

Learning game theory from Reinhard Selten

some thoughts for his 80th birthday

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"Nash equilibrium and the history of economic theory," *J. Econ. Lit.* 37 (1999)

<http://home.uchicago.edu/~rmyerson/research/jelnash.pdf>

"Political economics and the Weimar disaster," *J. Institutional and Theoretical Economics* 160 (2004)

<http://home.uchicago.edu/~rmyerson/research/weimar.pdf>

Learning game theory from Harsanyi and Selten

Reinhard Selten and I first met as people who both liked to learn from John Harsanyi. As a student, I wanted to generalize Harsanyi's (1963) NTU solution and Harsanyi-Selten's (1972) generalized Nash bargaining solution to Harsanyi's (1967-8) general Bayesian games with incomplete information.

Intellectual starting point: the value of thinking fundamentally about society from individualistic basis, using logical analysis with conceptual generality.

Rational individual behavior for individual interests: a great idea to study, even if people do not always fit this ideal.

System-building and methodological dualism: descriptive and normative theory.

It's hard to believe that Harsanyi and Selten co-authored only twice.

Their book is the most ambitious attempt to formulate a comprehensive characterization of rational behavior.

Counterpoint with Thomas Schelling began with footnotes (1961, 1964, 1965).

Role of the extensive form in game theory

Game theory began with the idea of strategic normalization: the generality of the one-period strategic-form games, analyzed by Nash equilibria.

(Von Neumann's 1928 normalization of extensive games, Nash's 1951 program.)

This simple general framework was good for starting the new field, but unfortunately it is not completely right.

One person's ex ante strategic planning could ignore events that have zero probability to him, even if his behavior in these events may matter to others.

Reinhard Selten led the return to dynamic extensive-form game models.

1964: Valuation of n-person games.

1965: Theoretical treatment of a oligopoly model.

1975: Re-examination of perfectness for equilibria in extensive-form games.

1978: Chain-store paradox.

(My properness in 1977, and Kreps-Wilson's sequential equilibrium in 1982.)

Luce & Raiffa (1957; p 104, 180) found noncooperative game theory inadequate from considering battle-of-sexes game and finitely repeated prisoners' dilemma.

Schelling (1960) and Harsanyi-Selten (1988) responded to the former problem,

Selten (1978) and Kreps-Milgrom-Roberts-Wilson (1982) to the latter.

Triumph of noncooperative game theory by mid-1980s.

Cooperation with incomplete information

Harsanyi and Selten's "Generalized Nash solution for two-person bargaining games with incomplete information" (1972) founded the theory of cooperative games with incomplete information.

Interim efficiency as basic welfare criterion with incomplete information.

Simplifying the feasible set with Hurwicz's (1972) incentive compatibility led to the revelation principle (1979). (Rational honesty in mediation, w.l.o.g.)

The probability-invariance problem led to virtual utility (1983, 1984):
using Lagrange multipliers of incentive constraints.

Strategic normalization versus the revelation principle:
the inadequacy of the normal form for games with communication.

A case study to measure what has been learned

Re-examining the Weimar disaster: what have social theorists learned since 1919, when John Maynard Keynes advised at the Paris peace conference and Max Weber advised at the Weimar constitutional convention?

Keynes's *Economic Consequences of the Peace* was a brilliant polemic against the peace treaty, focusing on the reparations bill (for about $3.3 \times \text{GDP}_{1913}$).

Keynes seemed to understand everything and foresee the whole disaster:

"Who believes that the Allies will, over a period of one or two generations, exert adequate force over the German government to extract continuing fruits on a vast scale from forced labor?"

In 1922 he recommended annual reparations of 3% prewar GDP for 30 years.

The 1929 Young plan offered similar terms and withdrawal from Rhineland, but the Nazis' rise to national power began after that.

Lloyd George (1938): Germany also had plans to seize valuable assets and property if they won WW1, *"but they had not hit on the idea of levying a tribute for 30 to 40 years on the profits and earnings of the Allied peoples.*

Mr. Keynes is the sole patentee and promoter of that method of extraction."

