Analogy, Visualisation and the Praxeology of the Abstraction Gap

Notes on the use of rendering practices in mathematical sociology

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Preamble

This Note fell out of a discussion of formal and mathematical 'methods' in sociology, we have been developing. We will share this in due course. In the meanwhile, this little exercise seemed self-contained enough to be floated off on its own.

I INTRODUCTION

Once upon a time, Keith Basso (BASSO 1974) admonished linguistics and anthropology (and by implication, sociology as well) for a lack of interest in the social character of writing.

> *Adequate ethnographies of writing do not yet exist because linguists and anthropologists alike have grown accustomed to investigating written codes with only passing reference to the social systems in which they are embedded.....When all is said and done, we shall find that the activity of writing, like the activity of speaking, is a supremely social act. Simultaneously, I believe, we shall find it far more complex — and therefore more intriguing — than we have suspected heretofore. (BASSO 1974: P 269)*

As far as we can tell, not much has changed in the meantime. What interest there has been has largely concerned itself with the ideational shaping of what is written rather than the practice of writing itself. This is especially true of studies of sociological writing where the theme has mostly been the perspectival limitations of contributions provided by researchers construed as representatives of this or that social type.[1]

We want to take a different approach. In this Note, we will try to make a small (and undoubtedly belated) contribution to the *ethnography* of writing considered as a disciplinary social practice rather than the epiphenomenon of a modernist *weltanschaung* or the institutionalisation of professionalised ideology. To give some direct relevance to the points we make (though, we do admit, with tongue slightly in cheek), we have chosen examples from sociology itself. We could have chosen them from any other intellectual or professional field or indeed, as Basso did in the paper referred to above, from ordinary life. The reason we use sociology is simply a combination of contingency (they were the examples we had to hand when the topic crystalized for us), collaborative history (we wrote about not

[1] The classic sources are , CLIFFORD & MARCUS (UPDATED 2010) and SMITH (1999)

unrelated matters many years ago) and curiosity (we wanted to see if it was possible to give an analytic treatment to reflexivity rather than the more usual autobiographical and methodological ones).

We recognise it is important to set the right tone from the start otherwise one is liable to be misread or misheard. When we talk of the practices of sociology, this should not be taken to be a weasel euphemism for alleged *mal*practices. We start from a position which recognises writing and particularly the writing of research reports to be a central and creative part of practical sociological work. We intend no allegations, no indictments and no judgements about what that work entails or what it produces. We are simply interested in it as one of the things sociologists routinely do and want to describe how they/we do it; that is, to provide a sociological account of this element of sociology (hence the comment about reflexivity above). We are not concerned (or, at least, not here) with its rights or wrongs, facts or fictions. Just as studies of policemen, lawyers, teachers, doctors and whoever else may be concerned with detailed management of the routine work of such professions and occupations, here we are interested in the detailed management of the routine work of sociology. Our aim is to describe one particular way that researchers undertaking a particular form of research secure the shape and substance of the analyses they offer when writing it up.[2] The point is to bring out and describe the detailed order which comprises part of sociology's professional practice; an order which depends upon the recognisably appropriate and competent use by researchers and their readers of devices such as the rendering practice we describe.

A further introductory caveat may be necessary. Our examples are taken from the use of mathematics to provide sociological descriptions and analyses. However, we are not joining in the argument over mathematical sociology (or formal sociology more generally) and its loss of dominance in the discipline. We are neither 'for' nor 'against' formal methods and formalisation. As we have tried to make clear in a number of places, we feel it is much too early in the discipline's evolution to take hard and fast stands on these matters. In sociology, we simply have not done the work to know whether formal descriptions are desirable in general and what value they might provide.

