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# *Notes and Comments*

## *Newtonian Mechanics and Predictive Election Theory*

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Analyses of elections, whether academic or journalistic, are permeated by terms drawn from physics. We discuss the inertia or volatility of an electorate, the momentum of a campaign, pressures and cross-pressures, party actions and reactions, the impact of short-term forces. Although imprecise, these borrowings convey genuine information about the characteristics of an election, and they would be difficult to replace.

The implicit physical analogies that underlie the use of such terms (along with others related to cybernetics and economics) have been used to support the general contention that politics too can become a science. The differences, which are equally apparent, between political usages and those in the other disciplines have then been enumerated by critics of this idea, and long controversies at a high level of abstraction have ensued.

It seems more fruitful to eschew wide-ranging debate and instead to develop working theories about the detailed problems that confront us in specific areas. Such a specific approach will explore analogies where they are useful, but in the full consciousness that they will break down when pushed too far. The interesting question then becomes whether we are totally dependent on imprecise borrowings or whether out of the analogy with physics we can develop a specifically political concept and measure which does the job better.

This type of enquiry should be especially rewarding in regard to election analyses in general and to the analysis of short-term election forces in particular. Elections have been studied systematically and quantitatively to a greater extent than any other political phenomenon. The very use of the term 'forces' invites comparison with the key element in Newtonian mechanics. Converse's pioneering work on the measurement of short-term forces[1] (perhaps initiated under the influence of the general Newtonian analogy) has been followed by the extended American debate on policy voting[2] and by related conceptualizations.[3] So the concept has already been developed at the operational level to a much greater extent than is usual in political science. Hence comparisons with the precisely-delimited Newtonian 'force' are capable of improving our understanding in a way impossible with vaguer usages which might simply fade away under closer inspection.

* Department of Mathematics, Department of Government, University of Essex. This note is one of a series of papers arising out of work on elections and voting behaviour, under the SSRC grant HR 2129/1. The order of names is alternated to indicate our equal collaboration in the research.

[1] Philip Converse, 'The Concept of a Normal Vote' in Angus Campbell, Philip E. Converse, Warren E. Miller and Donald E. Stokes, eds., *Elections and the Political Order* (New York: Wiley, 1966), pp. 9–39.

[2] For an influential symposium see G. M. Pomper, R. A. Brody, B. I. Page and R. W. Boyd, 'Issues and American Voters 1956–68', *American Political Science Review*, LXVI (1972), 417–78. For an up-to-date review see M. Margolis, 'From Confusion to Confusion: Issues and the American Voter 1956–72', *American Political Science Review* (forthcoming, March 1977).

[3] Ian Budge and Dennis Farlie, 'Towards a Comprehensive Theory of Elections: Assessing the Impact of Campaign Cues' (in preparation).

We should expect to find both similarities and dissimilarities with Newtonian reasoning. Very likely the dissimilarities will go deeper. But we should end up with a better specified conception of election forces in political terms, from which a working theory might be developed.

The concept of physical force is embedded within the theoretical context of the Laws of Motion (and the associated Laws of, for example, Gravitational Attraction). These should first be stated:

(1) Every body continues in a state of rest or of uniform motion in a straight line except when it is compelled by external force to change that state (First Law).

(2) The rate of change of motion is proportional to the applied force and takes place in the direction in which that force acts (Second Law).

The Second Law leads to the measure of force:

$$F = M \times A. \tag{1}$$

Force = mass × acceleration (i.e. rate of change of motion).

(3) To every action there is an equal and opposite reaction (Third Law).

(4) There is an attractive force between two bodies which is proportional to the product of their masses and inversely proportional to the square of the distance between them. (Other formulations can be made for other types of forces such as electro-static attraction and repulsion.)

It is instructive to note that the First Law is in strict logic an unnecessary gloss on the Second and on the concept of force. Since only force is envisaged as an agent of change in motion, its non-application necessarily implies that things will continue as they are. The heuristic value of making this presumption explicit is, on the other hand, enormous. It alerts analysts to look beyond the minor observed perturbations of natural bodies to their basically unchanged state where no discernible force is applied.

