The Role of Narratives in Transferring Rational Choice Models into Political Science

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Abstract

One striking observation in the history of rational choice models is that those models have not only been used in economics but spread widely across the social and behavioral sciences. How do such model transfers proceed? By closely studying the early efforts to transfer such models by William Riker – a major protagonist in pushing the adoption of game theoretic models in political science – this article examines the transfer process as one of 'translation' by which abstract and mathematical rational choice models were constructed and modified such that they applied to a specific target system in a new domain. In this paper, we argue that to overcome a set of challenges that hampered the straightforward transfer of game theoretic models into political science, Riker complemented theoretical and conceptual modifications of von Neumann and Morgenstern's game schemes with the use of narratives to turn them into applicable and testable models. As such, those narratives played a crucial role in enabling their transfer and ultimately facilitated the applicability of game theoretic models in political science.

1. Rational Choice Models and the Role of Narratives in Analyzing their Transfer

The history of rational choice models has been explored mainly by focusing on their adoption in economics (e.g., Giocoli 2003, Herfeld 2017, 2018, Morgan 2006, Moscati 2018). While especially the early years of the history of game theory in economics are well studied (Dimand/Dimand 1995, Dimand 2000, Erickson 2010, Giocoli 2003, Leonard 2010, Weintraub 1992, 2002), the history of their adoption in other social sciences has received less attention (but see, e.g., Amadae 2003, 2015, Erickson 2010, 2015, Erickson et al. 2013, Isaac 2010). This is striking, given that rational choice models have not only been used in economics but spread widely across the social and behavioral sciences and even beyond. To explain this spread, Herfeld and Doehne (2019) propose that the diffusion of rational choice models into domains as diverse as economics, biology, psychology, and political science required what they call

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'translation' of the original models for each of those fields. While this process is domain-specific and depends on the epistemic goals within a field, translation can generally be described as the way in which the highly abstract and mathematical schemes of rational choice approaches were modified to construct models that could be applied to specific target systems in fundamentally different domains.

In this paper, we analyze one instance of such a translation process by studying the initial transfer of rational choice models into political science. As the political scientist William Riker had been a major protagonist in pushing the adoption of game theoretic models in political science (Herfeld/Doehne 2019), we focus on his attempts to translate game theory for political science in his seminal book *The Theory of Political Coalitions* (1962). We show that to overcome a set of challenges in the process of translation, Riker not only modified the original game schemes theoretically and conceptually but also drew on narratives. By fulfilling different roles in the translation of game theoretic models – in constructing, applying and testing the model – these narratives contributed in important ways to the transfer.

The role of narratives in science has recently become an explicit concern in history and philosophy of science (e.g., Morgan/Wise 2017, Morgan et al. 2022). Among various proposals, the suggestion that narratives and formal models complement each other serves as our primary background for discussing the role of narratives in the transfer of game theoretic models (Currie/Sterelny 2017, Hartmann 1999, Morgan 2001, 2007, 2012, Rosales 2017, Wise 2011, 2017). In our analysis, we rely on a minimal definition of narrative as a representation of a connected sequence of events, which identifies its defining feature by contrasting a narrative with a chronicle: a narrative unlike a chronicle also draws connections between the events that they both order into a sequence (e.g., Morgan/Wise 2017, Ryan 2007).

Morgan (2007) explores how narratives can complement mathematical models by discussing their role in the use of game theoretic models in economics. One important role Morgan identifies is that narratives enable the application of game theoretic models in economics because they allow economists to reason with the model about an economic phenomenon by matching the formal game model with its target. Focusing on the Prisoner's Dilemma game, Morgan argues that in matching the model with its target, these narratives match a 'model situation' – or what she, inspired by Popper's situational logic, also calls 'types of situations' that are characterized by different types of games – with a particular empirical 'economic

situation' to be found in the real world. The narrative sequences surrounding the application then allow exploring the plausibility of this match. When matching is successful, a particular economic situation can be shown to be a case of the type of situation captured in the model thus facilitating the model's application.

Another important position for analyzing the role of narratives in transferring game theoretic models into political science is Sharon Crasnow's (2017) discussion of their importance in case-based reasoning in contemporary political science. Crasnow suggests that narratives play a critical role in 'process tracing', a method where case studies are used to test empirically or theoretically derived hypotheses about causal mechanisms.[2] While experimental and statistical methods can establish a link between dependent and independent variables, process tracing can test the causal mechanism that might generate this link. Crasnow provides an account of process tracing where narratives are crucial for providing evidence for such causal mechanisms. As narratives pull together a set of events leading up to a phenomenon they can provide a coherent account of the interrelationships of the parts of the mechanism. As such, the narrative can provide evidence that goes beyond the individual "diagnostic pieces of evidence" for distinct parts of the mechanism (ibid, 10). While the naturalistic methodology underlying the kind of process tracing that Crasnow analyses in contemporary political science was certainly not yet broadly accepted among political scientists during the early days of game theory (Riker 1962, ch. 1), Crasnow's account helps to understand Riker's use of narratives whose self-proclaimed goal in transferring game theoretic models into political science was precisely to establish just such a naturalistic methodology (Riker 1962, 1977).

Building on these two major contributions, we analyze the role that narratives played in translating game theoretic models for political science. First, we suggest that similarly to the early adopters of game theory in economics, Riker relied on narratives to match the game theoretic model with the empirical situation in his attempt to apply the model to a concrete target (Morgan 2007). Second, similarly to how Crasnow describes the role of narratives in causal process tracing, Riker used a narrative to provide evidence for his model by tracing a process in a specific case study. However, narratives also played additional roles in the model

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[2] Crasnow (2017, 8) characterizes mechanisms as having 1) "parts - they may be identified as activities, events, or entities, but the parts are in some sense discrete (if only analytically); 2) the parts are organized in some way - the mechanism has a structure; and 3*) there is an active element that is seen through the inter-relationship of the partsdall characterizations of mechanism include the idea that an effect is brought about, produced, propagated, or maintained through the inter-relationship of the parts."

transfer. Riker not only drew on narratives to apply and test the model, he also used narratives to validate and expand his model in the construction and application process.