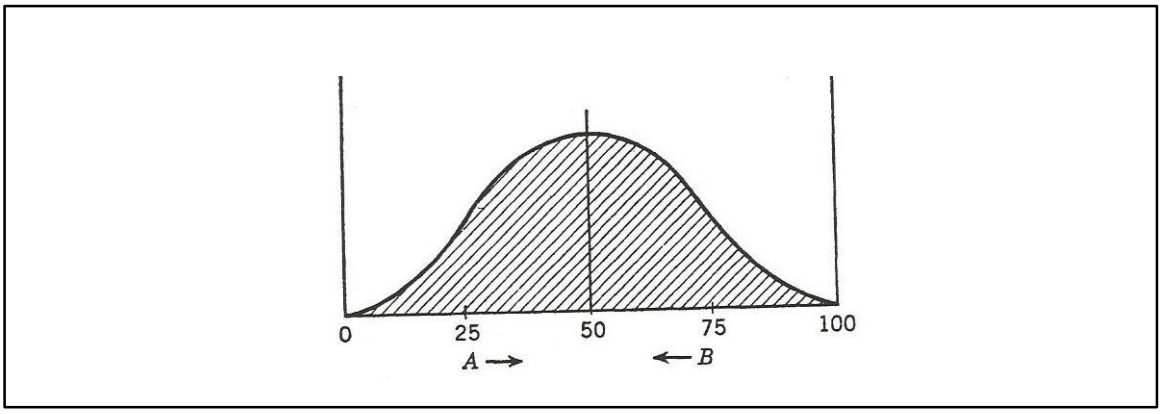
We anchor our analysis to a number of specific examples. We start with a famous and relatively straightforward (though not necessarily simple) one, the competitive space of political parties. Using considerations arising in that case, we move on to more complex ones. In each, the point of our analysis is to bring out how a mapping of the properties of mathematical structures onto the properties of social structures is achieved. For reasons we will explain, we call this mapping "analogising". We suggest the success of this kind of analogising is critically dependent on the features of the visualisations used, features that are necessarily taken for granted in the analysis and description given.

[2] We would have preferred to say "secure the plausibility structure" but epithets such as 'plausible deniability' have tainted that term.

II THE NORMAL CURVE OF PARTY POLITICAL COMPETITION

The idea that democratic political parties occupy positions in a competitive ideological space is so much part of our contemporary conception of political life that it is hard to remember just how recently the metaphor developed. Probably the most influential early use was by Anthony Downs (DOWNS 1957) in a discussion of US party politics. Downs took his central ideas from a classic analysis of spatial distribution among economic agents developed by Harold Hotelling (HOTELLING 1929) almost a hundred years ago. Hotelling suggested that if customers for particular products are distributed uniformly along a single spatial dimension (such as a road or a railway), providing certain assumptions regarding price, product and supplier competition are made, it will be economically rational for suppliers of those products to be located at the median point along the line. This, he said, was why department stores and the like tended to be in the middle of towns. He also mused that it might explain why political parties tended to become 'middle of the road'.

Downs took this suggestion and adapted it as follows. Assume that possible governmental policies can be placed across the 'left-right' spectrum defined by association with a master policy choice over increased or decreased governmental intervention in the economy. Also assume that in terms of its overall willingness to support policy choices, the population of electors forms a normal distribution along this spectrum. Finally, assume the parties in a two party system have an 'ideological centering' on the left or right wing which prevents them from completely 'hopping over' one another; that is, without any other intervening factors, they would tend to be located towards the ends of the spectrum but pressure to be electable forces them to move towards each other in order to increase the range of their coverage. The net result is that competitive forces between the parties will draw them to the centre ground where they will display significant overlap. The closer they come together, the more they will look and sound alike. However, the need to maintain support at the extremes will prevent them from occupying identical positions. The parties end up situated in left and right 'ranges' across the political spectrum. Down's pictured his version of Hotelling's model like this.



For Downs, there were two likely consequences of party competition under these circumstances. First, in order to distinguish themselves, the parties will emphasise more and more marginal differences between them. This will have the effect of concentrating the debate on a narrower and narrower set of issues. Second, the more the two parties crowded together in the centre, the more likely it was that each would suffer erosion of support in its 'ideological base'. Each party, then, would be in permanent dynamic tension both trying to keep faith with its traditions and trying to be be electable.