The value of the First Law for us is in making an obvious link with the prediction of overall election outcomes. Here too the major initial question is whether the next outcome will be the same as, or different from, the last. It is here that the ability to detect and measure short-term forces is important. If none operates in either election, or if the forces are identical, the outcome should be the same. If different short-term forces operate, and act disproportionately on the side of one of the parties, then the next outcome will differ from the last and the favoured party will gain.

In drawing these parallels we are making what seems to be a plausible assimilation between natural bodies and the total electorate, whose distribution of results gives the outcome. We also assume that the physical space implied in the First Law can be approximated by the space of outcomes, whose ends are complete victory for one or other of the parties. This is illustrated

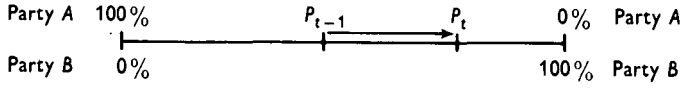


*Fig. 1. A party-defined space showing the extent and direction of change between two election outcomes.*

for a two-party situation in Fig. 1, where $P_{t-1}$ represents the percentage voting for Party $A$ in the last election, and where $P_t$ represents the percentage voting for it in the present election. The extent and direction of change are indicated by the arrow from $P_{t-1}$ to $P_t$.

If change is of the extent shown in the figure, it is presumably associated with the influence of new forces. At this point, therefore, we turn to a comparison with the Second Law and the Newtonian concept of force proper.

Newtonian force has two attributes: direction and magnitude. With regard to direction there is no obstacle to the transfer of the idea. We naturally infer from a representation like that of Fig. 1 that any change takes place in the direction in which short-term forces have acted. If Party *A* usually wins but Party *B* wins the current election, we assume that short-term forces have favoured Party *B*.

The magnitude of a force is the other attribute cited in the Second Law, and then measured exactly through the formula that force equals mass times acceleration (i.e. rate of change of motion). Mass is introduced into the definition to meet the observation that the same force applied to different bodies produces different effects. Hence a body propelled into slower motion than another by the same force is viewed as having greater mass.

Most measures of short-term electoral forces are data-based estimates for particular elections of the net gains made by a party compared with the support that it would have enjoyed had the votes been distributed solely on the basis of long-term predispositions and partisan commitments.[4] Formally this type of measure of the effects of a short-term 'cue' or 'election force' can be generalized as:

$$\begin{array}{lcll} C_i & = & P_{p+C_i} & - \quad P_p \\ \text{effects of a particular cue or force} & = & \text{per cent voting for a party under predispositions plus the cue} & - \quad \text{per cent voting for a party under predispositions alone} \end{array} \tag{2}$$

Give this measure, the outcome for a given election can be described as:

$$\begin{array}{lcllll} P_t & = & P_{t-1} & \pm \Sigma C_{it-1} & \pm \Sigma C_{it} \\ \text{percentage voting for a party in the current election at time } t & = & \text{percentage voting for party in last election at time } t-1 & \pm \text{ summed net effect of cues in last election at time } t-1 & \pm \text{ summed net effect of cues in present election at time } t \end{array} \tag{3}$$

In other words, we would (under the usual procedures applied) take as the basis of calculation the percentage voting for a party in the last election, subtract from this the net gains (or add the net losses) accruing from cues operative in that election, and add/subtract the net gains or losses accruing from cues in the present election. If we believed that long-term predispositions were also producing long-term voting shifts, we could complicate equation (3) by adding a term to express this long-term change:

$$\begin{array}{lcllllll} P_t & = & P_{t-1} & \pm \Sigma C_{it-1} & \pm \Sigma C_{it} & \pm L_p \\ \text{percentage voting for a party in the current election at time } t & = & \text{percentage voting for party in last election at time } t-1 & \pm \text{ summed net effect of cues in last election at time } t & \pm \text{ summed net effect of cues in present election at time } t & \pm \text{ long-term change associated with predispositions} \end{array} \tag{4}$$

[4] This statement over-simplifies in that it presupposes some ability to measure first what the vote *would have been* under predispositions, then under predispositions plus a particular kind of cue, and from the comparison to estimate the net effects associated with a particular kind of cue. This is possible in terms of the procedures we suggest in our own paper (fn. 4). Converse's normal vote measure simply compares the net effects on one direction or the other

While these formalizations indicate that short-term election forces are indeed amenable to systematic measurement, they have on the face of them little relationship to the Newtonian function $F = M \times A$. Equation (2) seems to imply that no function exists at all, that there is a simple equivalence between the short-term election forces ($C_i$) and the magnitude of the resultant change ($P_{p+C_i} - P_p$). It is certainly obvious that election forces are measured through the extent of change rather than the rate of change.