Our analysis - directly and indirectly - contributes to a more comprehensive history of the spread of game theory in three specific ways. First, it offers a starting point for historically analyzing the discipline-specific differences in the diffusion of rational choice models with respect to the kinds of models adopted, the pace and timing of adoption, and into the variety of ways in which they were used. Focusing on the role that narratives have played in the modification process points to important differences in the early adoption of game theory in economics and political science respectively that require further attention. Second, by analyzing the early adoption of game theoretic models beyond economics, we offer a detailed case study of how such model transfer processes more generally look like. In doing so, we further unpack one exemplary instance of the processes of translation that are critical for successful model transfers (Herfeld/Doehne 2019). Third, by directly adding to the literature that has begun to examine the role of narratives in the social sciences (Morgan 2001, 2007, 2012, 2017, Grüne-Yanoff/Schweinzer 2007, Crasnow 2017) and contributing an in-depth examination of how narratives can complement mathematical models particularly in model transfer, it provides the ground for further analyses of narrative's role in the spread of game theoretic models into the social and behavioral sciences at large.

2. Model Templates, Rational Choice Models, and their Transfer

Although game theoretic models spread extensively across highly divergent domains throughout the second half of the 20th century, game theory began as a set of theoretical contributions to mathematics made by John von Neumann. But since von Neumann's work first appeared in the *Theory of Games and Economic Behavior* (1944 [1947]) co-authored with the economist Oskar Morgenstern, his contributions quickly raised interest among, and were first adopted by, economists (Leonard 2010). This early engagement reflected Morgenstern's efforts – especially in the first chapter – to link the mathematics of game theory to a set of conceptual ideas long accepted among economists. Widely read book reviews by Marschak (1946) and Hurwicz (1945) demonstrating the potential benefits for analyzing economic situations further substantiated the relevance of game theory for economics (Herfeld 2017). However, the broader diffusion process of the original contributions varied across domains not only with respect to the time and pace of adoption but also with respect to the objects transferred, i.e., the

conceptual, methodological, and theoretical elements from game theory that were transferred and ultimately used in each domain (e.g., Erickson 2010, Herfeld/Doehne 2019, Isaac 2010).

What might partly explain the extensive diffusion of rational choice models was their highly abstract character, their sophisticated mathematical formulation, and their grounding in a set of fundamental principles taken to be characteristic for human behavior as a whole (e.g., Humphreys 2019). Von Neumann, strongly influenced by the Hilbert school of mathematics, aimed at providing the social sciences with axiomatic foundations in line with what David Hilbert had seen as a necessary condition for any endeavor to be considered a serious science (Weintraub 2002). For von Neumann, this meant finding "the mathematically complete principles which define 'rational behavior' for the participants in a social economy, and [deriving] from them the general characteristics of that behavior" (von Neumann/Morgenstern 1944, 31). Introducing what they called "axiomatic models," von Neumann and Morgenstern made clear that they did not want to establish "correlation with any meaning which the verbal associations of names may suggest" (ibid., 74). The result was a mathematical theory of 'games of strategy' formulated by mathematical logic, set theory and functional analysis that provided a large number of different game schemes.

While von Neumann and Morgenstern (1944) introduced a purely formal apparatus, for many economists the game schemes that built on this apparatus were linked with an abstract conceptual idea that connected them to situations of social interaction between agents. Morgenstern's efforts to interpret the relevant mathematical concepts in economic terms drew the conceptual links to traditional utility theory and thus to a theoretical and conceptual framework familiar to economists (ibid., chapter 1). For example, Morgenstern interpreted the mathematical concept of a binary ordering as a preference ordering of a 'rational agent,' payoffs as utilities, and alternatives in terms of choices. He thereby provided a general conceptual vision for those abstract models that suggested applying them to phenomena characterized by general patterns of strategic interaction. Yet, for other social scientists – particularly for political scientists who at the time were often committed to a historical approach, philosophically-inspired political theory, and an antinaturalist methodology – it was initially unclear how these abstract game schemes could be applied to their respective target systems (e.g. Damiani 2022). In political science, the thin and technical definition of rational behavior in game theoretic models proved especially controversial (Riker 1962, 23). Unlike in economics, where the

rationality principle at the core of game theory had been part of economic theory since John Stuart Mill (Morgan 2006), it was much less accepted in political science.

The importance of Morgenstern's attempts to link those abstract models to a general conceptual vision of the main characteristics of economic phenomena can be captured more systematically when we consider the notion of a model template that Knuuttila and Loettgers (2016, 2020) have introduced to explain model transfers. Expanding on Paul Humphrey's notion of theoretical templates (2004, 2019), a model template is an abstract mathematical structure or a computational method that is coupled with a general conceptual idea or vision "capable of taking on various kinds of interpretations in view of empirically observed patterns in materially different systems" (Knuuttila/Loettgers 2016, 396). In the model transfer literature, the object of transfer is not a model itself but such a template from which a more detailed applicable computational models constructed mainly by specifying construction assumptions, an ontology, an interpretation, an output representation, etc. Knuuttila and Loettgers emphasize that it is both a template's abstractness and its accompanying conceptual vision that can explain its transfer across domains. While the template's abstractness yields flexibility and generality, the conceptual vision identifies general patterns across domains that make the application of a model to a set of phenomena sharing those patterns attractive. However, as the template itself only provides "a formal platform for minimal model construction coupled with very general conceptualization without yet any subject-specific interpretation or adjustment," its wide application is constrained only to some degree (Knuuttila/Loettgers 2016, 382, Humphreys 2019). For its successful transfer, the template still needs to be significantly modified to build a model on its basis.