The apparent simplicity and realism of this analysis has proven so attractive that the metaphor of a competitive space for party support has passed into conventional wisdom. In fact, the metaphor itself is now defunct and commentaries, analyses and prognostications use it as a taken for granted factual characterisation. We want to tease out how this 'story' came to be so compelling. In doing so, we will make use of the notion of 'sociological rendering practices'. This refers to a group of analytic 'rendering' activities first described by Harold Garfinkel and Michael Lynch (GARFINKEL 2002; LYNCH 1985). Using this notion, we will show how the observations about political life that Downs makes are translated into the components of a tractable analytical structure. This rendering takes the form of an analogical comparison between the distribution of party policies and party support as objects in a political space and distributions of objects in a one dimensional mathematical space. In just the same way that Hotelling's distribution along a line was a metaphor for the distribution of customers and suppliers, Downs' mathematically defined space is an analogy for the socio-political space. On the basis of the analogy, Downs proposes a structural isomorphism between the two spaces and thus allows key or characteristic properties of the mathematics to be directly transferred to the politics, Formal properties of the mathematical space are thus mapped onto the socio-political space as part of the analysis being offered and explicated through the visualisation. We will call this analytic pairing the "analogy → visualisation rendering practice". The power and realism of the visual depiction provides just the buttressing Downs needs to ensure the success of his analysis.[3]

[3] Notice we are not saying anything about the *simplicity* of the model. It is, rather, what is carried over in the modelling from the mathematics to the politics that we are drawing attention to. The capacity of visualisations to have this 'transfer capability' is commented on at length by Freeman (2004)

What is this isomorphism and what is the work it does in the description Downs gives?[4] Let's start with the form of the space — its unidimensionality. Assuming a linear one dimensional space allows Downs to push political debate into a single spectrum. The detailed differentiation of positionings on the issues of the day is collapsed. Although this looks like a simplifying assumption, it does more than just that. It becomes the way in which political debate is characterised. It defines its key or essential feature. Everything is construed in terms the left-right spectrum.

The second aspect is the assumption of a stable spatial structure. In Hotelling's original example, the metaphor of a road or railway carried with it the idea of permanent location across a fixed geographical space. Although people and businesses can move across the space, the space itself cannot move. This stability literally 'grounds' the metaphor. What this does is direct attention away from the fact that the actors in political debate (politicians, pundits, advocates and so on) all seek 'to shape' the space of the debate. To provide clarity of description, Downs sets aside the complications which would necessarily follow from the varying saliences and interpretations of issues.

The power of Downs' visual model depends upon the ordered character of the left-right dimension. The global metaphor of a normal distribution would make no sense if the ordering was binary (parties and the public are either 'for' or 'against' — though in some cases this is just how opinion is divided) nor if it has a limited qualitative character (with policies being ranked on something like a Likert scale of "fully supported" to "fully rejected"). The centripetal pressures are brought out through the assumption that the space is divisible an infinite number of locational points. This allows a common sense interpretation of what 'the area under the curve' must mean. Downs reinforces this interpretation by using the number system to characterise the left-right axis. Using the number system to give sense to the normal curve pre-supposes a standardised distribution of policies across the left-right spectrum. Any particular policy can be precisely located as 'half way' between left and right; 75% left; 60% right and so on.

Invoking the number system to provide linear positioning provides a fixed and common frame of reference for the public's perception of policies and of party support for them. Again, this works as a filtering mechanism. Questions about the degree to which the public's perception of how the real choices differ for politicians replicates how politicians see their real choices can be safely ignored. Instead, the public's perception of the reality of the socio-political space is defined as the same as that of politicians

Downs' model is a powerful metaphor for the nature of political competition in two party systems. It provides a core common rationality to what otherwise might appear to be divergent, short term manoeuvrings, unstructured, if not chaotic, debate and a plethora of different ways of marking,

