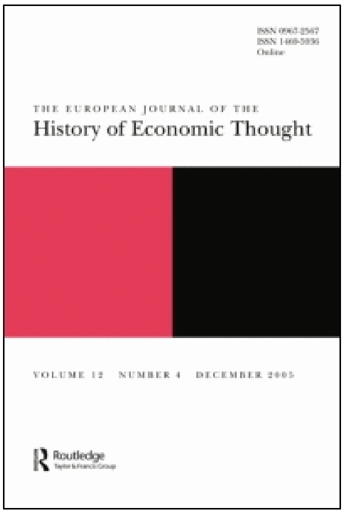

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Value, sign, and social structure: the 'game' metaphor and modern social science*

Robert J. Leonard

> But of all the comparisons one might think of, the most revealing is the likeness between what happens in a language and what happens in a game of chess. In both cases, we are dealing with a system of values and with modifications of the system. A game of chess is like an artificial form of what languages present in a natural form.
>
> (de Saussure 1992 [1916]: 87)

> What, exactly, is a game of strategy? A great many different things come under this heading, anything from roulette to chess, from baccarat to bridge. And after all, any event – given the external conditions and the participants in the situation (provided the latter are acting of their own free will) may be regarded as a game of strategy.
>
> (von Neumann 1959 [1928]: 13)

> In any society, communication operates on three different levels: communication of women, communication of goods and services, communication of messages. Therefore, kinship studies, economics, and linguistics approach the same kinds of problems on different strategic levels and really pertain to the same field.... The complete upheaval of economic studies resulting from the publication of Von Neumann and Morgenstern's book ushers in an era of closer cooperation between the economist and the anthropologist.... [An] advantage of this increasing consolidation of social anthropology, economics, and linguistics into one great field, that of communication, is to make clear that they consist exclusively of the study of rules and have little concern with the nature of the partners (either individuals or groups) whose play is being patterned after these rules. As Von Neumann puts it, 'The game is simply the totality of the rules which describe it.'
>
> (Lévi-Strauss 1968 [1953]: 296–8)

Introduction

With the 1994 Nobel Prize in economics being awarded to Nash, Harsanyi and Selten, mainstream economics has given its imprimatur to the adoption

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of the metaphor of the 'game', and thinking in terms of strategic interaction is now second-nature to an entire generation of contemporary theorists. What follows is an attempt to understand, in terms of the broader intellectual transformations of the first half of the twentieth century, the original emergence in economics of the metaphor of the 'game', to see how the ground was prepared, so to speak, for Nash, Harsanyi and Selten. It will be suggested that the historiographical inadequacy of looking to economics for the sources of its own transformation is nowhere more evident than in the case of the history of game-theoretic economics: the mutation wrought by von Neumann and Morgenstern can be better understood when it is related to several related contemporaneous shifts in other disciplines, including linguistics, mathematics, ethics, and anthropology.[1] These various shifts may be gathered under the rubric of the Structuralist method.

Given the space limitations of the present format, our examination will be confined to selected features of this shift. We focus on three exemplars – Karl Menger's 1934 analysis of ethics, von Neumann's 1928-44 theory of games and Claude Lévi-Strauss's 1949 analysis of kinship systems. We weave a web, describing these three seemingly disparate developments, showing how they are directly and indirectly linked, and portraying them in context of the history of science in the early part of this century. The emergence of an economics based on the metaphor of the 'game' thereby emerges as part of a larger development touching on much of contemporary social science.[2]

Geneva 1910: the arbitrariness of the sign

The story of the rise of Structuralism is a familiar one. Most accounts locate what has been called the 'Structuralist Turn' in the posthumously published *Course in General Linguistics* by Ferdinand de Saussure (1916). In this remarkable book, Saussure essentially founded what became the discipline of linguistics by radically reorienting the study of language. Whereas the philologists and grammarians of the nineteenth century were interested primarily in the historical evolution of vocabulary, the etymology of words, Saussure suggested that language should be studied as a coherent system of essentially arbitrary signs. He emphasized the distinction between *langue* and *parole*, language and speech, stressing that the relation between the signifiers (words) and what they signified (concepts) was an arbitrary one. That the word 'dream' seemed to evoke from within itself the concept of dreaming was inessential: there was no reason why the same concept could not be evoked by any other word. Saussure thus emphasized the essentially social, conventional, quality of language: words mean what they mean because we agree that it should be so, not because of any deep-rooted psychological linking of 'dream' and the concept of dreaming, nor because of any apparent intrinsic suitability conjoining the two, e.g., onomatopoeia. Saussure thus severed the elements of a vocabulary from the 'reality' they purported to describe and, in so doing, emphasized language's synchronic aspect, i.e., language as a static system of interdependent elements, whose linguistic 'value' depends not on their intrinsic worth, but on their relationships of similitude and difference to other elements in the system. Linguistic value is a relative concept: by showing that the linking of 'cat' with the purring, furry, quadruped, is arbitrary/conventional, the significance of the term 'cat' was shifted towards its differential relationship with other elements, such as 'mat' or 'bat'. That this discussion of value as a relation linking elements of a system is evocative of economic discourse was not lost on Saussure, who used the parallel with economics to illustrate his ideas. Of the distinction between statics and evolution, or synchronics and diachronics, he said:

> Economics . . . is a science which is forced to recognise this duality. . . . [The] study of political economy and of economic history constitute two clearly distinguishable disciplines belonging to one and the same science. Recent work in this field emphasises this distinction [which is] required by an inner necessity of the subject. . . . The reason is that, as in the study of political economy, one is dealing with the notion of value. In both cases, we have a system of equivalence between things belonging to different orders. In one case, work and wages; in the other case, signification and signal.
>
> (de Saussure 1916: 80)

He went on to indicate that whilst, in economics, there was some natural connection between elements – the value of land being dependent on the income derivable from it – in language there were no such natural connections. Language is a 'system of pure values', a network or grid of essentially arbitrary design. Saussure's occasional references to political economy have given rise to the hypothesis that his linguistics was inspired by contemporary work in economics and sociology, in particular that of Walras and Gabriel Tarde.[3]

While elements of Saussure's ideas were retrospectively rediscovered in the work of several of his predecessors, giving rise to the linguists' equivalent of the debate on the Marginalist Revolution, it can be safely said that, with Saussure, linguists learnt to 'see' language differently. The emphasis was shifted from the history and evolution of language, towards seeing it as a synchronic system of floating, arbitrary signs. It marks a departure from regarding language as a collection of words of differing etymological 'content', laden with historical meaning, to seeing it as a 'system', of scientific interest as a coherent formal structure rather than as a historically evolving means of representation.

Moscow 1917: linguistic form and literary structure

While Saussure's students were posthumously compiling his *Course* in Geneva, an important break was occurring in Russia in the area of poetics and literary criticism. Throughout the latter half of the nineteenth century, Russian study of poetry and texts had been dominated first by a realist view and then, towards the end of the century, by Symbolism. The latter sought to locate the poem's deeper meanings in a reality that became 'increasingly abstract, remote and mysterious', and, ultimately, religious. By the turn of the century, in the eyes of the young Turks in Moscow and St Petersburg, literary criticism had become altogether too mystical and mushy: in its 'intense rarefaction' (Pike 1979: 2–3) Symbolism became a prime target in a revolutionary period intent on dismantling staid outdated icons. The reaction took two linked forms, Futurism among the artists, and Formalism among the critics.