In their analysis, Herfeld and Doehne (2019) treat the different mathematical game schemes suggested by von Neumann and Morgenstern as model templates. Each game is an abstract mathematical structure, which contains mathematical concepts, such as the binary relation and a set of lotteries, that have in a first instance only a mathematical interpretation. The implicit physical interpretation for the concepts of 'preferences,' 'utility,' and 'rationality' was thus initially detachable from the template. This is why Morgenstern's use of such vocabulary was crucial to make explicit the general conceptual vision that should accompany the abstract templates. Herfeld and Doehne further suggest that we can understand the diffusion process of those templates as a four-stage process. Diffusion begins with an 'innovator' contribution, in our case the *Theory of Games*, in which a scientific innovation – a new template, for example

– is introduced into some domain. Next comes a second stage of elaboration contributions that engage with the template, clarify it, specify, or explicate it further, and explore possible ways in which it can be made fruitful for other domains. This elaboration process lays the ground for the third stage of translation, in which the elaborated template becomes conceptually and/or theoretically modified, complemented, integrated, or even transformed in such a way that it can be applied to concrete problems in a specific domain. At the last stage, the template becomes applied in a specific target domain by a specialist contribution, i.e., by a contribution that illustrates how the translated model, for example, can define and/or solve new problems in that target domain.

In justifying this four-fold process, Herfeld and Doehne (2019) identify all elaborator, translator, and specialist contributions for each of the domains into which both game and decision theory were transferred. For political science, their analysis shows that William Riker's *The Theory of Political Coalitions* (1962) had been the key translator contribution undertaking large parts of the modifications necessary for transferring game theoretic models from mathematics to political science, whereby a key elaborator contribution that Riker was grounding his analysis on was R. Duncan Luce and Howard Raiffa's textbook *Games and Decisions: Introduction and Critical Survey* (1957). Herfeld and Doehne's analysis substantiates the idea that the transfer of such mathematical game schemes would have been unlikely to happen by just transferring those templates from one domain to another without any modifications. The object transferred had to be translated in such a way that it became applicable to one or more target systems in the new domain.

3. Transferring Game Theoretic Model Templates into Political Science

As in other fields, not all of what the *Theory of Games* contained was of interest to political scientists. Riker focused on what he considered most useful for thinking about a core problem in political science, which he took to be the prediction of political behavior mainly instantiated in coalition formation processes. To model such processes and predict and explain their outcomes, he argued that von Neumann and Morgenstern's theory of n-person (zero-sum) games was best. It allowed for analyzing social interaction processes between any number of people larger than two. By focusing on n-person, zero-sum games, Riker chose a less celebrated template from the *Theory of Games*. At the time, two-person, zero-sum games were considered to be the heart of von Neumann and Morgenstern's contribution and also most important for economics because many economic situations could be reconstructed as the interaction of two

parties. In contrast, earlier attempts by Martin Shubik and others to import them into political science were less successful. For one, the minimax theorem – the solution concept for such games – faced difficulties in application. Also, Riker (1962, 14ff., 1992) in particular, considered Shubik's adoption of two-person games to be of limited use for political science because they did not capture the types of political situations Riker took to be the most important object of study in his field.

While Riker was primarily interested in using game theory to model coalition formation, his mission was more profound. Being strongly inspired by the economists' image of science at the time, his goal was to introduce a whole new methodology of deductive reasoning, mathematical modeling, and hypothesis testing into political science, which he perceived to be prevailing and successful in economics but not yet widely accepted among political scientists. Thereby, Riker's main idea was to turn political science into what he considered to be a proper science (Riker 1962, Riker/Ordeshook 1973). Political science should start from fundamental behavioral principles to derive robust generalizations about causal relationships governing political phenomena, which would allow for formulating mathematical models that provided testable predictions whose accuracy would require support by empirical evidence. While for Riker political science was still far away from this ideal, he argued that the *Theory of Games* had put not only economics but all the social sciences one step closer towards reaching it.

In order to transfer game theoretic templates into political science and thereby convince political scientists of their value, Riker had to overcome at least three kinds of challenges. To establish rational choice models as part of a naturalistic methodology in political science – or "positive political theory" as Riker would come to call it (Riker/Ordeshook 1973) – Riker had to justify that the models were plausible both conceptually and by showing in concrete ways how they could be applied in political science. To succeed, Riker had to cope especially with the substantial disagreement among political scientists about the concept of rationality and the axioms von Neumann and Morgenstern had introduced to model political agents as rational agents (Riker 1962, ch. 1). Riker was aware of serious doubts among some political scientists, and his *Theory of Political Coalitions* sought to convince them that the rationality assumption could be a useful behavioral principle in political science.

Another set of challenges related to both the need to satisfy the demands of a deductive approach using mathematical models and the need to arrive at an empirically supported theory

of political coalitions that allowed for the construction of hypotheses about causal processes underlying coalition formation. The concern for tracing causal processes behind relevant political phenomena signals Riker's ambition to use game theoretic models to provide causal explanations.

A final set of challenges concerned the technical and conceptual features of n-person games. While von Neumann and Morgenstern had introduced the mathematics, the theoretical framework, and the conceptual apparatus required for adopting game theory in political science, applying them to concrete social situations was not straightforward. Two major shortcomings of von Neumann and Morgenstern's n-person theory impeded such application: First, the theory was static. Agents' preference patterns were assumed to stay invariant over time and remain independent of an agent's experience unfolding throughout the game. Similarly, the strategy space was also assumed to be invariant. As such, dynamic processes of coalition formation could not easily be studied with such models, which also made them less attractive for providing causal explanations. Second, the characterization of a (normal form) game did not contain any information about possible sanctions or restrictions on coalition formation. This was problematic, given that in a real society, various restrictions – including its legal structure and a society's history – would shape the process by which coalitions form and how they change (Luce/Raiffa 1957). That the scheme of n-person games did not contain any additional sociological assumptions to introduce such restrictions meant that they could not be used to predict the actual outcome of concrete cases of coalition formation. Therefore, such usage required additional conceptual elements and empirical assumptions.

Riker's efforts to modify von Neumann and Morgenstern's game schemes to fit them into the new domain of political science reflected his attempts to overcome those challenges. He translated the template in such a way that the resulting model was applicable to those target systems that political scientists would study. At the same time, his translation also reflected pre-existing methodological commitments that were already accepted among naturalistically inclined political scientists (namely aiming at causal explanations). Roughly, his translation process can be divided into four stages including both his model construction and application process. First, he constructed what he calls a 'static' model on the basis of von Neumann and Morgenstern's model template, from which he derived one of his major theoretical and testable predictions, i.e., the so-called size principle, about coalition formation outcomes. Second, he expanded this static model towards the 'dynamic' model such that the theory would enable him

to also formulate hypotheses about the causal processes behind coalition formation, which the static model could not provide. Third, he applied this dynamic model to a concrete historical case of coalition formation trying to demonstrate how the model could yield fruitful analyses. Finally, this application also served to test his model because – akin to a case study – it provided evidence for the model's hypotheses and respective predictions, which his expanded model would yield about a concrete empirical situation.[3] In this translation, which required turning von Neumann and Morgenstern's template into a computational model, applying the model and testing it, Riker not only engaged in theoretical and conceptual modification, but he also drew extensively on narratives.

