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Multiple Streams Framework as Scientific Research Program and Tool for the Analysis of Public Policy Issues[1]

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Abstract

The Multiple Streams Framework (MSF) is currently one of the most widely used frameworks in policy process research. It explains how policy agenda develops in the policy process with emphasis on policy adoption. This article examines MSF from the perspective of the history of science and Lakatos' methodology of scientific research programs. In this respect, we consider MSF a "semi-strong theory" that uses a form of subsumption under theory for scientific explanation. This differs from a "strong" explanatory theory (e.g., physics), which uses explanations in the form of subsumptions under scientific law. From the point of view of Lakatos' methodology, MSF represents a scientific research program.

The basic element is a hard core given mainly by the MSF hypothesis for the framework as a whole and MSF assumptions and key structural elements. Around the hard core there is a protective belt of auxiliary hypotheses. They correspond to hypotheses related to the framework's key elements and to the hypothesis for the framework as a whole. MSF has negative heuristics (prohibition of the use of the modus tollens rule) and positive heuristics, which are represented by a set of theoretically and empirically progressive theories that further develop the MSF

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research program. An analysis of studies on MSF reveals that single hypotheses are only exceptionally tested using "hard" data and quantitative methods. Qualitative analysis (case studies) predominates, which contributes to the development of MSF theory. Therefore, we can consider a progressive shift in theory.

In this respect, MSF can be considered a successful research program. However, in terms of the methodology of scientific research programs, MSF has a number of other opportunities to develop hypothesis testing further and use various modelling methods with data sets. Thus, MSF represents an interesting scientific research program, which needs to be further developed and specified in the spirit of the methodology of scientific research programs. It is a challenge for interdisciplinary research in the field of social sciences.

Keywords:

Multiple Streams Framework; policy process; public policy; scientific research program

1. Introduction

Current crises, such as the covid-19 pandemic, show us that social reality is undergoing various changes. These changes affect all spheres of society, including the field of public policy (e.g., Potůček et al., 2017). Public policy theories respond to these dynamic reality changes by seeking procedures and methods that would help better to understand current public policy issues and contribute to their solution. It is thus the very complex nature of reality, the effective exploration of which requires both the search for new approaches and methods of scientific research and the innovative development of existing ones.

One such approach is the Multiple Streams Framework (MSF), one of the most widely used frameworks for policy process research at present (e.g., Jones et al., 2016; Weible & Sabatier, 2017). MSF fundaments are based on Kingdon's conceptualization of the idea of multiple streams (1984, 1995). Zahariadis (e.g., 2003, 2007, 2014) developed it into a full-fledged framework of the policy process. The origin and development of MSF are analyzed in several scientific publications and works that further develop the topic of MSF (see, e.g., Cairney & Jones, 2016; Jones et al., 2016; Herweg & Zahariadis, 2017; Herweg et al., 2017). MSF focuses on the public policy agenda, initially primarily on the agenda-setting and specifying alternatives (Kingdon, 1984, 1995, 2011) and later on decision making and implementation (Zahariadis, 2003, 2014; Herweg et al., 2017). The founders of MSF wanted to offer a tool to understand the policy process and explain the ongoing changes in the policy agenda because they are among the key issues of the theory and practice of public policy (e.g., Peters, 2015; Potůček et al., 2017). In this respect, MSF represents a dominant and innovative

framework for exploring agenda change opportunities in public policy (e.g., Weible & Sabatier, 2017).

MSF initially opens a number of methodological and epistemological questions that need to be answered when considering the progressive development and innovation of a particular policy process framework. However, we do not find a satisfactory answer to these issues in the current scholarly discussion of MSF (e.g., Jones et al., 2016; Herweg et al., 2017). Therefore, our approach does not focus on studying applications of multiple streams or individual concepts of MSF. It views MSF from another perspective, i. e. a scientific research program (Lakatos, 1978a). In our opinion, this represents both a complementary but different view from the dominant approaches (meta-reviews, e.g., Jones et al. 2016) and a more rational than empirical consideration of the issues.

We see the scientific contribution of our paper in the elaboration of methodological and epistemological bases of MSF as a scientific research program. The research concerning the examination of MSF from Lakatos' methodology of scientific research programs brings innovative results. MSF has the attributes of a scientific research program with significant research potential and practical application in public policy. The study brings new insights from the perspective of exploring MSF as a semi-strong theory using explanation in the form of subsumption under the theory to explain public policy issues. It is a challenge for further interdisciplinary research.

This study aims to examine the methodological and explanatory basis of MSF. We use Lakatos' methodology of scientific research programs to inquire the possibilities to innovate the MSF conceptualization. Thus, we would like to contribute to the development of public policy theory in the field of policy process research, more specifically in policy decision making analysis and the specification of alternatives.

With regard to the set objective, we ask ourselves two research questions (RQ).

RQ 1: What is the explanatory nature of MSF or, respectively, what is the explanatory potential of MSF?

RQ 2: How can Lakatos' methodology of scientific research programs be applied to MSF research on the policy process?