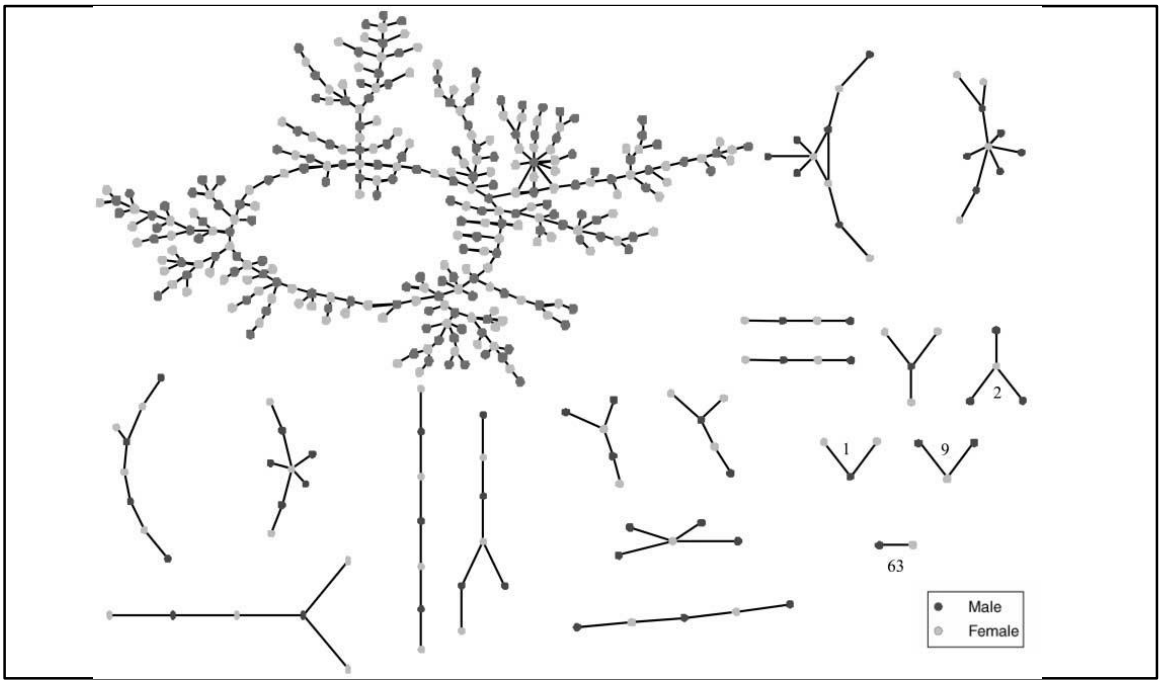
[4] DONALD STOKES (1963) suggested that Down's model had caused a degree of "mischief" in the understanding of US politics. That is not for us to say. However, many of the components we point to are just those things that Stokes expressed reservations about.

distinguishing and positioning particular views. The use of the normal curve hides the creation of an isomorphism between the mathematics and the social so that the actual analogy → visualisation rendering practice passes unnoticed. The depiction and the account it gives shape party competition and its support so that the normal curve of competitive space is 'clearly' and 'obviously' how things are, the rendering practice having filtered out the 'noise' of divergences and differentiations in our common sense experience of political debate.

III ADOLESCENTS AND THEIR SEXUAL NETWORKS

The Hotelling-Downs model of competitive space utilises the analogy → visualisation rendering practice to construct a conceptual model. Our next example uses it to provide an analytic description of survey data. The data were collected by Peter Bearman and his colleagues (BEARMAN, MOODY AND STOVEL 2004, hereafter BMS) as part of an investigation into the pattern of diffusion of sexually transmitted diseases among adolescents. BMS surveyed 800 students at a particular High School. The participants were asked if they had been in a romantic relationship recently and, if so, were asked to name no more than 3 sexual partners with whom they had been romantically engaged over the previous 18 months and no more than 3 non-romantic partners they had been involved with. This resulted in a data set of 573 named 'partners'.

What BMS were interested in was the pattern of relationships among the students. One of the ordinary ways that we talk about friendship and other groups is as networks of ties making up a lattice or a weave of some kind. BMS use this analogy to map the data onto the mathematical conception of a network. Each of the reported relationships is viewed as an edge in an overall network. BMS found the core of the resulting distribution to be a pattern called a spanning tree; that is, a network with a clearly identifiable central spinal ring and short branches (as is shown in the diagram below). BMS compared this topology to the structure of a rural telephone line. In the diagram the pattern of relationships is clearly visible in the structure of nodes and links. We can 'see' the social pattern in the mathematical pattern.



Having produced the analogised isomorphism, the task BMS face is to provide a sociological account of the mathematical pattern. On the assumption that the structure was very unlikely to have been produced by individuals randomly selecting partners, BMS wondered what precise social process might have produced it.