4. The Roles of Narratives in Riker's *Theory of Political Coalitions*

We discuss the role of narratives in model transfer by locating them in the four steps of model translation that Riker undertakes in his *Theory of Political Coalitions.*

4.1. Narratives in Model Justification

The first time Riker critically relies on narratives is after having derived the size principle, the "assertion that, with complete and perfect information, winning coalitions tend toward the minimal winning size" (Riker 1962, 211). Riker derived this principle from the 'static model,' a model of an n-person, zero-sum (cooperative) game that is grounded in the set of axioms – including the rationality axioms – von Neumann and Morgenstern had introduced. Derived deductively, Riker took the principle to have the status of a testable theory that was not only supposed to predict the outcome of coalition formation processes but such a high degree of what Riker also labeled verification by observation would further contribute to the axioms' validation (ibid., 7).

To derive the size principle, Riker drew on von Neumann and Morgenstern's model template to model coalition formation in n-person games, namely the characteristic function form. Roughly, the idea behind the characteristic function was to derive a function from the normal form representation of a game that would assign each coalition a payoff – the value of that coalition – to describe the game situation at the penultimate stage of the game. At this stage, all players who are not yet members of the coalition get conceptually fused into one player, a

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[3] Riker also introduced the 'disequilibrium principle' as a third proposition about coalition formation, which does, however, not play an important role for our purposes.

'counter coalition,' a step which yields a two-person, zero-sum game. In the resulting coalition game, the payoffs to each coalition were the sum of the payoffs for each member of the coalition. The coalition strategies are the coordinated strategies of their members and the value of the coalitions in the characteristic function are that of the coalitions in the coalition game. In providing an interpretation of the original model template in terms of agents as members of coalitions, of utility as winning, and of rational strategy as choosing the optimal coalition size, and by deriving the size principle as its specific output representation, Riker turned the template into an applicable computational model.

Deriving this principle from an n-person, zero-sum game was far from trivial. One major concern in n-person games was to narrow down the possible solution space in such a way that any predictions could be made at all (Riker 1962, 38). While von Neumann and Morgenstern's concept of imputations helped constrain the solution space, this constraining did not result in unique predictions of winning coalitions (Luce/Raiffa 1957, Riker 1962, 37). Rather, von Neumann and Morgenstern arrived at a set of possible imputations associated with a specific coalition structure, which all to the same degree presented a reasonable outcome for rational players. Despite attempts by scholars like Luce (1955) and Milnor (1952) to find other ways to restrict the set of solutions, Riker and others had concluded that "[n]ot enough limitations have been successfully imposed to limit the possibilities in a way that admits of useful application in the study of real coalition-making" (Riker 1962, 38; Luce/Raiffa 1957). Thus, to predict winning coalitions in 'real coalition-making,' both the set of characteristic functions and the number of imputations required constraints. The size principle was one of Riker's solutions. By predicting that minimally winning coalitions will prevail in coalition formation, he thus made the applicability and empirical usefulness of n-person, zero-sum games in political science initially plausible.

While derived from an abstract model template, Riker considered the size principle to have the status of a "sociological law" (Riker 1962, 32) that simultaneously predicted the outcome of political coalition building processes and introduced constraints into the model. Riker granted that it required empirical "verification" (Riker 1962, 4), which would ideally be done by providing experimental evidence. Yet, he considered the little existing evidence to be either indirect and preliminary, or irrelevant and thus useless for his purposes (1962, 49-51). He cautioned, for example, that small-n experimental settings (presumably assuming that large-n experimental settings are impracticable) would not be able to test the principle because other

factors might dominate it in such settings (1962, 51). His proposed alternative was to provide what he called 'observational evidence.' Effectively, this evidence consisted of seven narratives that recounted seven historical episodes in an attempt to show how the size principle operated as predicted by the model in each episode. While those historical episodes differed significantly – Riker discussed how the major political parties of the United States evolved at three points in American history (1820, 1852, 1872), how the winners of the Napoleonic wars, World War I and World War II acted after victory was won, and how the Indian Congress party developed after India's independence – the narratives of those episodes resembled each other in that each recounted how a political situation evolves in line with what the size principle would predict. In each case, a coalition much larger than the one that would have the minimal size needed to win (a so-called "coalition of the whole" (Riker 1962, 54)) diminished in size because the leaders of larger-than-minimal coalitions attempted to reduce their coalition size "in the direction" of a minimal winning coalition (Riker 1962, 54).

For example, in one narrative Riker reconstructs the behavior of the major political parties in the United States circa 1820, namely the Federalist and the Democratic-Republican party. He describes a sequence of events where one party (the Federalist party) transformed from a winning into a losing coalition and the other party (the Democratic-Republican party) transformed from a losing into a winning coalition of the whole and then into a minimal winning coalition. Characterizing the historical turn of events in terms of the transformation of coalitions, Riker outlines how both parties reacted to and were shaped by these historical events throughout the process. Riker tells the reader that while the Federalist party at the beginning of the 1790s started as a winning coalition, it began to lose vis-à-vis the Democratic-Republican party as new states joined the confederation and as suffrage was broadened, thereby increasing the size of the electorate. Because the voting behavior of the new voters was significantly skewed towards the Democratic-Republican party, the latter could improve its position. This came at the cost of the Federalist party. By 1816, it was so diminished that the Democratic-Republican party had "almost" become a coalition of the whole (Riker 1962, 57). Yet, Riker continues, the Democratic-Republican soon dissolved into several blocking coalitions until – in 1820 – a minimal winning emerged. While Riker thus describes how the behavior of the actors was shaped by historical events, he suggests that, overall, the episode displays how the size principle operates.