Following the direction of our research, our paper is divided into the following sections. In the first section, we formulate a theoretical and conceptual framework for the study of MSF. Based on the desk research method and analysis of studies dealing with MSF, we examine the genesis of the MSF idea and its development. The second section considers MSF research results and discussion. This section is divided into three parts. In the first part, we focus on finding the answer to the first research question. We are looking for arguments to justify what explanatory type of scientific theory MSF can be classified as. At the same time, we are looking for a rationale for the explanatory potential of MSF. In the second part, we present the characteristics of Lakatos' methodology of scientific research programs. It is followed by the third part, which examines MSF from the perspective of the methodology of scientific research

programs. We are seeking an answer to the question of the extent to which MSF can be considered a scientific research program corresponding to the attributes of Lakatos' methodology of scientific research programs. Also, in this case, the basic research methods are desk research and content analysis of Lakatos' legacy studies and analysis of studies dealing with the methodology of scientific research programs. The conclusion contains a synthesis of the results.

2. Theoretical and Conceptual Framework of MSF

Every scientific research program has its genesis. It can be gradually revealed based on the study of works that stand at the birth of a new scientific research program. In the case of MSF, we find this information especially in Herweg et al. (2017), which can currently be considered the main MSF reference source. The authors mention that "MSF was originally developed for the analysis of agenda setting processes" (Herweg et al. 2017, p. 18). They refer to Kindon's concentration on the agenda setting and specification of alternatives. They also discuss the possibilities of using MSF theory to examine "other stages of the policy process (decision making, implementation, etc.)" (ibid.). We will try to follow up on this discussion in our article.

In general, the emergence of MSF was conditioned by two types of factors (ontological and epistemological). The first is the existence of a dynamic social reality. The second is the need for social actors to find a way to respond to these changes in the policy process, including agenda setting and decision making. Today's complex modern societies are a dynamic system (Prigogine & Stengers, 1984). They are characterized by increasing variability, "fluidity", and turbulence – ambiguity in the MSF parlance. It is characteristic of dynamic systems that their future states cannot be reliably predicted. Accidental, unexpected events can also significantly affect the stability and behavior of such systems (e.g., the Covid-19 pandemic). These events can have a double impact on societal functioning. In the case of a positive impact, we say that new opportunities open up for society. In the case of negative impacts, we face the problem of how to deal with threats. In general, we say that society has to cope with new challenges.

Since the policy is a subsystem of the society, the mentioned characteristics are also valid for the policy. The policy process is therefore dynamic, volatile, and linked to risk and ambiguity in decision making. They contain the potential for opportunities and threats to society. One of the tasks of a policy is to be able to respond to these opportunities and threats with policy tools. This presupposes having the ability to understand the policy process based on adequate knowledge of the ongoing policy process. It also supposes the ability to "benefit" from opportunities and how to respond to risks.

MSF responses to this fact. MSF is a representation of "fluid" reality. The epistemic depiction of this "fluid reality" is three streams: the problem stream, the

policy stream and the political stream. The opportunity to interconnect them and the possible shift of a certain proposal in the agenda appears when the window of opportunity opens. In defining an opportunity (policy) window, MSF refers to Kingdon, who has already considered this window to be "an opportunity for advocates of proposals to push their pet solutions or to push attention to their special problems" (Kingdon, 2011, p. 165, cf. Herweg et al., 2017, p. 26). The key to connecting the streams in the opportunity window is active actors. They are entrepreneurs (particularly policy and political ones), who "must immediately seize the opportunity to initiate action" (Herweg et al., 2017, p. 28) in the open window. The role of these actors has been addressed in detail by MSF (see Kingdon, 1995 for the roots of MSF and Zahariadis, 2003 and Herweg et al., 2017 for MSF).

From the point of view of the methodology of science, opportunity windows are a set of possible states of the world (Kripke, 1980). For instance, the current MSF version takes over the conceptualization by Herweg et al. (2015). They usefully distinguish two windows, and consequently two coupling processes: agenda windows (with its associated agenda coupling) and decision windows with the related decision coupling. This dual differentiation enables viewing the content of possible states of the world as a "variety of the future" (competing framings of an issue under conditions of ambiguity). These frames or varieties of the future can take the form of challenges, scenarios, strategies, as shown in the following figure.

Figure 1:

Tangible varieties of the future: challenges, scenarios and strategies

Challenge Ch_i Derived from W_i	**Time T_i**	**Scenarios Sc Derived from Challenges (identified opportunities and threats)**		**Strategy S_i**
		Opportunities	Threats	
Ch_1	T_1	Scenarios		S_1
Ch_2	T_2	Scenarios		S_2
...	...	Scenarios		...
Ch_n	T_n	Scenarios		S_n

Source: Authors

These elements can be incorporated into a model developed by Herweg et al. (2017, p. 33). Methodologically, we can proceed as follows: In the first step, we identify possible states of the world Wi (This step can support the identification of problems within the problem stream). These states of the world can indeed occur at a specific (estimated) time Ti. From these states of the world Wi, in the next step, we identify the challenges Chi, and for each challenge Chi, we make specifications for the areas of opportunities Oi and the threats Thi. Then we create scenarios. We project the identified opportunities Oi and threats Thi into them. The final step is to set up strategies that show what steps and measures to take in meeting the challenges.

These are activities that can be used to support the decision-making process. In

this respect, we can take this as strengthening the MSF prediction possibilities. They are emphasized in the field of policy process research (Sabatier, 1999a, 2007; Sabatier & Weible, 2014; Weible & Sabatier, 2017), for which MSF has been criticized (Sabatier, 1999b). At the same time, we must not forget that it is necessary to consider the assumptions that determine the appropriateness of using a specific policy process framework (e.g., ambiguity, time constraints, organized anarchy given by problematic policy preferences, unclear technology, and fluid participation, within MSF).

3. Results of Research and Discussion

In this part of the article, we will look for answers to the above research questions. The first research question asks, what the explanatory nature of MSF is, or, what is the explanatory potential of MSF? In this sense, we ask what kind of theories the MSF research program is based on.