This constitutes a fundamental divergence from Newtonian force, stemming from political scientists' and physicists' differing foci of interest. Predictive election theory is primarily concerned with characterizing one future location – that of the next election outcome. Newtonian theory on the other hand is concerned with continuing motion; thus prediction of one future location is incidental to predicting the total shape of the whole path. To characterize this we need to know acceleration, whereas a single future location can be given more simply by the magnitude of change from one time-point to the next.

Another divergence seems evident when we consider the other component of the Newtonian definition: mass. No such term appears in the formalization for data-based estimates of election forces ($C_i = P_{p+C_i} - P_p$), where the effect of a cue is regarded as the net change in voting for a party from the voting that would have occurred under predispositions alone.

Before concluding that there is no correspondence between the measures of force in this respect, however, let us envisage a situation in which we were confined to making purely data-based estimates of physical forces without recourse to Newtonian theory. Accepting that we should be concerned with the rate rather than the magnitude of change, would we not follow a somewhat similar procedure as in the case of election forces? That is to say, would we not form estimates of physical force in each specific instance by subtracting the initial speed of a body at each time unit from its end speed, over a number of such time-units, and then equate force with the acceleration it produces? Formalizing, this would produce the following equation:

$$F = S_t - S_{t-1} \qquad (5)$$

| | | | | |
|---|---|---|---|---|
| force | = | speed at end of time unit $t$ | − | speed at beginning of time unit $t-1$ |

Now equation, (5) the data-based estimate of physical force, looks rather like Equation (2), the data-based estimate of election forces – allowing for the fact that one measures magnitude of change and the other the rate of change.

Given that physical force can be so measured, what is the function of adding in mass in the Newtonian formula? This is obvious once we try to reconcile data-based observations based on Equation (5). For these would differ sharply, even though we applied what we thought was the same force to different bodies. Rather than conclude that these measures were unique to each particular situation and physical body, physicists early sought to reconcile differing observed estimates by arguing that the same force applied to a body of less mass than another will produce higher acceleration. Hence the inclusion of mass in the Newtonian formula $F = M \times A$. Here mass is a name for that which slows down change (or, at the extreme, prevents it altogether). Its theoretical value lies in reconciling different data-based estimates of acceleration produced by the same force acting on different bodies.

Putting the matter this way round clearly reveals the danger of relying solely on data-based

(*cont.*) produced by all election cues acting together, with what would have been produced under predispositions *or* in a situation where short-term effects balanced each other out. The pure predispositional situation is thus not distinguished from a situation involving a balance between the short-term cues.

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estimates of change produced by cues. Such estimates are likely to differ for the same force or cue between different election situations. An immediate reaction is, then, to conclude that the measures are unique to each election and that no over-time or cross-national generalization is possible. The Newtonian analogy suggests, however, that, if some factor (an equivalent for mass) can be postulated to slow down or accelerate change in one case relative to another, a general formulation may still be possible.

If we now ask what could limit or favour election change, the most likely factors are traditions, loyalties and attachments to existing parties. We have already examined the operation of these in some detail, as long-term predispositions which contrast with campaign cues.[5] These seem to afford a good functional equivalent of mass in mechanics, and suggest a more general formulation of the definition of election force, modelled on the Newtonian formula and capable of accounting for variation in the data-based estimates formalized in equation (2) above:

| $c$ | = | $p$ | × | $e$ | (6) |
|---|---|---|---|---|---|
| election cue or force | = | strength of the pre-dispositions operating in current election | × | extent of change from last election to current | |

The idea that such a direct borrowing from the Newtonian framework could apply to elections needs of course to be checked empirically. While demonstrating the practical usefulness for election theory of a detailed examination of the analogy with physics, one should not imply that electoral predispositions can be regarded as exactly analogous to Newtonian mass. The most obvious measure for a given electorate would be to use proportions of firmly committed voters. However this, unlike Newtonian mass, then restricts the range of locations available for the election outcome. For example, in the space sketched above an electorate with proportions $p$ committed to Conservatives, $q$ committed to Labour, and $r$ free to re-align could only move from $p$ to $p+r$ for the Conservative co-ordinate and $q$ to $q+r$ for the Labour co-ordinate.

