probability of the loss in a nuclear war under previous conditions is near 1

Putting empirical situation and consequences in terms of variable we have :

1) a and b $\neq 0$
2) $x_1(A) \neq 00$ and $x_1 (B) \neq 00$
3) $a' = 0$ (therefore $b' = 1$)
3') $a > a'$ obviously
4) $x_2(B) = - y (B) = - 00$
5) $x_1 \neq 00$

Graphically we have the situation of graphic 5 . Here we have the straight line r_1 always at the right of the straight line r_2 which is reduced to the point P (- 00 ; 0). The meaning of this situation is clear. In fact for r_1 the loss is neve 00.Of course the gain is determined. Therefore the choice of r_1 and therefore of of A is too obvious in this context. Formarly:

1-1-2-1) - 1 $\quad r_1) \quad a x_1 - b y(A) = c \quad$ (c surely finite)

$r_2) \quad a'x_1 - b'y(B) = c'$

and thefefore we have

$$r_2 - \text{bis}) \qquad - b\,y\,(\,B\,) = c'$$

$$c' = -\,OO$$

and then $c' > c$

A few words are necessary at this point.We put two questions:

a) Is the empirical situation near the reality?
It is necessary to remember what we have said in paragraphs 1 and 1-1. Effectively the relation between empirical reality and our models is not unique. That is,it is possible to conceive many models for the same empirical situation following the the choices that put on our perception of the complex reality. A model is always a simplification of the reality and the forecast is therefore never exact.To sum up, if the empirical situation is not well reproduced in our model,it is possible to build another model,model more complex and then we can have a succession of models M_1, M_2, M_3 ...... that we think never convergent to the reality M, that we do not know . Therefore it is not possible to fix a measure of the error $M_i - M$ in a direct manner but only indirectly by the error in our forecast and it is not possible to link this indirect measure with the unkognoscible direct measure . Therefore even if we obtain a good forecast ,we cannot say that we know the realityin her essence.

b) Are we in front of a good translation into numerical terms of the empirical condition ?
Our answer is obviously ' yes '.In fact we have supposed an extreme situation. Our duty now is the check of the piints 1), 2),3),4),and 5) . But how can we verify that conditions 1),2),3),4),5),are really true? It is necessary to define some indicators . In fact until now we have only developed a theoretical model . We shall discuss these questions in subsequent paragraph.

1-1-3- Operationalization of the model previously discussed

In last paragraph we have indicated five conditions and following the model we have a forecast ,that is that Pr(A) $\geq$ 0,5.We must assume the axioms and verify the conditions. These conditions are presented in a theoretical language.therefore it is necessary to introduce an empirical language and to furnish some indicators for evaluating operationally the parameters . At this point there are many possibilities.Let us consider before:

1) a,b, a',b', are probability
2) $x_1(A)$, $x_2(A)$, $x_1(B)$ and $x_2(B)$ are gains or losses.

The probabilities previously mentioned are conditioned probabilities. In fact we have:

$$a= Pr(x_1 / A \text{ choiced })$$

$$a'= Pr (x_1 / B \text{ choiced })$$

and so on.

Theorem on conditional probability gives:

$$Pr (A \wedge x_1) = Pr A) . Pr (x_1 / A)$$ wher ^ means ' and'.

It should be interesting to know pr($A \wedge x_1$), that is the probability of the choice of A and the subsequent succces x_1. But must know $Pr(x_1 / A) = a$ and so on.

We can consider empirically a,a',b,and b' as the results of the calculus of the political and military managers of the country C. This calculation is grounded on informations (i_1.....i_m) and on the importance attributed by the same managers to these informations.Informations are grounded on a global analysis of interaction among the country C and its enemies.
Consider now two countries,C and N..As previously indicated the problem of the political and military managers is of evaluating the parameters a,a',b, . The informations are the following:

z_1 = Reliability of e I C B M system of N.

z_2 = Reliability of e I C B M system of C

z_3 = Reliability of A B M system of N

Z_4 = Reliability of A B M system of C

z_5 = % of the whole capability of fight of N,destroied by a first strike of C.

z_6 = % of the whole capability of fight of C,destroied by a first strike of N.

z_7 = % of the whole capability of fight of N,des'roisd by a second strike of C

z_8 = % of the whole capability of fight of C,destroied by a second strike of N

z_9 = % of the population of C surviving the first strike of N

z_{10}= % of the population of N surviving the first strike of C.

z_{11}= % of the population of C surviving the second strike of N

z_{12}= % of the population of N surviving the second strike of C.

These indicarors are all with range (0 -- 1) and also the parameters a,a',b,b', are with range (0 -- 1).The choice of these indicators is obviously arbitrary but we think that interactionbetween C and N, in this particular case ,can be measured by these variables.Obviously we can choice other variables and obviously we shall have,it may be,other results.