To support this point, Riker constructed a narrative that spans a historical episode from the early 1790s until the middle of the 19th century. It exemplifies how Riker selects and assembles a bulk of information – political events, actors, their motivations, their relations, etc. – into a sequence of events that is linked conceptually through theoretical concepts like 'coalition of the whole,' 'losing,' 'winning' and 'blocking' coalitions into a narrative. Differing slightly in length and depth, Riker does this for all seven episodes.

In Morgan's (2007) terms, Riker, then, seems to use those narratives to make a first attempt to match his model with his envisaged political but still stylized target system. When narratives act as matching devices, they ideally match a type of situation characterized by the model with a concrete empirical situation and thereby enable a "smooth transition" between the two (Morgan 2007, 172). In Riker's case, the seven, highly schematic narratives enabled the match between the static model and the empirical situation to the extent that they defined the kind of situation to which the model was meant to be applicable: all seven narratives recount political processes of coalition expansion and contraction that are shaped by the strategic behavior of political actors whose preferences and strategies change.

According to Morgan (2007), the narrative sequences surrounding the model application can furthermore be used to explore the adequacy of such a match. If a match is inadequate, narratives can ground possible changes to the model so that the match between model and target becomes more plausible. As such, these seven very schematic narratives can furthermore be viewed as Riker's first exploration of the match between the model and its target. Without reconstructing the historical episodes in detail but using a set of stylized narratives instead, Riker aimed at showing how the size principle operated in actual political situations of coalition formation to confer an initial plausibility to the model, its axioms and its major prediction. At the same time, these narratives also highlighted the limitations of the model as developed up until now. As we discuss further below, the static model itself could not account for such processes of coalition formation where preferences and strategies change, which led Riker to its extension. Thus, just like Morgan (2007) has shown for the early adoption of the prisoner's dilemma game in economics, Riker uses the narrative to explore the plausibility of the match between model and target, initiating changes to the model as the matching had not been fully successful. Thereby, both dimensions of matching conferred an initial plausibility and thus some degree of justification to the size principle and the axioms Riker had been deriving it from.

4.2.Narratives in Model Extension

The static model and the associated size principle was one of Riker's major contributions in his *Theory*. It allowed him to demonstrate how a game theoretic model could be empirically useful for political science in that it predicts what kind of coalition will emerge in specific kinds of situations of strategic interaction that give rise to coalitions. However, while the size principle allowed for predictions of the emerging coalition, Riker could not yet causally explain specific outcomes in empirical situations. This was because the static model could not provide any hypotheses about causal processes, since it did not specify the coalition formation process itself. This limitation of the static model corresponded to Luce and Raiffa's (1957, 191-92) caution that von Neumann and Morgenstern's n-person game schemes could not be used to analyze social processes because their n-person theory was static. In the original model template, agents' preference patterns were assumed to be invariant over time and independent of an agent's experience unfolding throughout the game. Similarly, the strategy space was also assumed to be invariant. As such, dynamic processes of coalition formation could not be easily studied with such models (ibid.).

Riker responded to this difficulty by constructing what he referred to as a "dynamic model" (Riker 1962, 103) from which he derived what he called the 'strategic principle,' the "assertion that, in systems or bodies in which the size principle is operative, participants in the final stages of coalition formation should and do move toward a minimal winning coalition" (ibid.). To develop this model, Riker expanded on his 'static model' by stipulating a narrative that specified the process of coalition formation in the model. As before, Riker formally represented the model in characteristic function form but now also determined how the process of building winning coalitions proceeded in stages: "The first stage is that situation in which there are n single-member proto-coalitions. The second stage is that situation in which there is one two-member proto-coalition and (n-2) single-member proto-coalitions, that is, (n-1) proto-coalitions in total. The last stage, r, exists when there is a winning coalition or two blocking ones" (Riker 1962, 105). Riker also determined that members build proto-coalitions with the aim of eventually establishing winning coalitions in a leader-follower dynamic. As such, not all members have the same roles to play in the model. Essentially, leaders were those players in the game who offered so-called 'side-payments' to build 'proto-coalitions,' while followers rejected or accepted side-payments to join leaders' proto-coalitions.

When discussing the consequences of the nature of side-payments in politics, Riker specified this process further: "Typically, a prospective leader starts with a proposed decision (e.g., a bill in legislature). Typically, also, a number of like-minded members join him immediately in support of it and thereby become his followers […] But, unless the initial followers are a winning coalition, this payment is not enough to win the decision" (Riker 1962, 111-12). Riker also determined that every attempt to build a coalition will always invite opposition because leaders' means for side-payments are limited, which is why they cannot ask all members to become their followers (1962, 106). Following this dynamic, several proto-coalitions form and will increase or decrease in size in response to members resigning from or joining proto-coalitions (1962, 104). Joining or resigning from proto-coalitions are modeled as the 'moves' of the game, whereby each move changes the strategic situation of the agents and thereby initiates a new stage of the process. Formally, the process of coalition formation ends when a coalition has formed, i.e., when no further moves are possible because one proto-coalition's weight constitutes a majority.

This process specification that Riker labeled "an abstract statement of key points of a process we constantly observe" (Riker 1962, 107) amounts to a narrative in that it constitutes a representation of a connected sequence of events that Riker takes to be typical of those coalition formation processes where the size principle operates. While sequencing this process into distinct and consecutive stages alone would not yet necessarily yield a narrative, Riker causally connects those stages by specifying how the actions of 'leaders,' 'followers,' and 'proto-coalitions' lead to the formation of a winning coalition in a sequence of 'moves'. While Riker claims that these 'key points' are "intuitively fairly clear" (1962, 107), the whole process of coalition formation could neither be easily identified empirically, nor could it be extracted theoretically from von Neumann and Morgenstern's model template. Theoretically, only an extensive form game, but not a normal form or characteristic function form game, could capture the dynamic features of strategic interactions represented in games (1957, 163-64). Riker did not specify a game in extensive form. With a large number of agents in the game, it was not actually possible to do so; specifying all the moves, players, proto-coalitions, etc. for every outcome at each stage was infeasible. However, by using a narrative instead, Riker could introduce the processual dimension into the model that specified informally what could, in principle, only be specified formally by an extensive form game.