> *Put most starkly, adolescents do not account for their partner choice by saying, "By selecting this partner, I maximize the probability of inducing a spanning tree." First, they cannot see the global structure, and second, they do not care about it. What 'social rules' might the students be following which could produce such a distinctive pattern? (p67)*

In western societies, homophily is generally the basis of partner choice. People form relationships with people like themselves. BMS tried to use partner similarity explain the pattern. This was indeed evident. Individuals tended to seek partners who were very much like themselves. Unsurprisingly, though, this rule did not apply to two key characteristics; gender and age. Overwhelmingly, both genders formed partnerships across gender categories and girls strongly preferred to form partnerships with older boys.

Although conventional wisdom seems to provide a pretty clear explanation for partner choice, what is the social process that produces those choices as a spanning tree pattern? To try to find out, BMS used simulation. They re-structured their data by stripping out the actual partnerships formed and modelling the resulting data set using homophily, random selection and prior sexual experience. This proved inadequate. A third simulation was run in which there was 2x2 partner sharing (John partners Jane and Mary partners Michael; after which, John and Mary and Jane and Michael get together) which gives a 4 link cycle. This did generate a network somewhat similar to the observed one. Finally, BMS simulated a model based ≤ 3 links (John partners Jane and Mary partners Michael; after which Jane and

Michael get together but John does not get together with Mary). This produced the requisite spanning tree. A partnership forming rule specified as a preference for homophily together with a ≤ 3 link rule explains the spanning tree network.

BMS have a mathematical description of the spanning tree pattern. To generate a sociological description of the relationship data, that rule has to be expressed in terms of the social space of adolescent friendships. BMS propose the rule is an expression of the fact that adolescents value peer group status and hence its loss is avoided. Two forces are at work; attraction to people like oneself and one's immediate peer group and avoidance of what they term "seconds" (i.e. recent partners of an individual who is closely linked to oneself through the network). This is the unarticulated (and possibly unarticulatable) "social rule" analogy of the mathematical rule underlying the choices the students make. Once we see the students as following this norm, the spanning tree pattern becomes sociologically intelligible. The analogical isomorphism of the pattern of sexual relationships and the pattern of mathematical relationships constructed by the visualisation is secured by the translation of the mathematical rule into a social rule. The formulation of the rule 'hides' the isomorphism's constructed character.

To sustain the structural isomorphism of the two topologies (the pattern in mathematical space and the pattern is social space), BMS insert a mechanism, the norm, to provide a social motivation for the 'adolescents-in-the-mathematical-space' and, even though the actual students would neither recognise nor avow it, they then transfer that mechanism across into the social space. The students and relationships that BMS describe are analogues of the nodes and edges in the mathematical space. The visualisation renders the isomorphism in an intuitively comprehensible way. We can see the students and their relationships in the spanning tree. Having achieved this, the analysis proceeds to find the characteristic properties of the mathematical space and translate them back into the social space as the rules constituting the norms about partnerships.

IV Path Diagrams and the Pattern of Domestic Roles

Our final example demonstrates features that appear in both the previous ones. The formalisation device is Structural Equation Modelling (SEMS) and the domain is the relationship between gender ideology and the domestic division of labour, a topic that has been of great interest to much of modern sociology.