In their rejection of metaphysics, the Futurist poets turned, with a vengeance, to considering the physicality of verbal forms. Their 'zaum', or trans-sense language, with its deformation of existing words and creation of new ones, was an experimental celebration of words as physical utterances, as pure sounds. They experimented similarly with the combination of media, giving theatrical readings of poetry, and writing poems on decorative wallpaper. To quote one observer:

> The Futurists' poetic games disclosed unexplored aesthetic sound texture arranged so as to fascinate by its very physiognomy, and these games served as alluring examples of a linguistic usage capable of releasing the formal means of utterance from subordination to the semantic load.
>
> (Matejka 1971, quoted in Pike, 1979: 10)

Alternatively put, playing with unconventional linguistic forms would help reveal the arbitrary quality of conventional language use: play would reveal the rules of the game. Pike suggests that this experimentation constituted 'the focal point of futurist concentration on the pure poetic word' (1979: 7), a concern that the Formalists, in turn, would reflect in their criticism.

The Formalists comprised two groups, the Moscow Linguistic Circle and, in St Petersburg, the Society for the Study of Poetic Language. An amalgam of theorists and historians of literature, linguists, and ethnographers, their common characteristic was a positive interest in language, shaped by their reading of the Russian critic Baudouin de Courtenay, and, later, Saussure.

The key figures among the Formalists were Nicholas Troubetskoy, Victor Shklovsky, Vladimir Propp and, most enduringly, Roman Jakobson.[4] Of their approach, one of their contemporaries writes:

> Our method is usually referred to as Formalist. I would prefer to call it morphological, to differentiate it from other approaches such as psychological, sociological and the like, where the object of inquiry is not the work itself, but that which, in the scholar's opinion, is reflected in the work.
>
> (Ejxenbaum, *Molodoj Tolstoj*, Petrograd, 1922: 8, translated and quoted in Erlich 1980 [1950]: 171)

What was an aesthetic shift for the Futurists thus became a critical method for the Formalists: attention was focused on the 'literary work' itself. A shared suspicion of psychology, sociology and cultural history, led to a twin narrowing of the definitions of literary criticism and of literature. Criticism was now the examination of *literaturnost*, or 'literariness' i.e., that which gave a work its literary quality, and this was to be located, not by straining towards the visual images presumably intended by the poet, nor by reflecting on the sociopoliticial circumstances in which he or she wrote, but by attending to the way language is *used* in poetry, seeing poetry as 'verbal art', an autonomous activity, with its own internal structure. Thus, what mattered for Jakobson was not language's capacity to represent, but the rules underlying the wordplay of the poet. As Erlich (1980) puts it:

> Formalist theoreticians were intent on sidestepping the vexing issue of the creative personality. Literary technology seemed to them a much firmer ground than the psychology of creation. Hence the tendency to treat literature as a suprapersonal, if not impersonal, phenomenon, as a deliberate application of techniques to 'materials' rather than as self-expression, as a convention rather than as a confession.
>
> (Erlich 1980: 190)

Both the Futurists and the Formalists soon fell foul of an increasingly doctrinaire Bolshevism, and the Formalist denial of literature's 'social connection' as an object of literary criticism became a bone of growing contention: by the early 1920's, Troubetskoy and Jakobson were in exile in Czechslovakia. In 1926, along with others including Mukharovsky, they founded the Prague Linguistic Circle, the centre of what became known as Czech Structuralism.

Merquior (1986) presents Prague as something of a crossroads in the history of literary structuralism, in which, among the formalists, the hardliners won out over pragmatists. The latter were represented primarily by Jan Mukharovsky, a Czech, whose theory of aesthetics, while Structuralist, still left room for social influences. Following Saussure, Mukharovsky distinguished between two functions of a piece of art: the artwork as a material thing, or signifier, and as an aesthetic object, a message, something signified. However, he insisted that the norms and rules which governed the interpretation of such aesthetic objects had sociological or institutional grounding. As Merquior writes, Mukharovsky represented a 'departure from the fetishism of form' and a recovery of the 'sense of the changing social contexts of literary functions and literary meaning' (1986: 27).

The hardliners were Troubetskoy and Jakobson, who, following Shklovsky, continued to emphasize a 'technology' for literary criticism. This method stressed the text's purely literary dimension, treating writing as if it were, to borrow Merquior's phrase, 'about nothing but language'. The influences on the Prague Circle were diverse, ranging from Russian formalism and Saussure's linguistics, to Köhler's *Gestalt* psychology and the logical positivism of Carnap and the Vienna Circle. Their central idea was that of phonological Structuralism, which they proclaimed in their anonymous 1929 manifesto, 'Les Thèses de 1929'. Language, they said, at any given point constituted a closed system of permissible combinations of phonemes. The latter were language's basic units: they were what made words different from each other. Note that the Structuralists were now putting some structure on the Saussurean notion of 'difference'. As noted by Sturrock (1993), 'p' and 'b' are separate phonemes, in English, because 'pill' and 'bill' are different words. So, for the same reason, are 'u' and 'i', and 'l' and 't'. However, as distinct from phonetics, which is concerned with the physiology of sound, phonology is concerned with produced *meaning*. Thus while 'l' and 'r' are distinct phonemes in English, they are not in Korean: the phoneme, says Sturrock, is the locus at which nature and culture meet. During the 1930s, Jakobson analysed phonemes by identifying their distinctive features, e.g, whether they are voiced or unvoiced, nasalized or not nasalized. Thus, in English, 'b' stands in the same relation (voiced to unvoiced) to 'p', as 'd' does to 't'. Note that what is key here is the *relation* itself: it is *not* being claimed that 'b' and 'p' are different variants of something common to both. Applying this method, Jakobson showed that French could be reduced to the operation of five distinctive features, and Turkish to three. A language, therefore, could be studied as a *combinatorics* of *relations*, a structure with its own inner logic.

Göttingen 1928: mathematical formalism

In 1912, a year before Saussure's death, and midway between the appearance of the Futurist movement in poetry and the emergence of a Formalist movement in criticism, the mathematician Ernest Zermelo delivered a paper to the International Congress of Mathematicians at Cambridge, England. He was interested in chess, of which he asked:

can the value of a particular feasible position in a game for one of the players be mathematically and objectively decided, or can it at least be defined without resorting to more subjective psychological concepts?

(1912: 501)

That the answer was 'yes' he showed with an inductive proof, demonstrating that the outcome of chess is strictly determined, i.e., either white can force win, or black can force a win, or both sides can force a draw (Aumann 1989: 1). While, to some, the result might seem so general as to be trivial, what is significant for us is the fact that Zermelo turned to the mathematics of games at all, and, more importantly, that this was presented as an act of demystification: chess was being stripped of its psychological dimension, being reduced to a mathematical formalism with a determinate outcome. The subject was taken up further by others, with related papers by Kõnig (1927), Kalmar (1928–9), and John von Neumann (1928). By showing the logically possible outcomes at the last move of the game, Zermelo showed that one can reason backwards to inductively prove that the same possibilities are present at the outset of the game. Von Neumann represented the generic two-person, zero-sum, game – of which chess, simple poker, baccarat, scissors-paper-stone are examples – as a set of strategic choices and associated payoffs for each player, and showed, in a tortuous proof based on functional calculus and topology, that the game has a minimax equilibrium. In his paper, too, mathematical explanation and debunking of psychology are linked:

The agreement of the results with the well-known rules of thumb of the the games (e.g. proof of the necessity to 'bluff' in poker) may be regarded as an empirical corroboration of the results of our theory.