Modifying the static model to construct a dynamic model that would be able to account for coalition formation *processes*, Riker specified a narrative that created a "productive order" (Morgan 2017) amongst the model's various conceptual and theoretical elements. It specifies how to conceive of the process by causally connecting the theoretical and conceptual elements of 'leaders,' 'followers,' 'proto-coalitions,' and 'side-payments' and thereby organizing the empirically and theoretically undetermined process into a temporally ordered sequence in the model. Morgan (2007, 2012) has shown that in economics narratives often only become visible when economists use a model to apply it to a concrete case or answer specific questions with the model. In contrast, in Riker's case, the narrative elements are already present in the model itself, playing a crucial role in constructing the model because they posit what is, in contemporary terms, best described as a causal mechanism. As such, in expanding the model towards the 'dynamic' model by specifying the narrative, Riker could construct hypotheses about the causal processes underlying coalition formation that political scientists cared about. As such, it played an important role in paving the way for model-based causal explanations of why and how coalitions form in concrete political situations as discussed in the next section.

4.3. Narratives in Model Application

While the narrative in Riker's dynamic model is very abstract, the nature and significance of this narrative can be further appreciated by considering the third instance in which Riker resorts to narratives. Having built the 'dynamic' model, Riker was still one step away from effectively demonstrating that the model could enable causal explanations of coalition formation processes, which required showing how his model could be applied to a concrete political event (Riker 1962, ch. 7). To this end, he again relied on a narrative.

In chapter 7 of the *Theory*, Riker demonstrates by way of an exemplary analysis how the model and the theoretical results he derived – such as the size and strategic principles – could be applied to causally explain a specific political situation, i.e., a concrete target system. The political situation that Riker analyzes is the so-called "corrupt bargain of 1825" (Riker 1962, 149), referring to the American Presidential Elections of 1824/5 in which four candidates – Andrew Jackson, Henry Clay, John Quincy Adams, and William Crawford – competed for the presidency. Riker wanted to explain how in this election Jackson, who had won the popular vote, lost the election to Adams because of the apparent support of Clay. Criticizing traditional

explanations of the event that had focused too much on personal, ideological, or customary factors, he aimed to replace those explanations with a more general one (1962, 157-58).

The explanatory account that Riker offers has a clear narrative structure. Riker begins by outlining the relevant historical background, describing the institutional setup, and introducing the major historical actors of the event (1962, 150-1). Then, after having set the stage, Riker begins to recount the historical turn of events:

"After the returns were in (December 1824), the weights of the proto-coalitions were [$w(P_4) = 11$ (Jackson), $w(Q_4) = 7$ (Adams), $w(R_4) = 3$ (Crawford), $w(S_4) = 3$ (Clay)]. This is the situation in cell (2,7) of Table 2 in which Q_4, R_4, and S_4 are members of a uniquely preferred winning coalition and P_4 is strategically weak. The appropriate strategy for some of the members of P_4 is, therefore, to desert, especially if time is available for extensive bargaining prior to the decision. This is, of course, precisely what happened. Jackson's support dissolved away. [...] Jackson lost four, Adams gained two, and each of the two others gained one [...]" (Riker 1962, 151-52).

From this passage, we can see how in recounting the historical turn of events, Riker views the shares of votes in the Electoral College as the weights of the different proto-coalitions whose leaders are the Presidential candidates in the running. But importantly, by pointing to a cell in Table 2 (see Figure 1), in which, as Riker had previously suggested, proto-coalitions can find themselves throughout the process of coalition formation, the outcome of the Electoral College vote is now identified as a specific strategic situation.

TABLE 2 *Uniqueness of position of proto-coalitions in four-set partitions of I*

	$z \geq y \geq x \geq m > v;\ w' \geq m > v$							$z \geq y \geq m > x;\ w' \geq m > v$								
	$w' > x$				$w' = x$	$w' < x$	$y > w'$	$y = w'$	$y < w'$							
	$w' > z$	$w' = z$	$w' < z$							$z > w'$	$z = w'$	$z < w'$				
			$w' > y$	$w' = y$	$w' < y$											
Row 1 $w(P^4) > w(Q^4) > w(R^4) > w(S^4)$	$(P^4)\ S^4$	$P^4\ S^4$	$P^4\ S^4$	$P^4\ S^4$	$P^4\ (S^4)$	(S^4)	$Q^4\ R^4\ (S^4)$	$Q^4\ R^4\ (S^4)$		$P^4\ (R^4)$	$P^4\ R^4$	$(P^4)\ R^4$	$Q^4\ (R^4)$			
Row 2 $w(P^4) > w(Q^4) > w(R^4) = w(S^4)$	(P^4)	—	—			—	$Q^4\ R^4\ S^4$									
Row 3 $w(P^4) > w(Q^4) = w(R^4) > w(S^4)$	$(P^4)\ S^4$	P^4			$P^4\ (S^4)$	(S^4)	$Q^4\ R^4\ (S^4)$	$Q^4\ R^4\ (S^4)$				(P^4)	$Q^4\ R^4$			
Row 4 $w(P^4) > w(Q^4) = w(R^4) = w(S^4)$	(P^4)					—	$Q^4\ R^4\ S^4$									
Column Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Key: For symbols in cells, see Table 1.

$w(P^4 \cup S^4) = x$ $w(Q^4 \cup R^4 \cup S^4) = w'$
$w(P^4 \cup R^4) = y$ $w(P^4 \cup Q^4 \cup R^4) = q$
$w(P^4 \cup Q^4) = z$ $w(P^4 \cup Q^4 \cup S^4) = r$
$w(Q^4 \cup R^4) = v$ $w(P^4 \cup R^4 \cup S^4) = t'$
$m = $ minimal winning weight

		13	14	15	16
Row 5	$w(P^4) = w(Q^4) > w(R^4) > w(S^4)$	(R^4)			
Row 6	$w(P^4) = w(Q^4) > w(R^4) = w(S^4)$			—	$P^4\ Q^4$
Row 7	$w(P^4) = w(Q^4) = w(R^4) > w(S^4)$		—		
Row 8	$w(P^4) = w(Q^4) = w(R^4) = w(S^4)$				—

Figure 1: Riker's analysis of the dynamic model of a game with four proto-coalitions; source: William Riker (1962, 136) "The Theory of Political Coalitions," Yale University Press; Table 2.