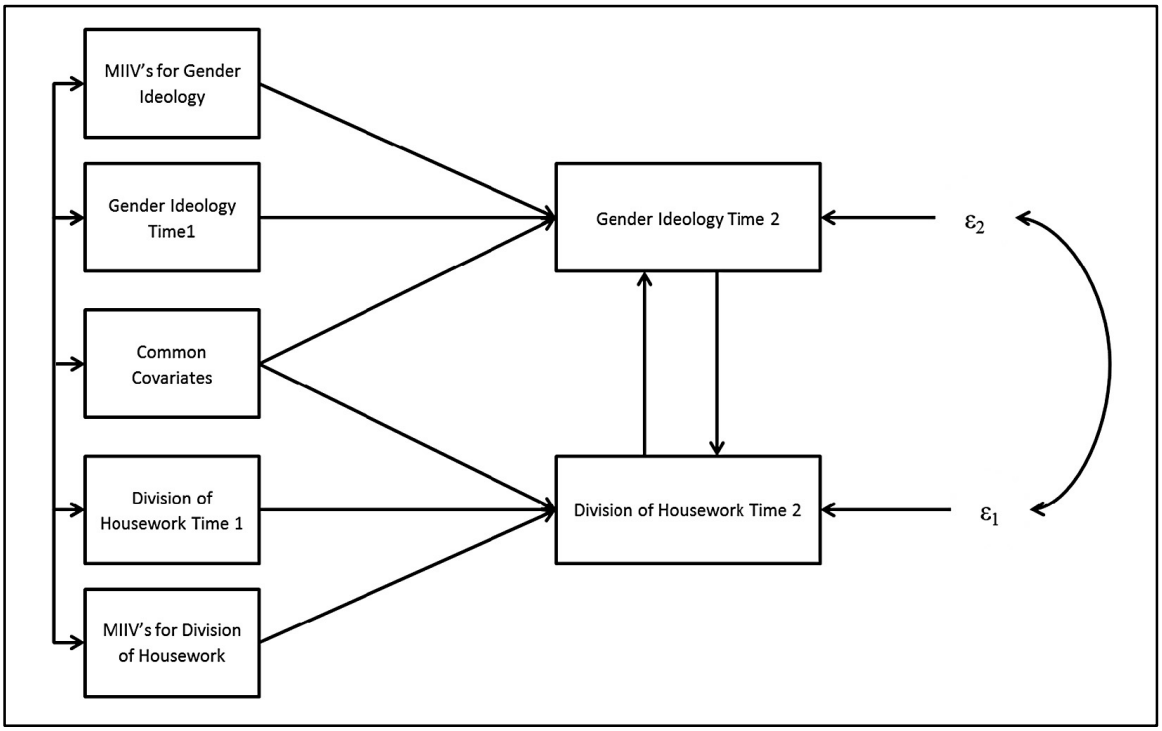
SEMS is a generalisation of the more familiar Path Analysis which, in turn, is based on Regression Analysis. It uses a combination of directed graphs for model construction and versions of Ordinary Least Squares regression for analysis and testing. As it has developed, SEMS has accreted a superstructure of complicated mathematics which allows it to be applied to complex cases. Unfortunately, this mathematics can appear unnervingly difficult, a problem which is often resolved by running relatively user-friendly software packages. The combination of these easy to use packages and the impenetrability of the underlying mathematics has led to the widespread use of SEMs in cases and under conditions for which it not suited. Despite the admonitions of a number of leaders in the field, this misuse continues.[5] As with our previous examples, we are not concerned with mathematical or statistical requirements for the modelling and analysis[6] but with the translation of its results into sociological descriptions of world of everyday life.

Daniel Carlson and Jamie Lynch (2013) tested a model of the relationship between gender ideology and the sharing of housework. Gender ideology is defined in terms of attitudes towards the the 'normality' of defined gender allocated household roles. Household division of labour refers to undertaking tasks such as cooking, washing up, cleaning, washing, mending and ironing, outdoor maintenance and shopping for household necessities. Using data from the US National Survey of Families and Households, Carlson and Lynch analyse the responses of 3874 married couples surveyed in 1987-8 and in 1992-4. Their aim was to see how far changes in attitudes over time were related to changes in behaviour. In particular, they posit that there is reciprocal causation at work.[7] The model they test is formally specified as the following directed graph.

5 Klein (2011) is particularly good on this especially Section III

6 There are three key sets of issues. Two are assumptions about causality and assumptions about measurement error. The third is assumptions about the form of the variables and the relationships between them. Our comments pertain to the last but not in the way that statistics community usually considers them.

7 That is, Carlson & Lynch are interested in the extent to which gender ideology is both a cause of and a consequence of the division of labour in household tasks. This poses interesting challenges for the use of the concept of 'cause'.