In this case we have 12/in direct measures ,that is we are in front of simple estimates.If we must measure really $z_1 \ldots z_{12}$ we must consider other just carried research works on this particular problem. Our aim now is to know the estimate of a,a',b,b', and therefore evaluate the link of these parameters with $z_1 \ldots\ldots z_{12}$ as we can find in the mind of the political and military managers of C. In fact we want not to choice war or peace ,but only forerecasting war.Therefore we can have:

$$a = f\ (\ z_1 \ldots\ldots z_{12};\ c_1 \ldots c_k\ )$$

$$a' = g\ (\ z_1 \ldots\ldots z_{12};\ c'_1 \ldots\ldots c'_h)$$

$$b = 1 - a$$

$$b' = 1 - a'$$

where c_i $(i=1\ldots k)$ and c'_j $(j=1..h)$ are parameters of the functions

At this point it is necessary to specify the parameters c_i and c'_j,that is specify the form of the two functions f and g.
If we have not at our disposal a suitable theory we can choice this strategy of research.
Let us consider a sample of n managers and ask for ordering the 12 variables. There are available many tachniques for reaching this aim and we shall suppose that we can weigh the 12

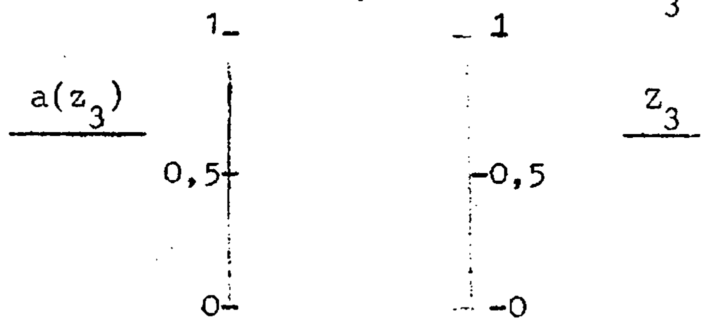
variables with suitable numbers. Successively let us put the foll owing 12 linear re ations between a and $z_1 \ldots\ldots z_{12}$ and 12 linear relations between a' and $z_1 \ldots\ldots z_{12}$, that is

1-1-3)-1 $$a(z_1) = m_1 z_1 + n_1$$
$$\ldots\ldots\ldots\ldots\ldots\ldots$$
$$\ldots\ldots\ldots\ldots\ldots\ldots$$
$$a(z_{22}) = m_{12} z_{12} + n_{12}$$

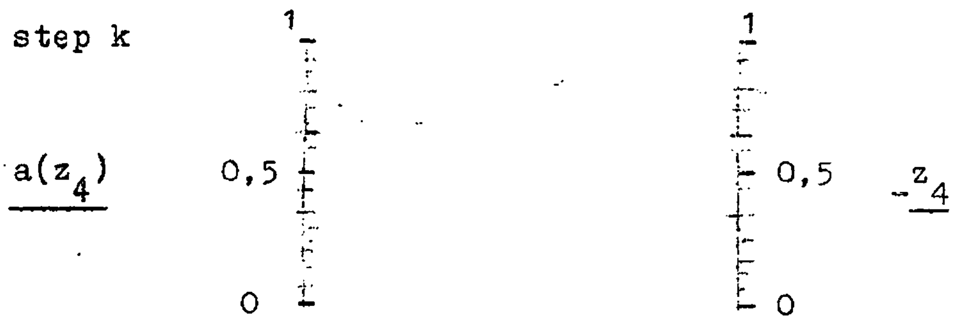
and for a'

$$a'_1 (z_1) = m'_1 z_1 + n'_1$$
$$\ldots\ldots\ldots\ldots\ldots\ldots$$
$$\ldots\ldots\ldots\ldots\ldots\ldots$$
$$a'_{12}(z_{12}) = m'_{12} z_{12} + n'_{12}$$

Now we ask the sample for joining, for every z_i, in k steps, the 2^k subintervals of a or a' with the 2^k subintervals of z_i. Let us consider for instence step 1 and a with z_3. We shall have



and at step 4, for instance, we shall have 2^4 subintervals;



and so on until step k. To sum up we build progressively a scale with 2^k subintervals. For k = 4 we have 16 subintervals. We shall call this procedure as interval dichotomy and mappping.
When we have colllected the datea for the whole sample we can biild the following table in which

l_i (a_j) and l_k (z_j) are the subintervals builded for a (z_j) and z_j; $n_{ik(j)}$ are the numbers of the pairing in the sample of n individuals. Now we can calculate simple regression coefficients with suitable correlation coefficients (squares) as measure of goodness of fitting the straight lines. Therefore we have for any z_i and for a and a' 24 tables of this type