As Riker had previously derived best strategies for this type of situation in his analysis of the dynamic model, he now tried to show that the actors in the actual political situation had behaved in line with the model's predictions. Votes now shifted in such a way that the weights of the proto-coalitions changed, yielding a new strategic political situation.[4]

In this new strategic situation, there were now two proto-coalitions that, according to the model's predictions, could potentially emerge as the winning coalition: either a coalition between Adams and Crawford or a coalition between Adams and Clay. Riker goes on to mention that "desperate bargaining" (Riker 1962, 153) shifted votes again. He explains that Clay was in a better bargaining position because of Crawford's fragile health, which prevented Crawford from being in Washington where the vote was to take place. Riker also indicated that Clay's extraordinary bargaining skills could have contributed to another, now decisive change in the distribution of votes (1962, 153):

"This is the situation of cell (1,4) where P⁴ and S⁴ are members of a uniquely preferred winning coalition […]. This left for Clay only one reasonable course of action" (Riker 1962, 153).

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[4] As Riker defined P as the largest proto-coalition in a game, Q as the second largest, R as the third largest and P as the fourth largest, it is now Adams who is proto-coalition P and Jackson is proto-coalition Q.

Once again votes shifted, producing another strategic situation (again identified by pointing to a cell of Table 2). But in this kind of situation, only "*one* reasonable course of action" (Riker 1962, 153; our emphasis) was left, which was the formation of a coalition between Clay and Adams (S_4 and P_4); and, in fact, Riker tells us that this is what happened. Clay supported Adams with his votes such that the two proto-coalitions could build a winning coalition. In return for supporting Adams, Clay was made secretary of state, yielding the "corrupt bargain of 1825" (1962, 149).

Applying the model to this concrete political situation, Riker could demonstrate how a particular instance of the kind of situation captured by the dynamic model could be causally explained with the help of his model. While Riker thereby drew extensively on the conceptual resources and theoretical predictions of his model, he relied on a narrative to smoothen this application. In the narrative, he ordered the process in question into a structured sequence of events, pinning down certain steps towards the formation of the coalition as crucial stages, and connecting those stages through the actions of the critical actors in this concrete case. Ordering the process in this way also allowed him to relate the conceptual terms and theoretical predictions with the political situation and the behavior of the historical actors: real historical actors with the conceptual terms of 'leaders,' 'followers,' and 'proto-coalitions'; real voting distributions with strategic situations as analyzed in the model; and real behavior with the rationally best strategies as predicted by the model.

Thus, Riker's demonstration of how the model could be applied to give explanations of coalition formation processes shows again how the narrative acts as a matching device. This time, however, Riker seems to succeed in matching the kind of situation represented in the model with the particular situation he wants to explain: the dynamic model as specified by him has more resources to study the coalition formation processes that Riker is interested in. Therefore, while the narratives of Section 4.1. explored the initial plausibility of the match and initiated an extension of the model, it is the narrative of this section that ultimately enables what Morgan describes as a "smooth transition" (Morgan 2007, 172) between the model and the particular political situation it sets out to explain.

4.4. Narratives in Model Testing

Not only did the narrative facilitate the application of the model by matching the model situation with the particular political situation, but by tracing the process that brought about the electoral outcome in a concrete political situation, the same narrative also constitutes a first attempt to test the model. To do so successfully, Riker had to show that the model's predictions about the hypothesized mechanism could be found to operate in a concrete case. Thus, Riker had to show how the model would be able to explain the concrete phenomenon. However, to do this, Riker had to narrow down the set of possible strategies to identify the one best strategy. The model by itself, however, did not yield unique predictions about best strategies. This was to be expected because, as Luce and Raiffa had pointed out, the characterization of a (normal form) game did not contain any additional information about possible sanctions or restrictions on coalition formation and, therefore, did not contain enough restrictions to narrow down the solutions to just one. This was problematic because in a real society – and in the real-world political situation that Riker was trying to explain – various restrictions, including its legal structure and a society's history, would shape the process by which coalitions form and how they change (Luce/Raiffa 1957, 164). Therefore, if n-person game schemes were to be used for the explanation and prediction of coalition formation, additional conceptual elements and empirical assumptions were required.

Riker had already introduced some additional sociological constraints into the dynamic model by specifying how coalition formation proceeds in a leader-follower dynamic. Furthermore, while the strategic considerations in his model analysis allowed Riker to restrict the set of coalitions that could ultimately form in the actual situation, Riker could not always narrow down the set of possible strategies to one optimal strategy with the model alone. Accordingly, he introduced further empirical details to pin down the causal process in this concrete political situation, the outcome of which he wanted to explain. This is especially apparent after the first stage of the narrative. According to the model, there are two possible minimal winning coalitions: both the proto-coalition Adams/Crawford and the proto-coalition Adams/Clay. Riker claimed that the Adams/Clay coalition was more likely to emerge because Crawford, having suffered from a stroke in the year prior to the election and therefore absent from Washington, could not maneuver equally well as Clay could. These concrete yet situation-contingent advantages, Riker implied, translated into a new strategic situation, where the Adams/Clay coalition was now the only minimal winning coalition. In this way, Riker was able to constrain the possible solutions of this game to just one: Riker's account ends with him

identifying which of the four candidates should and did emerge as President from the coalition formation processes in the Electoral College.