3.1 Explanatory Potential of MSF

Research programs can be built on explanatory theories of different strengths. According to their explanatory power, scientific theories and related scientific research programs can be divided into "strong theories", "semi-strong theories" and "weak theories" (or, respectively, explanatory strong, explanatory semi-strong and explanatory weak scientific research programs).

The criterion for distinction is the method of explanation. Explanation in the form of subsumption under the law (Hempel, 1958) is characteristic of "strong theories." In addition, we also distinguish explanation in the form of subsumption under theory (Ochrana, 2015). This is characteristic of "semi-strong theories" (or a semi-strong scientific research program). It should be noted that this classification does not automatically mean that a "strong" theory is a sign of "mature" science (or a mature scientific research program). In contrast, a semi-strong or weak theory signifies "immature" science (or an immature scientific research program). The classification into strong, semi-strong and weak theories (programs) refers to the use of the explanatory tool (especially the type of explanatory model and methods) that the theory employs.

Before we examine MSF and try to classify it according to its explanatory potential, it is necessary to point out the problem of scientific explanation. The problem of explanation is traditionally associated with the Hempel (or Hempel-Oppenheim) explanatory model. In the Hempel model, the premise of scientific explanation is the idea of "law" (scientific law). This model is classically developed for the conditions of natural sciences (physics). In his study The Theoretician's Dilemma, Hempel (1958) understands scientific explanation as a deductive inference, which takes the following form:

$C_1, C_2 \ldots C_k$	Explanans
$L_1, L_2 \ldots L_r$	
E	Explanandum

Hempel argues: "C_1, C_2 … C_k are statements of particular occurrences (e.g., of the position and momenta of certain celestial bodies at a specified time), L_1, … L_r are general laws (e.g., those of Newtonian mechanics), and E is a sentence stating whatever is being explained, predicted, or postdictioned. And the argument has its intended force only if its conclusion, E, follows deductively from the premises" (Hempel, 1958, pp. 37–38).

Hempel's model has two components, explanandum and explanans. Explanandum is a sentence that describes the phenomenon explained. An explanans is the class of sentences that are used to interpret a phenomenon. The structure of explanans consists of two subclasses of sentences. The first subclass of sentences $C_1, C_2 \ldots C_k$ includes statements defining the initial conditions. These statements show certain conditions that exist before the phenomenon; or, respectively, they accompany this phenomenon. The second group of sentences $L_1, L_2 \ldots L_r$ includes statements that represent universal laws. If the proposed explanation is correct, its components must meet the logical and empirical conditions of adequacy. The set of $C_1, C_2 \ldots C_k, L_1, L_2 \ldots L_r$, thus forms an explanans, by which we explain the occurrence of the phenomenon E. If this phenomenon E has not yet occurred, and we describe it as a future phenomenon, we speak of prediction. The scientific explanation takes various forms (Bunge, 2004; Little, 1991).

A significant form is this causal explanation: If E describes a single event, we can say that the initial circumstances described in $C_1, C_2 \ldots C_k$ together are the cause of the event in the sense that there are certain empirical regularities that express the laws of $L_1, L_2 \ldots L_r$. These general statements $L_1, L_2 \ldots L_r$ express, without exception, valid causal links between defined characteristics of events.

Explanation in the form of subsumption under the law is used by the natural sciences, especially by physics. This way of explanation has a strong explanatory potential. Based on the knowledge of conditions and knowledge of scientific laws, we can reliably explain the investigated phenomena (e.g., mechanical motions of bodies) by subsumption under the relevant law (e.g., laws of mechanics). We will classify scientific theories that explain problems in the form of subsumption under scientific laws as "strong theories." These include, in particular, the theories of natural sciences (mainly physics). Hempel was also a supporter of the idea of scientific law in society. He was convinced that also in society, the function of general laws in history is quite similar to their function in the natural sciences. Marx shared a similar view. The collapse of socialism based on the assumption of the existence of social laws refuted this view.

Social theories, as well as research programs of social sciences, use the tools of explanation and are classified as "semi-strong theories." Their explanation is mostly

based on the subsumption model under theory. In our opinion, the model of scientific explanation in the form of subsumption under theory may be expressed in the following form:

$C_1, C_2 \ldots C_k$	Explanans
$EP_1, EP_2 \ldots EP_r$	
E	Explanandum

Obviously, we were inspired by Hempel's model in his design. In the proposed model, $C_1, C_2 \ldots C_k$ are statements of particular occurrences. E is a sentence expressing what is to be explained. $EP_1, EP_2 \ldots EP_r$ form a set of theories that we choose to explain a problem.

The starting point of the explanation in the form of subsumption under the theory is to find a non-empty set of subsumption elements in the form of theories. In the original Hempel model, they were marked by the symbols $L_1, L_2 \ldots L_r$. If in the case of explanation in the form of subsumption under the scientific law, the role of $L_1, L_2 \ldots L_r$ was fulfilled by "scientific laws", then in the case of explanation in the form of subsumption under the scientific theory, the chosen scientific theory fulfils this role. The chosen theory acts as an explanatory paradigm of the studied phenomenon (Kuhn, 1970).