(1959 [1928], p. 42)

This reduction of social games at Göttingen appears to resonate with the Formalist reduction of literary texts in Moscow and Prague, and is surely linked to the fact that the context for the work of Zermelo and von Neumann was the emergence of Formalism in mathematics under Hilbert. This appeared at the turn of the century as a response to the crisis in mathematics caused by the paradoxes of Cantor and Russell. While Brouwer's reaction was to dismiss all mathematics that could not be justified on the basis of a supposedly natural *intuition*, Hilbert was concerned to retain as much existing mathematics as possible, and show *mathematically*, rather than intuitively, that its various fields were free of contradiction and complete. To do this, just as Saussure insisted on the arbitrariness of the links between signifiers and concepts, and the Formalists saw the poem as being self-referencing rather than representational, Hilbert dismissed any links between mathematical objects and reality.[5] While we cannot guarantee the absolute validity of classical mathematics, he said, we can cast aside any claims about extramathematical reality and look to the internal logic of mathematical structures themselves. As von Neumann put it, mathematics, with Hilbert, becomes 'an internally closed procedure which operates according to fixed rules known to all mathematicians and which consists basically in constructing successively certain combinations of primitive symbols, which are considered "correct", or "proved". [It becomes] a combinatorial game played with the primitive symbols' (1984 [1931]: 62).[6]

In Formalist mathematics, therefore, we see features which curiously parallel developments in literature in the same period. Hilbert reduces mathematics itself to a combinatorical game played with 'pieces' which have 'meaning' only in the context of the game itself. Zermelo reduces chess to mathematics: psychology is superfluous, the formalism is what counts. Von Neumann goes further, suggesting that any social situation, given appropriate conditions, may be interpreted as a strategic game, i.e. in a manner of speaking, reduced to chess. Following Saussure, who disclaimed any essential link between signs and objects, the Russian Formalists redefine literary criticism as an analysis that relegates psychological explanations of literary creation, strips texts of their referential function, and thus reduces literature to a formal structure, a verbal game. In both literature and mathematics, the referent comes under attack, attention is shifted towards viewing wholes as systems of relations linking the anonymous elements of a vocabulary, be they mathematical or verbal signs. And just as this form of modernism knocked the passion out of Shelley's poetry, so too, in another guise, would it do the same to age-old ethical debates on the nature of good and evil.

Vienna 1934: mathematical and social structure

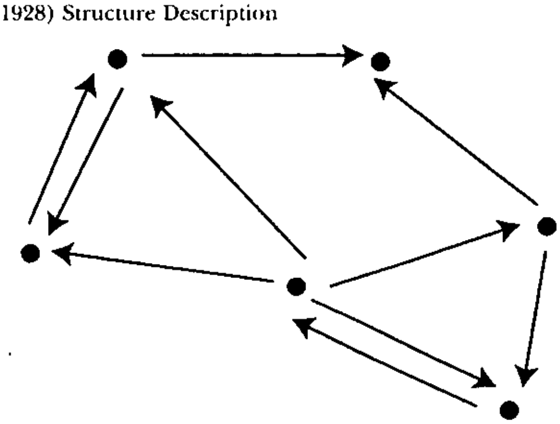
Among the direct influences on Jakobson and the Prague Circle was Rudolf Carnap's 1928 logical positivist tome, *The Logical Structure of the World* (*Der Logische Aufbau der Welt*). In this monumental work, Carnap drew a distinction between *property* descriptions of objects and their *relation* descriptions. For example, if *a*, *b*, *c*, are persons, property descriptions of the domain might include the observations that *a* is 20 years old and tall, that *c* is 21 and short, etc., while relation descriptions might include *a* is the father of *b*, *b* the mother of *c*, *c* the son of *a*, *a* is 40 years older than *c*, etc. Thus, to use Carnap's example, for a group of persons, a list of their dates of birth and death would be a property description, whilst an account of their kinship relations constitutes a relation description. According to Carnap, it is relation descriptions that constitute the basis of unified science. More particularly, Carnap emphasized the importance of a particular type of relation description called the *structure* description. In the latter,

> only the structure of the relation is indicated, i.e., the totality of its formal properties . . . By formal properties of a relation, we mean those that can be formulated without reference to the meaning of the relation and the type of objects between which it holds. They are the subject of the theory of relations . . . [and] can be described exclusively with the aid of logistic symbols.
>
> (Carnap 1928: 21)

Carnap proceeded to consider several of these formal properties of relations, such as symmetry, reflexivity and transitivity, suggesting that the structure of a relation might be described by an arrow diagram: 'Let all members of the relation be represented by points. From each point, an arrow runs to those other points which stand to the former in the relation in question. A double arrow designates a pair of members for which the relation holds in both directions. An arrow that returns to its origin designates a member which has the relation to itself. If two relations have the same arrow diagram, they they are called structurally equivalent, or isomorphic' (1928: 22).

Thus,

Figure 1 Carnap's (1928) Structure Description



For Carnap, such structural descriptions constituted

> the highest level of formalization and dematerialization. If we are given an arrow diagram which contains nothing but double arrows, then we know that it represents the structure of a symmetrical relations, but it is no longer evident whether it represents person under the relation of acquaintance, or towns under the relation of direct telephone connection, etc. Thus, our thesis, namely that *scientific statements relate only*

to structural properties, amounts to the assertion that scientific statements speak only of forms without stating what the elements and the relations of these forms are.

(Carnap 1928: 23, emphasis added)[7]

The impetus for this Carnap attributes to Russell and Whitehead, who in their *Principia Mathematica*, had shown how various branches of mathematics viz., arithmetic, analysis and geometry, could be reduced to structure statements. Using the example of the Eurasian railway map, which indicates the topological, but not metrical, relations between the towns, Carnap proceeds to show how such structural descriptions may frequently be used to 'give a definite description of all objects within a given object domain', in this case, the names of the towns. For Carnap, 'all scientific statements are structure statements' (1928: 28). He points to the success of Hilbert's axiomatic method in providing implicit definitions of mathematical objects, and to the prevalence of structure in physics, which he claims has been 'almost altogether desubjectivized, since almost all physical concepts have been transformed into purely structural concepts' (1928: 29). By overcoming the need for *ostensive* definition of objects, and thus overcoming the multiplicity of individual *perceptions* of what must be, after all, a single reality, only attention to logical structure, says Carnap, can underpin a unified scientific view of the world. For science, therefore, '*it is possible and at the same time necessary to restrict itself to structure statements*' (1928: 30, emphasis in original).