Thus, in this last step, the narrative allowed Riker to trace the process in a concrete empirical situation. Just like Crasnow suggests that narratives are critical when process tracing is used to provide evidence for causal mechanisms, Riker's use of narrative seems to perform a similar function. The narrative provides a coherent account of the process in a case study thus offering evidence for the (theoretical) hypothesis. As Crasnow has emphasized, the distinctive strength of narrative seems to lie in their capacity to draw together the different "diagnostic pieces of evidence" (Crasnow 2017, 9). For Riker, this meant that he had to combine the conceptual and theoretical resources of the model with contingent historical information by integrating the latter into the narrative of the concrete phenomenon. Only by this integration was Riker able to constrain the number of proto-coalitions such that he could ultimately identify one proto-coalition as the winning coalition and thereby causally explain the concrete situation. Thus, by using this narrative, Riker reconciled his intent to support his predictions empirically with the aforementioned difficulties of producing the evidence required to test his theory properly. Furthermore, empirically supporting the models' predictions further strengthened the plausibility of the models' axioms and thus of the heavily contested assumption of rationality (e.g., Riker/Ordeshook 1973). As such, narratives also played a crucial, though indirect, role in addressing the skepticism among political scientists to accept game theoretic models more generally.

5. The Reception of Riker's *Theory* Among Political Scientists

A comprehensive analysis of Riker's contribution to convince political scientists to adopt a naturalistic methodology and turn political science into the analytic and quantitative discipline that it is in part today goes beyond the scope of this paper (but see Damiani 2022). This would require, for example, a close examination of those specialist contributions identified by Herfeld and Doehne (2019) that adopted the size principle and other elements of the *Theory* and applied them in political science. However, there is no doubt that Riker as a translator played a crucial role in establishing game theory in political science and that his *Theory* was one of the most influential contributions in this regard (Maske/Durden 2003). With this seminal work, Riker not only established the game theoretic tradition as the dominant analytical framework to study

coalition formation in political science (Austen-Smith 2006, Strom/Nyblade 2007, 783), but also opened a fundamentally new methodological perspective on the study of politics.

Although his size principle – and minimal winning theories of coalition formation more generally – were later criticized extensively after empirical scrutiny (Austen-Smith 2006, Goodin/Tilly 2006, 107), Riker was among the first scholars conceiving of politicians as rational strategic actors (e.g., Beramendi 2007, 779). This distinguished him from the public choice tradition originating in Downs (1957), Black (1958), as well as Buchanan and Tullock (1962), who had proposed a scientific analysis of political behavior by using rational choice models before Riker. Riker rejected their basic assumption that political actions proceed from a simple calculation of costs and benefits. In his view, politics should be analyzed by a general science of human behavior and game theory offered the right modeling tools to do so (Maske/Durden 2003). Accordingly, there is no doubt that Riker's contributions were an important step to turn what has been called "empirical politics" into a science that proceeded deductively, draws on mathematical modeling to make predictions, and empirically tests its theories (e.g., Dryzek et al. 2006, 7).

Riker's mission was influential mainly on a theoretical level (Strom/Nyblade 2007). His self-conscious efforts to not only contrast his own approach with other game theoretic traditions in political science such as that of Robert Aumann, Lloyd Shapley, and Martin Shubik but also to consider only specific theoretical and conceptual elements contained in the *Theory of Games*, might have initially secured his impact. Apart from n-person, zero-sum games, he considered other game schemes as less useful for political science, mainly because those would not capture the types of situations typically found in political science. Yet, his focus on cooperative game theory would be questioned later. Political scientists quickly began to favor non-cooperative game theory to include contextual features in coalition formation processes and the possibility to model institutions (Goodin/Tilly 2006, 108, Strom/Nyblade 2007, 792).

Riker distinguished his approach also from other contemporary proposals by rejecting the usefulness of several solution concepts for political science (such as, e.g., the core, the v-solution, Aumann and Maschler's bargaining set, and the minimax theorem). Finally, while he granted that the Shapley value and the size principle were similarly the result of extending the general theory, Riker argued that they addressed different questions (Riker/Ordeshook 1973, 176f.). Working out this contrast to defend cooperative game theory, however, did not secure

him unconditional acceptance in political science. Ultimately, the biggest concerns with his approach became the difficulty of accommodating institutions, accepting the assumption of fixed sum payoffs to model the political world, and the plausibility of the assumptions of rationality and of complete and perfect information in politics (Strom/Nyblade 2007). Yet, while a new generation of game theoretic models for political science was developed, they did not diminish the profound contribution that Riker had made to enable such developments in the first place.

How the use of narratives affected the impact of Riker's contributions cannot be answered conclusively. Reviewing books, such as his *Liberalism and Populism* or *The Art of Political Manipulation*, we can only suspect that, although they were written for different audiences, the recounting of historical episodes in the form of narratives was one of Riker's methodological strategies to support a theoretical framework or approach. While the reviews following the *Theory*'s publication were largely positive and revealed a general interest and positive attitude towards game theory, none of the reviewers explicitly discussed Riker's use of narratives as a methodological strategy (see Brazil 1963, Fagen 1963, Flanigan 1965, Gamson 1964, Hotz 1963, Kaplan 1963, Matthews 1963, Robinson 1963). However, reviewers signaled that Riker's narratives contributed to making those abstract models and game theory more generally accessible for political scientists. Thus, given the lack of training in this new kind of mathematics, Riker's reference to what they called 'cases,' 'examples,' and 'historical evidence,'--i.e. narratives--certainly made a difference in the reception of Riker's efforts to translate the relevant template into an applicable set of models (Fagen 1963, Flanigan 1965, Kaplan 1963, Matthews 1963).

Political scientists continuously pointed out that these narratives gave empirical plausibility and evidential support to the theoretical status and analytical power of the size principle and its explanations (e.g., Flanigan 1965). Acknowledging the difficulty of gathering other forms of evidence for testing predictions about coalition formation, some reviewers even seemed to accept Riker's narratives as a preliminary form of evidence and as acceptable for providing some initial empirical support for the size principle (Robinson 1963, 767); Riker's neglect of what would have been more systematic evidence did not diminish their general enthusiasm. However, some reviews foreshadowed the major difficulties the size principle would face in the future: the given evidential basis would ultimately be too thin not only for supporting but also for potentially falsifying the size principle (Gamson 1964, 434).

Riker's use of narratives in testing his model predictions did not ultimately convince every political scientist. Yet, we have shown in this article that narratives initially played a crucial role in the construction, application, and testing of game theoretic models, which in turn substantially contributed to their transfer into political science.

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