To simplify the interpretation, it is possible to imagine that the given paradigm appears in the explanatory model in the form of a certain statement or individual statements. This is a fairly realistic assumption since the essence of the explanatory theory can indeed be expressed in several statements. Also, in this case, it is a deductive inference, where the chosen theory takes over the role of the explanatory tool as an explanatory paradigm of the studied phenomenon. Scientific theories, like scientific laws, are "universal statements" (Popper, 2002, p. 37). Unlike "scientific laws", they externally act as large-scale logical systems. Their basic function is to explain the studied phenomena and predict events. "Theories are nets to catch what we call 'the world': rationalize, to explain, and master it" (Popper, 2002, pp. 37–38).

An example of the functionality of explanation in the form of subsumption under theory can be shown in a well-known case from the history of natural science. Urban Hjaerne discovered in the 1790s that the level of the Baltic Sea was falling. There were two possible explanations: either the earth was rising in absolute terms, or the water was falling. It was not until later that Louis Agassiz gave a scientific explanation with his glacial theory (see Lehmann & Javidpour, 2010). The explanation was made in the form of subsumption under theory. We can see that the explanation in the form of subsumption under theory differs from the form of subsumption under scientific law. Explanation in the form of subsumption under theory is characteristic of semi-strong theories and semi-strong research programs.

MSF is also included in the set of semi-strong programs. The issues discussed within MSF are the subject of lively scientific debate. For example, in the Web of

Science database, when entering the keyword "multiple stream framework", we find 3,107 records. When entering the keywords "multiple stream framework" and "policy process", we find 186 entries. Our analysis of studies shows that the idea of MSF drew its ideational resources in the field of management theory, computer science, etc. This inspiration in the theory of management and organization is indicated by Kingdon's (1984) original strong inspiration by the garbage can model of Cohen et al. (1972). This is also taken over by the MSF founders (e.g., Zahariadis, 2003; Herweg et al., 2017).

To examine the methodological basis of MSF, it is important to note that MSF is, in most cases, demonstrated in case studies and uses qualitative analysis (see also Jones et al. 2016). It does not mean that it is not able to use quantitative concept (see Engler & Herweg, 2019; Herweg et al., 2017). The fact that MSF prioritizes case studies and qualitative analysis does not necessarily mean that MSF is an "inferior" theory compared to scientific theories (or econometric models). A case study is a recognized tool for scientific cognition (see Yin, 2009). In addition, it is suitable to recall that the quantitative analysis and use of econometric models have their significant limitations.

Quantitative models provide only a partial view because we abstract from the influence of other factors. The formal model is always an epistemological simplification of the investigated reality, formally expressed in the equation of models by a random error. This includes all influences that were not explicitly included in the model. The random error also encompasses other variables that we have neglected or for which we do not have data. The random error also entails unique effects, measurement errors, etc., that we did not consider. Thus, the quantitative model is always a partial view of the researched problem. In the research results, this partiality is reflected in the fact that the model explains only a certain percentage of the studied phenomena.

This means that the explanatory power of such models is not absolute, as it is based on incomplete induction. Incomplete induction is such induction where we draw conclusions on the basis of generalization from incomplete observation. The problem with induction is that science is a theoretical system that gives evidence of the researched problem in the form of general (universal) statements. The induction method does not provide such certainty when induction is incomplete (Popper, 2002). Therefore, the use of regression analysis in MSF has its limits (Thiem et al., 2016). We, therefore, fully agree with the statement of Herweg et al. (2017, p. 42) that the regression analysis "should not be treated as substitutes but as complements."

Although we find it useful to generate hypotheses within MSF and test them in Medium-to-Large-N Studies, we also consider quantitative analysis within MSF to be a complementary tool to provide an "additional explanation" of the issues examined. The mentioned explanation can provide this additional explanation in the form of subsumption under theory as well as a case study. The case study method is based on the examination of an individual case (or several cases). This does not diminish the explanatory power of MSF. The individual case studies, applied on the MSF basis, can

be taken as individual records that meet the conditions of Popper's logic of scientific discovery (Popper, 2002). The statements resulting from the case study may be "tested by experience." These considerations suggest that not the verifiability, but the falsifiability of a system is to be taken as "a criterion of demarcation" (Popper, 2002, p. 18). Case studies thus contribute to the MSF development.

3.2 Characteristics of Lakatos' Methodology of Scientific Research Programs as a Basis for MSF Research

In the following parts of this study, we will try to find a way to answer the question of whether Lakatos' methodology of scientific research programs can be applied within MSF. Based on desk research, we carried out our research in several steps. In the first step, we explored Lakatos' legacy and scientific discussion on scientific research programs. In the second step (detailed in the following paragraph), we briefly introduced Lakatos' methodology of scientific research programs. Then we explored MSF in the mirror of the methodology of scientific research programs. In the perspective of the policy process research, we follow Sabatier and Weible's concept of policy process frameworks (Weible & Sabatier, 2017).

We examined Lakatos' work on the methodology of scientific research programs (Lakatos, 1976, 1978a, 1978b) and the scientific discussion on it. We found a total of 146 records in journals registered in the Web of Science database using the keywords "Lakatos" and "research programs." If we aim at the field of society and social sciences, we find that these scientific articles usually address interdisciplinary problems. Their topics extend to other scientific disciplines, such as computing social science (Cioffi-Revilla, 2009), informatics (Chang & Chiu, 2008), cognitive science (Erdin, 2020), technical science (Silva, 2009), and management (Gold, 2014).

The analysis of the discussion shows that using the methodology of scientific research programs in the study of societal issues has its difficulties and vicissitudes (Walker, 2010). Therefore, we encounter both a critical view of the use of Lakatos' methodology of research programs and authors who creatively follow Lakatos' legacy (Elman & Elman, 2002). In our study, we set out on this second path.