Carnap was read by many in Vienna, including Oskar Morgenstern and Karl Menger.[8] In 1928, Karl Menger, mathematician, and son of the founder of the Austrian school of economics, had returned to the chair of geometry at the University of Vienna, following two and a half increasingly difficult years as docent with Brouwer in Amsterdam.[9] The interwar Vienna he reentered was a paradoxical one, with economic depression, political unrest, and widespread disease providing the backdrop for a period of intellectual fervour matched by few modern cities, before or since. He thus became involved in several of the city's loose, and not so loose, intellectual affiliations for which the city was well known, including the philosophers and mathematicians of the Schlick Kreis, the groups surrounding von Mises at his *Privaatseminar* and the National Economic Association, and his own Mathematical Colloquium, which included Gödel, Karl Schlesinger and Abraham Wald.

Menger's intellectual preoccupations during the 1930s were mathematics, in its various guises, from the theory of curves and dimension, to the debates on the foundations of mathematics, to the application of mathematical methods in areas such as economics and ethics. His papers on the foundations of mathematics may be read as direct responses to two events: first, the dogmatic streak he found present in Brouwer's Intuitionism, and which probably accounted for his increasingly strained relationship with the Dutch mathematician in Amsterdam; second, a similar dogmatism he encountered among some members of the Vienna Circle, whether it were the cavalier use of the term 'meaningless' by those attached to the teachings of Wittgenstein, or continuous references by others to '*the* language' and '*the* logic' as if these were both completely unique. Menger, in sympathy with Gödel, 'seriously questioned the uniqueness of language and logic' (1979: 12), and objected strenously to mathematical dogmatism whatever form it took (see also Menger 1995, *passim*).

In his paper 'On Intuitionism' (1930) he outlined the issues separating the various schools in the debates on the foundations of mathematics, and, in particular, condemned intuitionist judgements of what is or is not 'meaningful' in mathematics:

> What the intuitionistic attempts to date have done is to attach themselves dogmatically to some particular notion of constructivity (in most cases not clearly circumscribed), to accept only the resulting developments as meaningful, and to reject others as meaningless. In [my] opinion such a position is totally devoid of cognitive content. *For what matters in mathematics and logic is not which axioms and rules of inference are chosen, but rather what is derived from them.*
>
> (Menger 1979: 57)

The last sentence describes his *implicationist* position: the reasons why mathematicians have particular theoretical preferences, make theoretical choices, is perhaps interesting for biography and for history, 'but they are not relevant for mathematics and logic' (1979: 57). This point he reinforces in the second foundations paper 'The New Logic' (1933), where, following the proofs by Gödel two years previously, he is even more adamant about the contingent nature of mathematical truth and, thus, even more emphatic about separating mathematics itself from opinions about mathematics:

> *What interests the mathematician and all that he does is to derive propositions by methods which can be chosen in various ways but must be listed, from initial propositions which can be chosen in various ways but must be listed.* And to my mind all that mathematics and logic can say about this activity of mathematicians (which needs neither justification ... nor can be justified) lies in this simple statement of fact.
>
> (Menger 1933: 40, emphasis in original)

His 1934 book on ethics, *Moral, Wille, und Weltgestaltung* (*Morality, Decision and Social Organization: Towards a Logic of Ethics*) is a direct translation of his implicationist position in mathematical philosophy to the domain of ethical behaviour. Writing in the early 1930s, a time of strife, when ethical questions increasingly imposed themselves on the citizens of Vienna, Menger shaped his stance in response to several extant writings on ethics. First, there were Wittgenstein's famous lines towards the end of the *Tractatus*, in which he seemed to veer towards a sort of mysticism: 'The meaning of the world must lie outside of the world', or 'There is indeed the ineffable. It evinces itself; it is the mystical'. If Menger had reacted against the blind reverence shown Wittgenstein by some of the Schlick Circle, then as a mathematician he found such apparent sloppiness in Wittgenstein equally distasteful. There was also the treatment of ethics in Schlick's *Fragen der Ethik* (*Problems of Ethics*) (1930) which, although reflective of a humane English liberalism much appreciated by Menger, was to his mind largely devoid of 'logical analysis' (1974: 95). 'Should there be no room at all', Menger asked, 'for exact thinking in the field of ethics?' (1974: 95).

Menger's book on ethics is as free of the history and philosophy of ethics as any member of the Vienna Circle could have hoped for. He begins with a disclaimer: personal value judgements have no place in his treatment, nor is the latter concerned with the futile search for the essence of morals, or the principle of virtue. Menger proclaims his deliberate relativism in matters ethical, a stance related to present political conditions, and consonant with his anti-dogmatism in mathematics:

> I do not intend to present a particular moral system with a claim to universal validity. Neither do my thoughts lead me with cogency to any such doctrine, nor, in view of the actual conditions, is such a unified regulation in harmony with my feelings.
> (Menger 1974: 2)

He first shows ethical precepts such as that of Tolstoy – act according to the will of nature – and Kant – act according to that maxim of which you can wish that it become a general law – to be logically inadequate as guides to behaviour: the first offers little by way of concrete guidance; the second, depending on how it is interpreted, may require Herculean cognitive work by the individual in order to determine the consequences of a particular rule. Similarly, he retreats from ethical concepts such as 'intuition', 'insight', 'duty' and 'values' and, relying only on what logic can say about ethical situations, retreats to a *combinatorical* analysis of the *consequences* of normative choices. Applying to the study of ethical groups the philosophy he advocates in mathematics – disregard the ethical/mathematical choices, focus on the ethical/mathematical consequences derived according to transparent rules – Menger considers only the *relations* between individuals, as determined by their ethical stances, and, in particular, the consequences of such choices for the existence of groups of compatible individuals.

In his analysis of the compatibility groups contingent upon particular ethical stances, Menger is naturally led to the type of structural analysis of relations advocated by Carnap above. For example, suppose we have four types of individual:

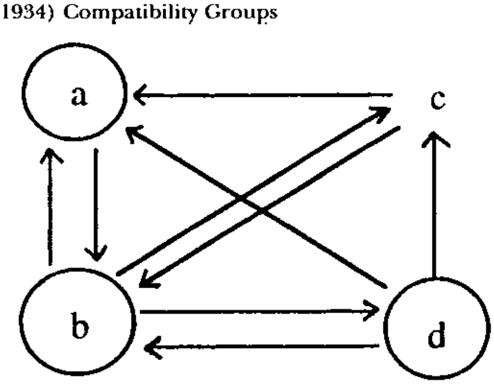
(a) polite, sensitive
(b) polite, insensitive
(c) impolite, sensitive
(d) impolite, insensitive

Any member of (c) is willing to associate with (a) and (b) – he is sensitive to their politeness or lack therof – but not with (d) or with other members of (c). We can thus link the various categories, the arrows in Figure 2 indicating willingness to associate.

When an arrow runs in both directions, there is compatibility. This relation, he notes, is in general not transitive: in Figure 2, group *a* is compatible with group *b*, and *b* with *d*, but *a* is incompatible with *d*. Depending on the size of the class of individuals and the number and type of characteristics, one can partition a given class of individuals in a number of different ways, and Menger shows how to survey the various total possible partitions of a given class. One might have different criteria for choosing among them. For example, one might wish to obtain compatibility groups of roughly equal size.