Analysis of incentives for reparations

Keynes proposed extending reparations to avoid the macroeconomic shock of vast short-term capital flows and imports from Germany. (Wagner, 1874)

Keynes spoke of Germany's ability to pay, never of incentive to pay (Ritschl).

Incentives to pay sovereign debt were lacking (contrast France 1871).

Now we see: Reparation fulfillment was not a subgame-perfect equilibrium (Selten).

Was the Rhineland a credible surety?

Odious payments: In the politics of property-rights protection, leaders' reputations depend on their defending legitimate rights, opposing illegitimate theft.

Reparations as a tax on prosperity: value of depression. (Parker Gilbert.)

Paying with borrowed dollars to put American bankers at risk.

War-of-attrition equilibrium in dynamic bargaining (Selten-VanDamme-Winter).

Purifying the equilibrium with incomplete information about cost-type.

Depression and extremism as costly signals of unwillingness to pay.

Allies finally abandoned reparations in 1932. (But the Nazi take-over was in 1933.)

Votes for extremists are costly only when risk of takeover becomes positive.)

Can a nation have a type unknown to foreigners (to foreign voters)?

Patriotic norms against communicating weakness.

(Underestimating differences in national views of justice: inconsistent beliefs?)

Finding better equilibria

More sensible approaches when dynamic incentives are considered:

How the Rhineland might have been used in 1919.

After Franco-Prussian war in 1871, reparations planned for 3 years,
paid in 1 to end occupation early, funds raised by bonds sold to French citizens.

Why was the repayment of these bonds credible?

At the foundations of the economy: property rights are enforced by a game with
multiple equilibria (which makes rights easily transferable).

Just one focal equilibrium, or the basis of civilization?

Question: What can make rational people want to choose militant leaders?

Importance of extending our general analytical frameworks.

Macroeconomics could crowd out strategic incentive analysis for Keynes,
given the limits of economic analysis in his time.

Game theory today gives economists a general tool for analysis of incentives in any
social structure: economic or political.

Reinhard Justus Reginald Selten is a German economist, who won the 1994 Nobel Memorial Prize in Economic Sciences, which he shared with John Harsanyi and John Nash. Selten further refined Nash equilibrium and came with concept of trembling hand. Game theory assumes that players are rational and not capable of making mistakes. Selten felt that there exists a small probability of other person making a mistake through what he called "slip of hand" or tremble, wherein a person may choose wrong strategy by mistake. "My first contact with game theory was a popular article in Fortune Magazine which I Reinhard Selten (1930-2016). On October 5, 1930, German economist and Nobel Laureate Reinhard Selten was born. Selten is well known for his work in bounded rationality and can be considered as one of the founding fathers of experimental economics. For his work in game theory, Selten won the 1994 Nobel Memorial Prize in Economic Sciences (shared with John Harsanyi and John Nash). "I was always skeptical about authority, about things which were told by authorities, because I was living in a country and in a time where the authority was utterly wrong, in my view. And therefore I distrusted, I fear noncooperative games," International Journal of Game Theory 4 (1975), 61-94. John C. Harsanyi and Reinhard Selten, A General Theory of Equilibrium Selection in Games, MIT Press (1988). John Nash, "The bargaining problem," Econometrica 18 (1950), 155-162. John Nash, "Non-cooperative games," Annals of Mathematics 54 (1951), 286-295. Reinhard Selten, it is no exaggeration, is a founding father of two massive branches of modern economics: experiments and industrial organization. He passed away last week after a long and idiosyncratic life. Game theory as developed by the three co-Nobel laureates Selten, Nash, and Harsanyi is so embedded in economic reasoning today that, to a great extent, it has replaced price theory as the core organizing principle of our field. That this would happen was not always so clear, however. Take a look at some canonical papers before 1980. Learning game theory from Harsanyi and Selten. Reinhard Selten and I first met as people who both liked to learn from John Harsanyi. As a student, I wanted to generalize Harsanyi's (1963) NTU solution. and Harsanyi-Selten's (1972) generalized Nash bargaining solution to Harsanyi's (1967-8) general Bayesian games with incomplete information. Intellectual starting point: the value of thinking fundamentally about society from individualistic basis, using logical analysis with conceptual generality. Rational individual behavior for individual interests: a great idea to study, even if people do not