It is worth noting that when searching for publications on the Web of Science according to the keywords "Lakatos, research programs, Multiple Streams Framework", there was zero response. The view of MSF issues in terms of the concept of research programs is therefore still unresolved.[5] Therefore, in our paper we will try to build on the first research stream, which is inspired by Lakatos' idea of research programs. We also try to look at MSF from the perspective of Lakatos' methodology (paradigm) of scientific research programs (see Lakatos, 1970, 1976, 1978a, 1978b;

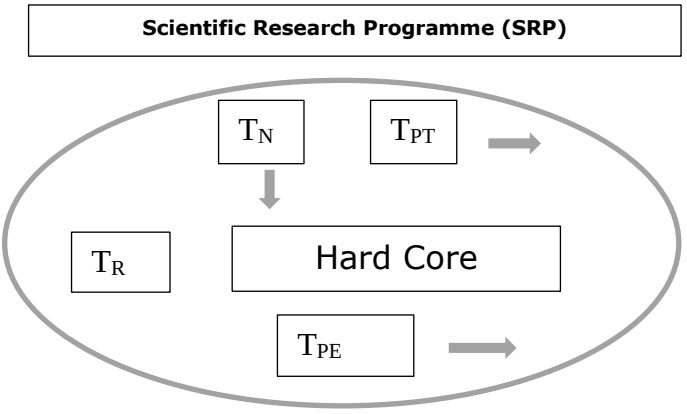
5 The analysis of studies dealing with the methodology of scientific research programs is performed in an article by Ochrana and Novotný (2021). These studies are registered in the Web of Science database. No study deals with the application of Lakatos' methodology to MSF research programs.

Lakatos & Musgrave, 1970).

First, we briefly introduce Lakatos' concept of the scientific research program. Lakatos calls his methodology of scientific research programs a new demarcation methodology. It expresses that, unlike other methodologies (neopositivism, Popper, Kuhn), the evaluation unit is not an isolated hypothesis or conjunction of hypotheses but the fact that a scientific research program consists of successively developing theories. The basic elements, subsystems and procedures of the scientific research program are as follows: hard core, auxiliary belt, positive heuristics (rules of research program development), negative heuristics (hard core protection, prohibition of using the rule of modus tollens in relation to hard core), problem shift in the form of theoretically progressive theories, empirically progressive theories, regressive (degenerated) theories, scientific revolution (it consists in refuting the main theory and replacing it with an undisputed competitor). Graphically, their relationship may be expressed as follows:

Figure 2:

MST as a scientific research program



Legend:
T_{PT}: set of theoretically progressive theories
T_{PE}: set of progressive empirical theories
T_N: set of hard core protection rules
T_R: set of regressive (degenerated) theories

Source: Diagram made by authors, based on Lakatos (1978a, 1978b).

A key element of the scientific research program is the hard core. The hard core remains intact.6 The hard core is represented by such theoretical research assumptions

6 Lakatos clarifies the term "hard core" with the example of Newton's research program. From the point of view of our previous analysis, we should not overlook that Newton's research program meets the conditions of "strong theory" (mechanical physics). In Newton's research program, the hard core are the three laws of motion and the law of gravitation. The program has a heuristic that contains a set of troubleshooting techniques. In Newton's scientific program, these are differential calculus, convergence theory, differential and integral equations. Finally, the research program has a wide range of auxiliary hypotheses, based on which it determines the initial

that are "solid." They cannot be omitted or changed. If this happened, it would mean that the scientist was leaving his current scientific research program. The hard core must be protected by a protective belt, which consists of the rules of hard-core protection and progressive theories "oscillating" around the hard core.7 These theories (auxiliary hypotheses) are used to explain phenomena that could threaten the strength of the hard core. Auxiliary hypotheses (as opposed to the hard core) are unnecessary (dispensable) research program entities. They can be changed, modified, or even abandoned if the hard core needs to be protected as a result of empirical discoveries. These theories are progressive if they increase the explanatory and predictive potential of the research program. They are admissible until it is possible to replace the given scientific research program with another (better) scientific research program. Until this change, we are talking about a progressive scientific research program. The degenerative research program signals the need to find a new system of progressive theories that will replace the system of currently prevailing (degenerative) theories. However, this transition can only take place if this transition is "agreed" before the end of the research program. Otherwise, the explanatory function of science would be weakened.[8]

The scientific research program consists of methodological rules: "Some tell us what paths of research to avoid (negative heuristic), and others what paths to pursue (positive heuristic)" (Lakatos, 1978a, p. 47). The negative heuristic of a scientific research program forbids the use of modus tollens in relation to the hard core. Instead, we must use our ingenuity to express the "auxiliary hypotheses" that form the protective belt around the hard core. Negative heuristics specify the hard core, which is "irrefutable" by the methodological decision of its protagonists. Therefore, we must not use modus tollens on the hard core. The hard core is protected by a protective belt, where (on the contrary) we can focus the modus tollens.[9] In contrast, positive heuristics stem from the creative nature of scientific research. Positive heuristics consist in part of suggestions (or instructions) on how to change, develop "disprovable variants" of the research program, and how to change the protective belt. Positive heuristics, therefore, point to other directions of research within a given scientific research program.[10]

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conditions.

7 In Newton's program, the protective belt includes geometric optics, the theory of atmospheric refraction, etc. If anomalies occur, these are not (unlike Kuhn, 1962) considered a refutation of the hard core, but they are some hypotheses in the protective belt. Partly under empirical pressure (but partly planned in accordance with its heuristics) the protective belt is still modified and extended.