Menger's analysis of ethics is interesting for many reasons. First, he aligns himself with the work of German sociologists Ratzenhofer (1907) and von Wiese (1932). In his *Systematic Sociology* (1932), the latter had made a strenuous case for the emancipation of sociology from metaphysics and value judgements if it were to become 'scientific'. He distinguished his approach from the ideas of the Conservative idealist philosopher Othmar Spann, who preached a *Völkish* social philosophy, based on an organic conception of society and an attendant dismissal of methodological individualism. Like the Viennese philosophers and the Austrian economists, von Wiese opposed Spann vigorously:

Figure 2 Menger's (1934) Compatibility Groups



> [The sociologist] has every warrant for attempting to discover what human beings cherish or condemn and how they have arrived at such evaluations. But . . . as a sociologist he is barred from judging the ethical rightness or wrongness of their predictions!. . . the sociologist has no value-judgement to make.
>
> (von Wiese 1932: 6, emphasis in the original)

Drawing an analogy with processes of atomic repulsion and attraction, von Wiese suggests that it is the fundamental oppositional relations of association and dissociation amongst individuals that constitute the starting-point for any scientific sociology:

> Analogically, scientific sociology regards human beings as pieces on the giant chessboard of life; with each succeeding move (social occurrence) they draw close together, separate, or converge in certain aspects and diverge in others. . . . Such approach and avoidance constitute the basis of the sociological frame of reference.
>
> (von Wiese 1932: 39)

And again:

> Perhaps the most usable metaphor for designating the 'moves' that make up the manifold and shifting interaction of the social zone is that of the chess game with all its complex and infinitely variable combinations.
>
> (von Wiese 1932: 69)

Von Wiese then took the basic relations of association and dissociation and further divided and subdivided them until he had constructed several massive lists of terms describing human interaction. However, what exactly this taxonomy referred to, and how its elements were logically related to one another, was somewhat unclear. To Menger, therefore, von Wiese, having made a promising logical start, had slipped into the realm of haziness.[10] It remains, however, that the basic shift towards combinatorics in sociology, of which Menger's ethics is a refinement, is to be found in von Wiese.

Second, as mentioned above, Menger's view of social theory – compatibility groups stemming from ethical stances – represents a clear projection into the social domain of his views on the philosophy of mathematics, and both are consonant with the expressed aim of the Vienna Circle of purging all science of value-judgements. While there were points of disagreement between Menger and other members of the Schlick *Kreis*, for example on Neurath's quest for a unified scientific method, Menger clearly sought to construct a value-free analysis of the domain of ethical values. The only way this can be done is to take the latter values as given (as ethical decisions) and to examine the logical implications of the interpersonal relations implied by such decisions. His analysis of ethics is *structural*, rather than genetic. Labelling according to ethical stance becomes a mechanism for classifying individuals and considering them in combination: individuals become anonymous counters in a combinatorial game, an analysis as far removed from the traditional philosophical discussion of ethics as synchronic linguistics was from nineteenth-century philology.

Third, the relational structures that Menger offers are similar to the types of structures described by Carnap in his *Logical Structure of the World.* Carnap's programme to reduce all science to a the study of structural relations is mirrored in Menger's social analysis: the latter offers a kind of social topology. Consigning to the periphery the study of the history and moral philosophy of ethics, Menger regards society and its component groups as a *system* of logical relations.

Apart from its relationship to contemporaneous ideas in sociology and mathematics, Menger's work on ethics is of interest to us because of its direct impact on Oskar Morgenstern, whom he grew to know well in the early 1930s. Morgenstern had been initially influenced by Spann, and then by third-generation Austrian economist, Hans Mayer. Mayer was interested in retaining the essentials of the Austrian variant of marginalist economics, but quite opposed to the use of mathematical formalism. He aimed to construct a 'genetic-causal' theory of equilibrium, which would allow for the influence of time and shifting tastes on the path to final equilibrium, and he saw the static quality of mathematical formalism as a barrier to this type of theory. Morgenstern took a while to escape the influence of Mayer, but when he did, gradually from 1933 onwards, it was in large measure due to the influence of Menger, whose work on economics, and lessons in mathematics, influenced him greatly.

Morgenstern discussed greatly with Menger and read two of his papers on economics: the first clarifying various treatments of the Petersburg Paradox (1934a), the second clarifying various proofs of the Law of Diminishing Returns (1936). Both were concerned with uncovering slips in logical reasoning in economic theory, and with exposing the subtle injection of value judgements into the analysis. Menger was critical of what he regarded as von Mises' inability to separate Austrian economics from advocacy of a liberal political agenda. This was no doubt related to von Mises' frequent, but in Menger's view poorly informed, references to the sciences and mathematical logic, which he used to undergird his claims. For example, his concept of a priorism rested on an appeal to a self-evident, natural, logic, upon which reason was based. Given his proximity to discussion on mathematical logic, given the blow to logical certainty struck by Gödel's proofs, and, above all, given his own mathematician's penchant for exact expression, Menger soon tired of what he regarded as so much loose, value-laden, polemics. And Morgenstern, too, expressed similar feelings.[11] By the mid-1930s, Morgenstern was completely under Menger's sway, taking lessons in mathematics from him at the University (as also from Franz Alt and Wald), and incorporating his work on logic, economics, and ethics directly into his own writings (see Morgenstern 1934a, 1935, 1941b).

Menger's book on ethics appealed to Morgenstern who had broken free of Spann's sham science and Mayer's anti-formalism, and was in search of some way of increasing the logical rigour of economic theory. It also seemed to address a pet problem of Morgenstern's in a way that nothing else had yet done. Beginning with his 1928 *Habilitation* thesis, *Economic Prediction* (*Wirtschaftsprognose*), Morgenstern had been intrigued by the possibilities of economic theory displaying paradoxes, as did set theory. The one he identified was the assumption of perfect foresight as a necessary condition for general equilbrium. Such an assumption, he said, rather than facilitating the resolution of the problem of equilibrium, could lead to an unresolvable infinite regress, in which each agent tried to outguess the other, each choosing an action based on his prediction of the other's action. This logical conundrum had to be resolved if the assumption of perfect foresight was to become anything other than loose talk. Menger's analysis of ethics, while it did not provide a solution to this problem, did seem to go in the right direction. To address the compatibility of normative positions was to pose the right kind of question. The difficulty was that individuals could choose their norms independently, whereas the kinds of economic choices that interested Morgenstern were intrinsically interdependent (see 1941b). Morgenstern was still mulling over these difficulties when he met his next mathematician friend, von Neumann, in Princeton at the end of the 1930's.

New York 1940: from phoneme to mytheme

While von Neumann and Morgenstern were discussing mathematics and economics at Princeton, two other expatriates at New York's New School for Social Research were discussing linguistics and anthropology. Roman Jakobson had gone from Prague to Sweden, and now found himself in New York as part of that wartime exodus from Europe facilitated by such organizations as the Rockefeller Foundation. Lévi-Strauss, also Jewish, had also arrived in New York, via Martinique, having fled France. Before then, he had spent several years during the 1930s studying several Indian tribes of the Amazon basin in Brazil. As he relates in his 'anthrobiography', *Tristes Tropiques*, his encounter with Jakobson was to have a lasting influence on his work, in particular on his analysis of kinship arrangements.