	$l_1(a_j)$ ..... $l_i(a_j)$...... $l_{2^k}(a_j)$	Tot.
$l_1(z_1)$	$n_{1,1}$	$n_{1,\circ}$
	....	
	....	
$l_k(z_i)$	..............$n_{ik(j)}$..............	$n_{k,\circ}$
	....	
$l_{2^k}(z_j)$	....	$n_{2^k,\circ}$
Tot	$n_{\circ,1}$ $n_{\circ,i}$ $n_{\circ,2^k}$	n

Fig.3

It is possible to eliminate some indicators. For instance we can consider that the pure reliability of a country can . considered as a new variable

$$O = Z_1 = z_1 \cdot (1 - z_4) = 1$$

or

$$Z_{11} = f(z_5, z_3,$$
$$z_5 = g(x_3)$$

and so on. Otherwise we can reduce some indicators by statistical devices.

At this point we can evaluate the 48 coefficients of the linear relations and evaluate a weighted mean value of the $(2^k)^{12}$ values of the 12 variables as previously calculated and then estimate the various possible values of a or of a'.We can also plot the graphic of the functuon

$$a = f(z_1 \ldots\ldots z_{12}).$$

or

$$a' = f(z_1 \ldots\ldots z_{12})$$

Therefore we can know for what combination of values $\bar{z}_1 \ldots\ldots \bar{z}_{12}$ we can look forward the particular value of a and a' which enable us to forecast pr(A) $\geq$ 0,5 and so on.We can also evaluate Pr (A ^ x_1). It is necessary to point th t we are not in front of a problem of optimal choice ,but only in front of a problem of forecast.

1-2- <u>Power of forecast of these types of research</u>

In this paper we have presented an outline of an explicative research.We have followed the plane in the first paragraph indicated and we have demonstrated how to go on.We have shown the rôle of the indicators introduced and therefore how can we operationalize our proc dure .The operationalization is so important because a good forecast,(and we know that explication is equal forecast)is essentially dependent on a good choice of the same indicators.We have also said that the choice of indicators does not follow the same procedure of physics where it is possible a narrow link between concept and physical operation.

Unfortunately in Peace researches it is not possible to achieve this result but it is necesaary to be satysfied of the availability of the data and of the good knowledge of the empirical problem.To convince oneself it is sufficient to give a look at the papers issued in the Journal of Peace Researches or in the Journal of Conflict Resolution. This arbitrary choice influences the goodness of forecast ,neither it is sufficient the use of tests techniques (χ^2 , t , or F). No statistical device can obviate a bad choice. Thus the forecast can be confirmed or not confirmed. But if we have a bad forecast it is impossible to locate the sources of the error. We must remember that in our model we have hypothized a conflictual situation.We have choiced further the indicators as an operational tool for evaluating a or a'.

To conclude our considerations it is necessary to spend some words on the types of forecast. In fact we can have two types of forecast proposition .the first one is of the type in this paper just introduced that is for instance

$$Pr (A) \geq 0,5 \text{ and therefore } Pr(A \wedge x_1) \geq 0,5$$

obviously if we put a= 1 and b = 0.

The second kind of forecast is the forecast of a number with a given confidence interval.

The second kind is obvious

The second kind of forecast is the forecast of a number with a given confidence interval:for instance we can say that in 1980 we shall have in Italy 59,000,000 of individuals.with a confidence interval of 1,000,000 at livel of confiednceof 95%.

This kind of forecast it too obvious.But when we consider the first kind of forecast ,as for instance $Pr(A) \geq 0,5$, what is tha meaning? This forecast can be conceived fairly deceiving from the point of view of the man in the street which fears the war. And even from the point of view of the man ,generally speaking , which fears uncertainty and chance and therefore the possible damages.

Unfortunately science today can offer only some probabilities, more or less well deduced from the models that our mind can build on the reality. Also in peace researches this fact is true and we consider peace research a scientific discipline as can be conceived every social science . In fact we have in peace researches :

1) A language ,more or less defined.
2) Available data (directily or indirectily collected)
3) Some technical devices as statistical devices
4) Problems and hypotheses
5) There esist a context of validation
6) It is possible therefore to explicate and to forecast new events.

As regards our model we hope that it shallnot be denied. But we have only a probability and therefore we are in the same situation of a gambler with a device that can produce two events with ,respectivelu, probability more than 0,5 and less then 0,5, since the two events are mutually exclusive so that the sum of the probabilities is 1. We must therefore conclude that can happen sometimes in the long run the unfavourable event.

But shall we be always in a conflictual situation?

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