8 An example of a scientific research program that was progressive at the time (and gradually replaced) was Newton's program with three laws of motion that formed a hard core.

9 Modus tollens is a procedure in propositional logic in which we deny the consequences of reasoning. The form is as follows: If A implies B and at the same time B is not true, A is not true.

10 Positive heuristics protect scientists from being confused by the number of anomalies. Lakatos brings this problem closer to Newton's physics again. It shows that the positive heuristics of a research program can be formulated as a "metaphysical" principle. Positive heuristics are thus

Falsification has an original role in the scientific research program. Lakatos' conception of falsification (so-called methodological falsificationism) differs significantly from Popper (so-called naive falsificationism). Lakatos' new view of the problem of falsification is that, unlike Popper, the possibility of falsifying the isolated theory has ceased to be considered:

> *"Sophisticated falsificationism differs from naive falsificationism both in its rules of acceptance (or 'demarcation criterion') and its rules of falsification or elimination. For the naive falsificationist any theory which can be interpreted as experimentally falsifiable, is 'acceptable' or 'scientific'. For the sophisticated falsificationist a theory is 'acceptable' or 'scientific' only if it has corrob orated excess empirical content over its predecessor (or rival), that is, only if it leads to the discovery of novel facts.*
>
> *This condition can be analyzed into two clauses: that the new theory has excess empirical content ("acceptability"1) and that some of this excess content is verified ("acceptability"2). The first clause can be checked instantly by a priori logical analysis; the second can be checked only empirically and this may take an indefinite time" (Lakatos, 1978a, pp. 31–32).*

This is also of methodological importance for examining those possible scientific contributions that are opposed to MSF. The crucial thing, then, is that the possibility of falsifying the isolated theory is no longer considered: "Contrary to naive falsificationism, no experiment, experimental report, observation statement or well-corroborated low-level falsifying hypothesis alone can lead to falsification. There is no falsification before the emergence of a better theory" (Lakatos, 1970, p. 119).

These findings are important to our efforts to introduce MSF as a scientific research program. It is also important to mention the conclusions from the book *Proofs and Refutations* (Lakatos, 1976), which contains a fundamental study of Euler's theorem on polyhedra.[11]

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more flexible than negative heuristics. It may be, Lakatos said, that if the research program enters a degenerating phase, a creative shift in positive heuristics can push it forward. Thus, it can be said that positive heuristics "pave the way forward" and almost completely ignore "refutation." Verification of the $(n+1)^{th}$ version of the program is a refutation of the n^{th} version. These are verifications that keep the program running regardless of defiant cases. We can evaluate scientific research programs according to their heuristic power, according to how many new facts they have brought, what their ability to explain their refutation during their growth was.

11 A Polyhedron is a closed solid shape which has faces and straight edges. Euler's formula is written $F + V = E + 2$. If you count the number V of vertices (corners), the number E of edges, and the number F of faces, you will find that $V - E + F = 2$. (See Lakatos, 1976, pp. 66–68). As the opponent of our article noted, "Lakatos comes to the fundamental conclusion that a scientific research program, even experiencing a long regressive shift, can exist forever, coming up with new and new explanations of facts that contradict the core, successfully doing this with the help of negative heuristics. Thus, the history of the proofs of Euler's theorem on polyhedra cannot be completed in principle." It is worth recalling that the publication "Proofs and Refutations" was

It is useful to note that Lakatos demonstrates this conclusion in the case of a mathematical research program. Mathematics is an axiomatic-deductive science. How can Lakatos' idea on polyhedra be inspiring for MSF? If MSF is built and developed as a normatively oriented axiomatic-deductive scientific research program (Ochrana, 2015), the conclusions resulting from Euler's theorem on polyhedra may apply to it. However, MSF can also be built as an inductive (or combined program), which is characteristic of the social sciences. In this case, MSF can be seen as a scientific research program, which is characterized by the conclusions that Lakatos came to later, such as *History of Science and Its Rational Reconstructions* (Lakatos, 1970). MSF might then be understood as a scientific research program that can be "postponed" as a regression program and replaced by a (new) progressive program due to the growth of scientific knowledge and competition.

3.3. MSF in the Mirror of the Methodology of Scientific Research Programs

In this part of the study, we will examine MSF from the lens of Lakatos' methodology of scientific research programs.12 The bases for this analysis are shown in Figure 3.

Figure 3:

Bases of application of Lakatos' methodology of scientific research programs for MSF research

Element (entity) of the scientific research program according to Lakatos	Description of the element in Lakatos' methodology of research programs and its application to MSF
Hard core	According to Lakatos, the hard core has a nomological basis (see Newton's program and his mechanical laws). MSF has a non-monologous hard core. It is a semi-strong theory presented by the basic MSF assumptions (ambiguity, time constraints, organized anarchy,

the first Lakatos article to be published in *The British Journal for the Philosophy of Science*, 14, 1963–1964 (Lakatos, 1976). Lakatos planned to return to the question of the philosophy of mathematics and apply the methodology of the scientific research program to it. Death prevented him from realizing this intention. In later publications, Lakatos already talks about the scientific revolution. This is the result of competition from scientific research programs when the regressive research program is "pushed out" and replaced by a new (progressive) program: "According to my methodology, the greatest scientific achievements are research programs which can be evaluated in terms of progressive and degenerating problem shifts; and scientific revolutions consist of one research programme superseding (overtaking in progress) another. This methodology offers a new rational reconstruction of science. It is best presented by contrasting it with falsificationism and conventionalism, from both of which it borrows essential elements" (Lakatos, 1970, p. 99).