Lévi-Strauss was particularly interested in Jakobson's phonology because the phoneme, as language's basic meaningful unit, provided a bridge between nature and culture, between pure sound and meaning. And

Jakobson's analysis of phoneme according to their distinctive features seemed to offer possibilities in the domain of anthropology. As Jakobson treated language as an organized synchronic system with its own recoverable internal logic, so Lévi-Strauss began to see social organization, with all its constituent features, from marriage practices to art and myth, as a system to be understood in terms similar to language, as *codes*. And if the phoneme provided the key to linguistic logic, social codes should be decipherable in a similar manner. For the analysis of kinship systems, the 'incest taboo' was key. As Sturrock (1993) writes:

> Lévi-Strauss believed that he could provide an ingenious parallel for the phoneme from the anthropological world, and that was the 'incest taboo' or proscription of sexual relations with near kinsfolk which he assumes to be common to all societies. The incest taboo is . . . the point at which culture takes over from nature, or from mere biology, leading as it does to marriage outside the immediate family, group and to the institution of a 'network of exchange' in which the items offered for exchange are women.
>
> (Sturrock 1993: 45)

In his analysis of kinship systems, therefore, Lévi-Strauss focuses on uncovering the logic implicit in different observed arrangements. While the intricacies of any particular system may be invisible to the members of the social group, the anthropologist can make them visible, revealing their 'concrete logic'. Whether it be a question of kinship systems, totemism or myths, all can be slotted into logical schemata: structure is ubiquitous.

> These schemata are a feature of all Structuralist thought and not just of Lévi-Straussian anthropology; they point to an almost mystical belief in the sovereignty of systematic thought, which has its own rules for generating new events from a more or less stable structure.
>
> (Sturrock 1993: 50)

Beginning in the 1940s, therefore, Lévi-Strauss's Structuralism constituted a venue for the use of mathematics in anthropology, a marriage proposal which, as he recalls, was initially treated as taboo in certain quarters:

> When, about 1944; [I] gradually became convinced that the rules of marriage and descent were not fundamentally different, as rules of communication, from those prevailing in linguistics, and that it should therefore be possible to give a rigorous treatment of them, the established mathematicians whom [I] first approached treated [me] with scorn. Marriage, they [said], could not be assimilated either to addition or to multiplication (still less to subtraction or division), and it was therefore impossible to express it in mathematical terms.
>
> (Lévi-Strauss 1954: 585)

Undeterred, Lévi-Strauss persisted until he piqued the interest of André Weil, University of Chicago algebraist, and 'one of the young leaders of the new school' of *qualitative* mathematics. As Lévi-Strauss recalls:

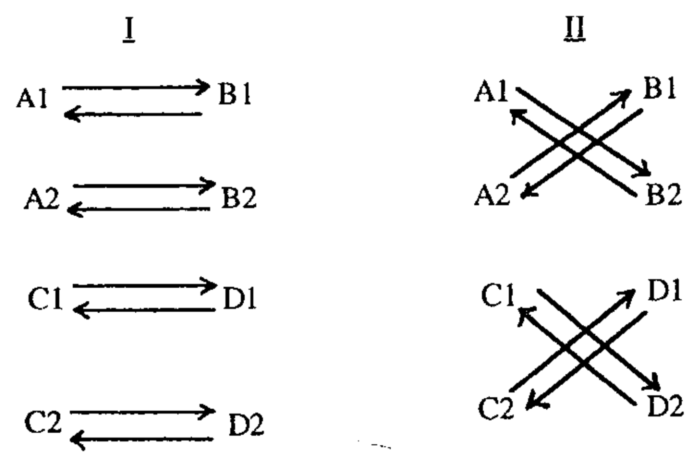
> [Weil] explained that, in order to develop a theory of rules of marriage, the mathematician had absolutely no need to reduce marriage to quantitative terms; in fact, he did not even need to know what marriage was. All he asked was, firstly, that it should be possible to reduce the marriages observed in any particular society to a finite number of categories and, secondly, that there should be definite relationships between the various categories. . . . From then on, all the rules of marriage in a given society can be expressed as equations and these equations can be treated by tested and reliable methods of reasoning, *while the intrinsic nature of the phenomenon studied – marriage – has nothing to do with the problem and can indeed be completely unknown.*
>
> (Lévi-Strauss 1954: 586, emphasis added)

Thus, in Lévi-Strauss's *Elementary Structures of Kinship* (1949, *Les structures élémentaires de la parenté*), Weil constructed a formalization of one of the kinship systems examined, that of the Murngin, an aboriginal group in Western Australia. The society is comprised of eight classes and two alternative marriage formulae as shown in Figure 3.

Rules are specified which determine the class of the offspring, and the choice of marriage formula. Weil then shows that each class *A*1, *A*2, *B*1 etc. may be represented by a triple index (*a*, *b*, *c*), each term being a number in modulo 2, and each marriage type (i.e. husband's class and marriage formula) may be given by a similar quadruple (*a*, *b*, *c*, *d*) in modulo 2. Thus a marriage (1, 0, 1, 1) indicates a husband from *C*2 marrying according to formula I. From this, one can deduce certain consequences, e.g. a marriage (*a*, *b*, *c*, *d*) will yield offspring of type (*a*+1, *b*+1, *a*+*c*+*d*+1).

Weil shows how the use of formulae of this kind can provide answers to all questions concerning the kinship structure of the group. For example, marriage to the father's sister's daughter is shown to be logically impossible.

Figure 3 Lévi-Strauss's (1949) Murngin Kinship Structure



He shows further how the fact that marriage with the mother's brother's daughter is always allowed in the Murngin implies restrictions on the rules governing the adoption of marriage formula (I and II) by offspring. Specifically, the Murngin system is consistent with either children always following the parents' formula, or daughters following while sons adopt the opposite one. Both cases give rise to a stable structure containing two subpopulations, with marriage taking place among, and remaining confined to, certain combinations of classes, regardless of the class change undergone by offspring.

That seemingly complicated kinship structures could be reduced to algebra and the theory of groups was a sign to Lévi-Strauss of a certain rapprochement between social science and mathematical modelling:

> [Weil's work] is a good illustration of the direction now likely to be followed in collaboration between mathematics and the sciences of man. In the past, the great difficulty has arisen from the qualitative nature of our studies. If they were to be treated quantitatively, it was either necessary to do a certain amount of juggling with them or to simplify to an excessive degree. Today, however, there are many branches of mathematics – set theory, group theory, topology, etc. – which are concerned with establishing exact relationships between classes of individuals distinguished from one another by discontinuous values.
>
> (Lévi-Strauss 1954: 586)

He goes on to note how this is based on a shift from the calculus to combinatorics:

> This mathematics of man ... will ... be very different from the mathematics which the social sciences once sought to use in order to express their observations in precise terms. It is resolutely determined to break away from the hopelessness of the 'great numbers' – the raft to which the social sciences, lost in a ocean of figures, have been helplessly clinging; its ultimate object is no longer to plot progressive and continuous movements in monotonous graphs. The field with which it is concerned is not that of the infinitesimal variations revealed by the analysis of vast accumulations of data. The picture it gives is, rather, that resulting from the study of small numbers and of the great changes brought about by the transition from one number to another.
>
> (Lévi-Strauss 1954: 586)[12]

Princeton 1944: from stable structures to stable sets[13]

Five years after the appearance of the *Theory of Games and Economic Behavior*, and while Lévi-Strauss was publishing his *The Elementary Structures of Kinship*, von Neumann's Institute colleague Hermann Weyl wrote:

> Perhaps the philosophically most relevant feature of modern science is the emergence of abstract symbolic structures as the hard core of objectivity behind ... the colorful tale of the subjective storyteller mind. ... The [subject concerned] deals with some of the simplest structures imaginable, the combinatorics of aggregates and complexes. It

> is gratifying that this primitive piece of symbolic mathematics . . . accounts for some of the most fundamental phenomena in inorganic and organic nature. The same structural viewpoint will govern our account of the foundations of quantum mechanics. . . . In a widely different field J. von Neumann's and O. Morgenstern's recent attempt to found economics on a theory of games is characteristic of the same trend.
>
> (Weyl 1949: 237)

The shift in the use of mathematics in scientific modelling referred to by Weyl was, of course, exactly that referred to by Lévi-Strauss above: the move towards the exploration of structure through combinatorial mathematical analysis. The structuralist centrepiece of the *Theory of Games* was the *stable set*, the solution to the n-person game, a general proof of whose existence was sought by von Neumann and Morgenstern.[14] An imputation, or game outcome, x is said to 'dominate' another, y, when 'there exists a group of participants each one of which prefers his individual situation in x to that in y, and who are convinced that they are able, as a group – i.e., as an alliance – to enforce their preferences' (1947: 38). A solution, S, is a set of imputations, with the characteristics that:

No y contained in S is dominated by an x contained in S
Every y not contained in S is dominated by some x contained in S

x and y being imputations.

A solution is thus a *set* of imputations which is *stable* in that none of them dominates any other, and every non-member imputation is dominated by at least one member. Von Neumann and Morgenstern align the plethora of possible solution sets with the various types of rules, customs or institutions that may exist at any stage of a society's history: *mathematical structure becomes a means of uncovering, gaining access to, social structure.* To understand this, they suggest that the reader 'temporarily forget the analogy with games and think entirely in terms of social organization' (1947: 41, n. 1):

> Let the physical basis of a social economy be given, – or to take a broader view of the matter, of a society. According to all tradition and experience human beings have a characteristic way of adjusting themselves to such a background. This consists of not setting up one rigid system of apportionment, i.e. of imputation, but rather a variety of alternatives, which will probably express some general principles but nevertheless differ among themselves in many particular respects. This system of imputations describes the 'established order of society' or 'accepted standard of behavior.
>
> (1947: 41)

Each solution has a kind of inner stability, as defined using the dominance relation amongst imputations, and it also expresses a general social acceptance of its defining standard of behavior. The theory does not predict which solution will be observed in any particular situation: rather it emphasizes the equilibrium, structural features of the possible outcomes. And on this, they are quite clear:

> Our problem is not to determine what ought to happen in pursuance of any set of – necessarily arbitrary – *a priori* principles, but to investigate where the equilibrium of forces lies.
>
> (von Neumann and Morgenstern 1947: 43)

In this regard, von Neumann and Morgenstern were explicit in their desire to break with the Hicks-Samuelson variant of neoclassical economics. To von Neumann, the mathematician, such economics was based on an outdated mathematics more appropriate to classical mechanics, whereas social phenomena required mathematical treatment of a different kind:

> Our static analysis alone necessitated the creation of a conceptual and formal mechanism which is very diffferent from anything used, for instance, in mathematical physics. Thus the conventional view of a solution as a uniquely defined number or aggregrate of numbers was seen to be too narrow for our purposes, in spite of its success in other fields.
>
> (von Neumann and Morgenstern 1947: 45)

To von Neumann, game theory was the means by which social theory would incorporate the contemporary emphasis, across the scientific spectrum, on combinatorics, indeterminacy and discontinuity.[15] And just as Morgenstern roped von Neumann into the creation of a distinctly Modern mathematical economics, so did Lévi-Strauss do likewise in his encouraging Weil in the algebraic analysis of the stability of Murngin marriage systems.

Conclusion

The fundamental thesis of this paper is that the emergence of a theory of games in economics can be conceptually linked with a broad contemporaneous shift in theorizing in a range of areas, in which the 'game' became the constitutive metaphor. Saussure's 'creation' of modern linguistics marks a shift towards analysing language as a synchronic system of arbitrary signs, to be understood in structural, rather than historical or evolutionary, terms. In literary criticism, the Prague structuralism of Jakobson can be seen in similar terms: the poem is deprived of its referential aspect – words become counters in a literary game – and poetry is analysed as a self-contained structure obeying a poetic logic. In anthropology, under Lévi-Strauss, kinship and myth are to be understood in similar structural terms, as variations on a logical theme, which can be portrayed using simple qualitative mathematics. These developments are all historically linked.

In the same period as Formalism took hold in Russian literary circles, a Formalist movement developed in mathematics around Hilbert. Here, mathematical terms are stripped of their referential aspect, becoming counters in a logical game. It was in this context that chess was given a mathematical interpretation by Zermelo and von Neumann, and that the latter, in turn, 'saw' the parlour game as a suggestive metaphor for understanding many social situations. Separately, in Vienna, also in the context of debates on the foundations of mathematics, and under the influence of the sociology of von Wiese and the philosophy of Carnap, Menger's analysis of ethics was another move towards seeing social interaction in combinatorial terms. His influence on Morgenstern was fundamental.

Menger's ethics, von Neumann's games, and the structural anthropology of Lévi-Strauss are all indicative of a shift in the way mathematics was used as a tool in social theory. Each responded to very different local and contingent influences, but all were representative, and constitutive, of a deflection of social theory towards *structural* analysis. Reflecting his philosophy of tolerance, as much in mathematics as in politics, Menger constructed an analysis of how norm adherence affected group formation. To von Neumann, the first step in the rehabiliation of social theory was the construction of a new body of appropriate, modern mathematics, where both 'appropriate' and 'modern' were linked to the achievements of mathematics in post-mechanism physics: the analysis of social structure, ensembles of feasible social outcomes, stable sets, with the possibility of discontinuous passage from one to the other.[16] Lévi-Strauss, following a similar deflection of linguistics, shifted the analysis of anthropological structures towards an archaeology of mathematical forms and patterns, with structural richness and elegance in the formalism becoming a barometer of its veridicality as a tool of social analysis. Thus, on encountering the theory of von Neumann and Morgenstern, in the quotation with which we opened this paper, Lévi-Strauss immediately perceived and applauded the similarity of approach (see also 1954 *passim*).

The above is simply an overture to a history portraying this particular 'shift in economics' in terms of a larger cultural-scientific matrix. By making connections that are not immediately obvious, we gain some distance from the now dominant strategic view of the world: to borrow the terms of the Formalist Shklovsky, we 'make strange' the strategic view, we see it from a different angle.[17] The danger, of course, in pursuing these broader connections, is that expressions such as the evolution of economics lose their hold on our imagination. As recent work by Mirowski, Weintraub, and others has shown, once we start to probe the intersections between shifting conceptions of the 'economic' and shifts in other areas of science and inquiry, we are led to a different kind of historiography, one which reveals the boundaries that have traditionally circumscribed the 'history of economic thought' to be arbitrary, narrow, and stifling.