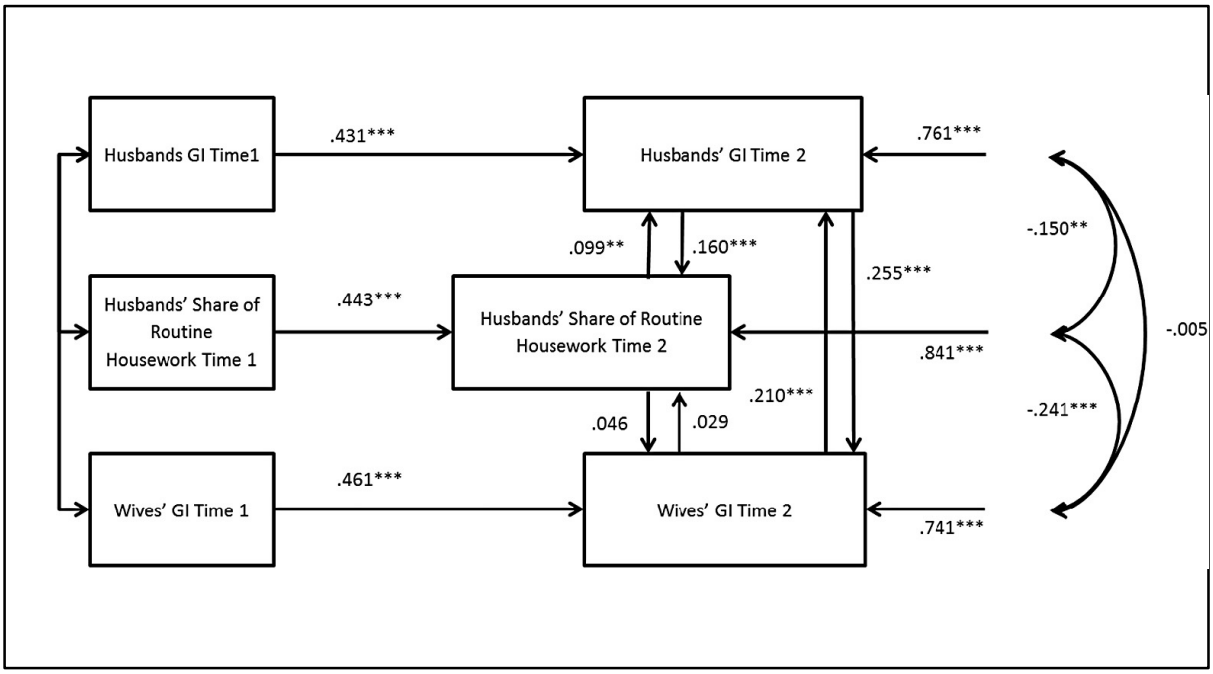


As is usual in SEMS, Carlson & Lynch distinguish between those variables which are specified within the detailed model (the MIIVs of the diagram), those which are outside the model (the common covariates) and the dependent variables whose distributions are of interest (gender ideology and housework). The error terms (**ε)** are unknown factors influencing the distributions and are assumed to be random.

Using stepwise regression, Carlson and Lynch build a structure of interrelated simultaneous equations whose coefficients are estimations of the effect of the variables upon one another. This is their summary of their results.

> *Our results indicate that the relationship between spouses' gender ideologies and the division of routine housework is reciprocal. Although we find evidence of reciprocal effects, the effect of attitudes on behavior is stronger (at least for men) than the effect of behavior on attitudes, a result consistent with the gender ideology hypothesis. (CARLSON AND LYNCH 2013 P. 1516).*

The "evidence" is the 'beta coefficients' of the modelled equations. These relationships are set out in the standard path diagram below.



Much of the analytic plausibility of the account is carried by the visualisations. In both diagrams, the linked boxes, left to right reading and arrow connections order the logical flow. In fact, the visual effectiveness of the two graphs serves to mask the metaphorical mapping taking place. Sets of responses concerning who does what in the home and statements of beliefs about what is appropriate domestic work for males and females are transformed into counts and frequencies which are translated into a structure of related objects in the directed graph which is also an 'operationalised' version of the prior directed graph model. The obviousness of the flow of proposed relationships secures the analogy between social objects and mathematised objects. The regression analysis carried out on the mathematised objects yields the path diagram which is then treated as transformation of the model. It provides a powerful visualisation of the mathematical relationships among the mathematical objects. The SEMS has rendered the modelled responses as a path analysis. The last step is to move back from describing properties of the mathematical space to describing properties in the social space by reading the path weights as causal weights underlying the observed distribution.