12 At the same time, we are aware that every first attempt has "children's imperfections." Our study is no exception.

	stream independence), basic features of essential structural elements (problem stream, politics stream, policy stream, window of opportunity, (policy) entrepreneurs), and the core hypothesis on agenda development (see below).
Negative heuristics	Hard core protection against falsification. Prohibition to use the rule of modus tolens. It also relates to MSF, where it is given by conditions under which MSF is applicable (given by MSF assumptions (see above) and their discussions (limitations, e.g., in Herweg et al., 2017, pp. 39–43)).
Protective belt	MSF hypotheses concerning the framework's key elements (see Figure 4) and decision-making stage (see Figure 5).
Positive heuristics	These are the rules according to which the scientific research program is developed and improved. This characteristic also applies to MSF, where it is presented in acknowledged applications (e.g., Herweg et al., 2017, pp. 35–39) and further research prospects (e.g., Herweg et al., 2017, pp. 43–46)
Anomalies	Anomalies must lead to changes only in the protective belt of auxiliary, observational hypotheses, and initial conditions (Lakatos, 1970). We register anomalies, or simple falsifications, but there is no need to respond to them. In general, this also applies to MSF, noting that in the case of MSF, protective belt theories may not only be explanatory in nature, but may also be narrative in nature. Lakatos applies his research only to explanation.
Change of research program	It happens in its protective belt. The core is irrefutable by the decision of the protagonists. It also applies to MSF.
Development of research program	It takes place within a series of alternating protective belt theories. The protective belt protects the hard core from falsification. In accordance with the rules of positive heuristics, scientists are constantly improving theories through the introduction of auxiliary hypotheses, modifications of protective belt theories. We apply the modus tollens rule to protective belt theories. It also applies in principle to MSF (see Zahariadis, 1999, 2003, 2007, 2014; Herweg et al., 2017). Protective belt theories are either explanatory (semi-strong) or interpretive (narrative).
Change and alternation of scientific research programs	Changes occur according to the evaluation rules of progressiveness, resp. regressiveness of theories. The source is a hidden clash between competing research programs. It also applies to MSF as a research program that is subject to conflict between competing research programs (e.g., Weible & Sabatier, 2017).
Scientific revolution	The result of competition in scientific research programs may be the "displacement" of one research program (which has a regressive character) and its replacement by a progressive program. Lakatos calls this qualitative change the "scientific revolution." These conclusions also apply to MSF. MSF as a research program is also subject to competition and may be replaced (as a regressive program) by a new (progressive) program (e.g., Weible & Sabatier, 2017).

Source: Authors, based on Lakatos (1970, 1976, 1978a, 1978b; Lakatos & Musgrave, 1970)

Observing the MSF development, the framework is not represented by isolated hypotheses or conjunctions of hypotheses, but it creates a scientific research program, the output of which is a sequentially evolving theory of MSF (Zahariadis, 1999, 2003, 2007, 2014; Herweg et al., 2017). Thus, one of the key conditions of the methodology of scientific research programs is fulfilled. In this respect, our analysis of MSF studies implies that current theoretical MSF leaders present MSF as a policy process framework. At the same time, none of the protagonists explicitly conceive of MSF as a

research program. In MSF studies, it is also possible to notice how loosely, i. e. ambiguously in terms of denotation (see Ochrana, 2012), the particular terms denoting MSF problems are used.

From the scientific research program perspective, the question is, what is the hard core of MSF? We conceive of the MSF hard core as being composed by both the basic assumptions of MSF in the form of ambiguity, time constraints, organized anarchy given by problematic policy preferences, unclear technology, and fluid participation, stream independence, on the one hand, and structural elements (problem stream, politics stream, policy stream, window of opportunity, (policy) entrepreneurs) and their basic features, on the other hand (Herweg et al., 2017, pp. 19–20). We consider the hypothesis for the framework as a whole to be the basis of the MSF hard core, namely "Agenda change becomes more likely if (a) a policy window opens, (b) the streams are ready for coupling, and (c) a policy entrepreneur promotes the agenda change." (Herweg et al., 2017, p. 31). In our opinion, this core hypothesis does not only apply to agenda setting, but to the change of agenda between the particular policy process stages.

This statement in the form of a hypothesis may seem surprising at first glance. But it does not contradict the contemporary conception of science. Contemporary science has the nature of a hypothesis (Popper, 2002) and a non-Cartesian epistemology (Bachelard, 1978). Popper characterizes this "state" in contemporary science with the words: "Science is not a system of certain, or well-established, statements; nor is it a system which steadily advances towards a state finality. Our science is not knowledge (epistémé): it can never claim to have attained truth, or even a substitute for it, such as probability … We do not know; we can only guess" (Popper, 2002, p. 278) and adds: "Every scientific statement must remain tentative for ever" (Popper, 2002, p. 280).

Examining the MSF research program and its case studies leads us to the conclusion that this characteristic fully applies to MSF. Comparing Newton's research program and the MSF program, we can conclude that Newton's research program is based on four laws (three laws of motion and the law of gravitation). This is due to the fact that Newtonian physics is a "strong" theory and a strong research program based on explanations in the form of subsumption under scientific law. From this perspective, we can consider MSF to be a semi-strong program. This program explains problems in the form of subsumption under theory. Within it, the key is the "hypothesis for the framework as a whole" based on basic assumptions and structural elements.