Notes

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1 The perspective adopted here is thus different from one which interprets the history of game theory as an unfolding sequence of newly proved theorems, e.g. Aumann (1989). We are more concerned with understanding the conditions – social, intellectual, political – in which certain types of mathematics, and thus certain types of theorems, begin to command attention, to gain scientific relevance.

2 These issues are dealt with in greater detail in Leonard, *From Red Vienna to Santa Monica: von Neumann, Morgenstern and Social Science, 1925–1955*, Cambridge University Press, forthcoming. For related treatments, see Leonard (1992, 1994, 1995, 1996) and Mirowski (1991, 1992). For a related interpretation of Lévi-Strauss, which came to my attention only after completing the present paper and which endorses some of the connections drawn here, see de Almeida (1990, 1992).

3 The case for the influence of economics is made by Bierbach (1978) and Rijlaarsdam (1978), and strenuously opposed by Koerner (1988).

4 An alliance between Jakobson, Troubetskoy, and the compilers of Saussure's Course, Charles Bally and Albert Séchehaye, was formed at the first International Linguistics Congress, at the Hague, in 1928 (See Dosse 1991: Ch. 7).

5 This move towards abstraction was aided by Hilbert's work on non-Euclidean geometry at the turn of the century. See Weyl (1949 [1927]).

6 This similarity between Hilbert's metamathematics and the theory of games is first noted in Mirowski (1992). While Gödel's proofs of 1930 showed Hilbert's grand aim of proving consistency and completeness to be futile, the Formalist approach in mathematics survived well beyond that. Von Neumann and Morgenstern (1947 [1944]) present their theory in explicitly Formalist terms, and the Structuralism of the Bourbaki is Formalism's doctrinal descendant in mathematics. Both von Neumann and Morgenstern and the Bourbaki influenced Debreu in his Formalist restatement of Walrasian general equilibrium theory. For a discussion of the Bourbaki connection, see Weintraub and Mirowski (1994).

7 Note that Carnap (1928) provided only the *description* of the diagram in his book, but not the drawing itself.

8 In 1928, Morgenstern wrote from Boston to his colleague Gottfried Haberler: 'I have moved away a good distance from Kant, the idealistic philosophy and Husserl. It seems to me that you cannot manage without mathematical logic and epistemology, and that sufficiently realistic and not simple empiricism. . . . [F]urthermore, I am just reading Carnap's book *Der Logische Aufbau der Welt*, which is also a very good piece of work' (Letter, Morgenstern to Haberler, 28 March, 1929, Morgenstern Papers, Special Collections Library, Duke University). And two days later: 'In the evenings, I

read Carnap, which is very difficult, but from which I gain a lot. I am slowly learning to think, and by doing that I come more and more into a mathematical way of thinking' (Morgenstern, Diary, 30 March, 1929, Morgenstern Papers, Special Collections Library, Duke University).

9 For a more detailed account of Menger see Leonard (1996).

10 In retrospect, Menger (1974) questions the clarity of some of von Wiese's classifications, and explanations. For example, the suggestion that a process, *P*, is the product of an attitude, *A*, and a situation, *S*; thus, $P = A \times S$ remained opaque to Menger and the deductions connected with he found to be logically inadequate. However, while 'von Wiese and his school did not result in any exact theory of social groups and relationships, their systematic treatment and classification of observable social phenomena compared favorably with the utterly vague discussions of many other sociologists of that period' (1974: 113).

11 Morgenstern's rupture with Mises is made clear in his diaries: 'Friday was Tintner's presentation. Good and interesting. Menger was also there. . . . Mises presided, and as usual, when exact topics (Monopoly) are dealt with, he doesn't talk, only if the discussion becomes political' (OMDU, Diary, 22 September 1935). And later: 'Yesterday in the Nat. Economics Association, Menger gave an excellent presentation about the law of diminishing returns. It was an exemplary piece of work for the proof of the necessity of exact thinking in economics. . . . Mises talks pure nonsense' (OMDU, Diary, 31 December 1935).

12 Here, Lévi-Strauss takes the opportunity to criticize what he calls Hayek's 'obscurantism' (1954: 585), referring to the latter's *Scientism and the Study of Society* (1952) and his insistence on a fundamental, irreducible difference between the natural and the social sciences. The key to the successful use of mathematics in the latter, Lévi-Strauss insists, lies not in the use of *quantitative* mathematics, the measurement of quantifiable phenomena but in the use of *qualitative* mathematics to illustrate underlying structures. He then goes on to praise von Neumann & Morgenstern (1947 [1944]) for its mathematical apparatus, 'more complicated and delicate . . . than that found in economic or even econometric treatises' (Lévi-Strauss 1954: 587).

13 The following section draws on a similar discussion in Leonard (1995).

14 The authors show that such a solution exists for games of smaller order, 3-person, 4-person, etc., but are unable to provide a general existence proof.

15 Thus, '[It] is to be expected – or feared – that mathematical discoveries of a stature comparable to that of calculus will be needed in order to produce decisive success in [the mathematical analysis of social phenomena]. . . . *These observations should be remembered in connection with the current overemphasis on the use of calculus, differential equations, etc. as the main tools of mathematical economics*' (von Neumann and Morgenstern 1947: 6, emphasis added). And, Gödel notwithstanding, the whole is offered in the spirit of Hilbert's modern axiomatic method, with the linking of mathematical concepts and social entities coming after the analysis is complete.

16 Von Neumann continued to emphasize the need to find a general existence proof for the stable set right through the early 1950s. See Leonard (1995).

17 It could be argued that recovering the 'strangeness' of economic theory's various interludes is an essential component of writing their *history*. The gentle irony in our putting Formalist strategies to historiographical use will be obvious to the reader.

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Abstract

This exploratory paper, part of continued work on the history of game theory, seeks to illustrate certain links between von Neumann's theory of games and contemporaneous ideas in other fields. In particular, we claim that the emergence of the analytical metaphor of the 'game' in economics can be viewed as part of a general reconceptualization of theory in a range of disciplines. That methodological reconstitution may be described as the emergence of a Structuralist view, an approach to theorizing which treated its object – be that a text, a kinship arrangement, or an economy – as a self-contained system, with its own internal logic, subject to its own 'laws'. In particular, individual texts, or observed social and economic arrangements, are now viewed as variations on an underlying logical theme, on a structural invariant. The latter is to be uncovered, in the case of linguistics, through

the analysis of phonemes; in kinship analysis, through the rules governing the exchange of women because of the incest taboo; in von Neumann and Morgensterns game theory, through the possibilities for equilibrium coalition formation, based on the stable set. There thus emerged a tendency, across the intellectual spectrum, towards seeing things in *combinatorial* terms. Theoretical coherence was to be found in examining how objects 'held together' rather than analysing where they 'came from': nineteenth-century concerns with history, evolution and individual psychology give way to a distinctly modern emphasis on synchronic, formal structure, on analogical reasoning. Atomism gave way to holism, and formal elegance superceded immediate empirical content. Recourse to the metaphor of the 'game' was constitutive of this shift, which we examine by referring to Saussures *General Course in Linguistics,* to Formalism in mathematics and literary analysis, to Lévi-Strauss's analysis of kinship and myth, and to von Neumann and Morgenstern's *Theory of Games and Economic Behaviour.*

Keywords

Von Neumann, Morgenstern, Menger, Lévi-Strauss, formalism, linguistics, structuralism