We could, of course, refine our measures by ceasing to regard committed electors as impervious to change and instead seek to construct psychological measures of resistance to change for individual electors, which could then be aggregated for the whole electorate. In this way we would cease to limit possible movement in the space. Another difficulty remains however, in that it is easy to envisage particular constituencies of sub-groups of electors whose predispositions were more resistant to change than that of the electorate as a whole. This creates the paradox that the 'mass' of two sub-electorates, considered as a unit, would not equal the sum of the 'masses' of the two sub-electorates estimated separately.

This illustrates a more general point: that we are considering an analogy between physical and election forces – two things which in their nature are very distinct – and that we cannot carry it too far. This becomes apparent when we consider the Third Law on action and reaction. This is redundant for election theory since election forces are not carried by physical intermediaries in the same way as ropes pulling a waggon.

In the case of gravitational attraction we have considered at some length whether any useful extension might be made in terms of the attractive/repulsive forces created by the parties through the medium of campaign cues. However these appear to be verbal usages which are

[5] The concept of predispositions is discussed at length by Ian Budge and Dennis Farlie in *Voting and Party Competition* (London and New York: Wiley, 1977), Chap. 2, section 4 and Chap. 7, section 4.

hard to operationalize and which do not seem necessary to election theory, at least in its current state of development.

This is not too disappointing since we must expect the physical analogy to fail beyond a certain stage. The surprising and practical use of this point-by-point comparison is that the analogy with the Second Law produces a potentially fruitful line of investigation – perhaps for political phenomena other than just elections.[6] What is now needed to complete the discussion is a comparative data-based investigation of the relationship $c = p \times e$, to see whether it does indeed hold up.[7]

[6] The First Law of Inertia seems applicable to many political fields – from budgeting and judicial discussions to the political stability of regimes – where the basic starting question is whether the outcome will be the same as last time or whether (and in what direction) it will change under the impact of new forces. This also raises the question of whether the definition of force for elections might also be applicable to these other areas.

[7] We hope to do this in the paper on campaign cues cited in fn. 4 above.

## *A Reply to K. I. Macdonald*

STEVEN LUKES*

K. I. Macdonald (this *Journal*, VI (1976), 380–2) asserts, first, that my claim that the concept of power is essentially contested is 'technically mistaken' and, second, that the mistake is 'substantively pernicious'. Unfortunately, he does not succeed in showing what the mistake is – nor indeed what makes it 'technical', rather than just a mistake. He does not even try to show why this alleged mistake is pernicious – let alone substantively so.

Macdonald rightly detects certain differences between my use of 'essential contestedness' and Gallie's. He concludes from these that my referring to Gallie is 'more obfuscatory than precise'; yet his own characterization of Gallie's problem as 'almost a taxonomy problem' hardly strikes one as illuminatingly exact. He identifies two points of disagreement, claiming that these indicate (again 'technically') the disparity between Gallie's account and mine. These concern (1) the appraisive character of essentially contested concepts and (2) their derivation from original exemplars. It is of course true that 'power' is not, overtly and directly, appraisive, though any given attribution of power will, I claim, favour certain ways of appraising the situation while disfavouring, and in some cases precluding, others. It is also true that the concept of power is not derived from an 'original exemplar whose authority is acknowledged by all the contestant users of the concept'. However, there are, clearly, standard cases of the possession and exercise of power about which all will agree. The significant disputes occur over where and how far the boundaries of the concept are to be extended.

Macdonald's central complaint is that I fail to distinguish between two kinds of contest. Thus he seeks to draw a distinction between (1) contests whose 'proper ground. . . is the essence of the concept' and 'inhere in that concept' and (2) contests which are 'about the values from which the concept depends'. In seeking to draw this distinction, Macdonald neatly misses the very point of my argument, which was to suggest that disputes about the proper interpretation and application of certain concepts *are* disputes between contending moral and political perspectives – that different interpretations (which I call 'views' and Rawls calls 'conceptions') of such concepts arise out of and operate within different perspectives.

In saying this, I am (precisely) following Gallie who speaks of 'endless disputes', which are

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