> *Despite decades of research on the causes and consequences of housework allocation in marriage, these central questions in gender and family research have not been adequately addressed. Ours was the first study to examine the possibility of a reciprocal relationship between gender ideology and one's share of routine housework, and the first to find evidence of one. In both cases we think that this study not only addresses key theoretical questions about this relationship but also raises new and important ones. Aside from answering questions about the nature of the relationship between housework allocation and gender ideology, the results of this study highlight the importance of developing*

> *and choosing appropriate analytic techniques and data to more rigorously test hypotheses. (CARLSON AND LYNCH 2013 P 1517)*

The heart of this particular analogy → visualisation rendering is an important assumption governing least squares regression. The initial directed graph is a distribution in a single dimension (connectivity). In the regression analysis, this is mapped into a manifold n-dimension space of variables in which each is assumed to be fixed, linear and orthogonal (that is, unrelated) to the others. The assumption of orthogonality allows is the use of conventional algebra to solve the simultaneous equations. What this assumption does is disregard the extent to which the key variables might be empirically entangled; that is, the extent to which conceptions of gender incorporate conceptions about what is or is not normal for men and women to do around the house or the extent to which conceptions of domestic roles will entail conceptions of what gender means. In like manner, the relationships among the detailed instrumental variables are smoothed out. For example, conceptions of gender ideology are treated as wholly independent from forms of religious belief, level of education, the definition of frequency of household task performance etc.

The same considerations regarding the fixed and linear nature of the space of political debate apply to the ideas, norms and values about gender. The modelling will not allow the complexities consequent upon varying levels of sensitivity to the political, social and cultural aspects of gender differentiation to result in axes of differential elasticity for measuring the intrinsic character of gender roles nor changes in cultural, social and political climate to transform such axes and their distributions over time. The analogy of the topology of the path diagram with the distribution of beliefs and tasks of the respondents rests upon the visualisations. The analogy → visualisation rendering practice enables Carlson and Lynch to describe the nature and changes in the distribution of domestic division of labour in relation to changes in gender ideology as the effects of reciprocal causality. The directed graph and path diagram enables us to 'see' the social relationships as the mathematical ones. This isomorphism allows us to translate a property of mathematics generated by the SEMS (the beta weights) into the social context of domesticity as an account of the social causes generating the patterns found in the data.

V CONCLUSION

The device we have described is hardly momentous. Nor, we suspect, will our description of it be any news to mathematical sociologists. It is part and parcel of 'what everybody knows' about doing certain

kinds of mathematical sociology; part of its skill, its competences, its *techné*. For us, what makes it interesting is not simply that it is part of the taken for granted background of knowledge and skills mathematical sociologists rely on but the 'problem' that calls for it in the first place. We have shown what the device does, but what, *praxeologically speaking*, is it for? To get a view of that, we need to turn to more general matters.

Mathematicians rightly pride themselves on the rigour of their mathematical systems. Given the assumptions that are made and the axioms which follow, the requirements of deductive proof ensure the theorems are true and their properties valid. In saying this, mathematicians are very clear they are claiming nothing about the relationship or 'goodness of fit' of any mathematical structure to any particular empirical phenomena. Mathematics, as they say, is an abstract language. This means that an investigator wishing to apply a mathematical structure to an empirical phenomenon has to *close the abstraction gap* so that observed features of the phenomenon can be processed by the mathematics and deduced properties of the mathematics applied to it. This is praxeological problem which the analogy -> visualisation rendering practice is directed to solving. And, as with all praxeological problems, it is solved not in principle, not in theory, but 'in flight' and 'for all practical purposes'. It is, however, just one of the ways that this resolution is achieved. Closing the abstraction gap is an absolutely normal, expectable, routine, standard, practical sociological task to be done when undertaking mathematical sociology and there are numerous ways by which it is accomplished. All consist in processes which Baldamus (1971) called "double-fitting" whereby sociological and mathematical phenomena are mutually aligned. This makes it a crucial component of the non-mathematical basis of practical mathematical sociology. As such, it can be of no interest to mathematical sociologists in the midst of their analysing since to turn to it would require a reframing of the activity in hand and a suspension of their formal analysis in favour of one of practical action. Formal mathematical sociology can offer no insight into closing the abstraction gap. It cannot appear as a phenomenon under its auspices. As we hope we have demonstrated, taking an analytic interest in the problem of closing the abstraction gap involves doing an entirely different kind of sociology, one that facilitates an analytical reflexivity about the sociology being undertaken without being transfixed by its practical or political character.

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