Compared to Newton's program, the hard core in MSF therefore is not "scientific laws" or the corresponding explanatory procedures of subsumption under scientific law. It is the key theory (hypothesis for the framework as a whole) that we use as a tool to explain the policy process involving agenda setting and decision making. Thus, the hard core of MSF does not constitute laws through which we make explanations. MSF

as a research program differs from Lakatos' characteristics of Newton's program, where the hard core is formed by the laws of motion, and explanations take the form of subsumption under scientific law (Hempel, 1958).

In the MSF case, the explanation takes the form of subsumption under the theory, which was laid by Kingdon and developed by other authors (see, e.g., Zahariadis, 1999, 2003, 2007, 2014; Herweg et al., 2017). This is not unusual for the social sciences. In the field of social science research, explanation in the form of subsumption under theory is usually used (Ochrana, 2015). Currently, only a minority of social scientists hold Hempel's view (Hempel, 1942) that similar general laws exist in history and nature and that it would be possible to successfully build research programs based on "social physics" in social research, as members of the Vienna Circle suggested (Wiener Kreis – e.g., Neurath, 1931–1932).

The MSF hard core is consequently delimited by negative heuristics, which forbid focusing the modus tollens rule on the MSF "hard core." It means that the hard core part has to be taken for granted and, thus, not changed. MSF negative heuristic also delimits conditions under which MSF is applicable. They are featured by MSF assumptions such as ambiguity, time constraints, political manipulation, streams independence, organized anarchy given by problematic policy preferences, unclear technology, and fluid participation, and their discussions (limitations, e.g., in Herweg et al. 2017, pp. 39–43).

In this context, Lakatos notes: "Instead, we must use our ingenuity to articulate or even invent auxiliary hypotheses, which form a protective belt around this core, and we must redirect the modus tollens to these. This protective belt of auxiliary hypotheses has to bear the brunt of tests and get adjusted and re-adjusted, or even completely replaced, to defend the thus-hardened core. A research programme is successful if all this leads to a progressive problemshift; unsuccessful if it leads to a degenerating problemshift" (Lakatos, 1978a, p. 50).

The MSF research program has a protective belt[13] formed by a wide range of auxiliary hypotheses, such as hypotheses concerning the determining features of the structural elements problem stream, political stream, policy stream, window of opportunity, entrepreneurs, and policy adoption. These hypotheses should be determined by the initial conditions for MSF given by the MSF hard core. In the current version, Herweg et al. (2017) tried to formulate two sets of auxiliary hypotheses concerning the framework's key elements (see Figure 4) and decision making (see Figure 5).

13 In the case of Newton's program, the protective belt included geometric optics, the theory of atmospheric refraction, etc. In the case of MSF, this protective belt consists of "theories" and conclusions drawn from research supported by the verification of auxiliary hypotheses. When studying case studies, we also discover anomalies. However, these are not anomalies in the sense of Kuhn (1970). In agreement with Lakatos, we do not consider them to refute the hard core, but rather to modify and develop the MSF theory.

Figure 4:

MSF Hypotheses for the Framework's Key Elements

Problem stream	A problem broker is likely to be more successful framing a condition as a problem the more an indicator changes to the negative, the more harmful a focusing event is, and the more definitely a government program does not work as expected.
Political stream	Policy proposals that fit the general ideology of a government or the majority in a legislature have a better chance of gaining agenda status.
Policy stream	• If a policy proposal does not fulfil the selection criteria, the likelihood of gaining agenda status, and thus being coupled, decreases significantly. • As the integration of policy communities decreases, it becomes more likely that entirely new ideas can become viable policy alternatives.
Policy window	• The policy window opens in the problem stream as a result of at least one of the following changes: change of indicators, focusing events, or feedback. • The more a condition puts a policymaker's re-election at risk, the more likely it is to open a policy window in the problem stream. • The policy window opens in the political stream as a result of at least one of the following changes: changes in legislature, election of a new government, interest group campaigns, or a change in the national mood.
Policy entrepreneur	Policy entrepreneurs are more likely to couple the streams successfully during an open policy window if (a) they have more access to core policymakers and (b) they are more persistent.

Source: Herweg et al., 2017, p. 30.

Figure 5:

MSF Hypotheses on Decision Making

Policy adoption	• Policy adoption is more likely if the proposal is put forward by political entrepreneurs who hold an elected leadership position in government. • Policy adoption is more likely if the proposal is put forward by a government or majority party that is not constrained by other veto actors. • Policy adoption is more likely if different viable alternatives embraced by different actors can be combined in one package. • Policy adoption is more likely if the problem that the policy is supposed to solve is salient among the voters.
Size of change to the original proposal during decision making	• The policy adopted will likely differ significantly from the original proposal if actors other than the government have veto power (e.g., second chambers). • The more powerful the interest groups' campaign against the original proposal, the more different the adopted policy is likely to be.

Source: Herweg et al., 2017, p. 33.

The protective belt is partly under empirical pressure, and at the same time, it is

constantly modified and expanded in accordance with its positive heuristic. An example within MSF is Kingdon's multiple streams idea (1995) in comparison with the extension of the element of decision making (Zahariadis, 2003) and the current reconceptualization of the policy process (Herweg et al., 2017).

MSF as a research program has, in addition to negative heuristics, also its positive heuristic. Positive heuristic, telling us which paths of research to pursue, is related to a protective belt of auxiliary hypotheses. In the MSF case, we can find a positive heuristic in acknowledged applications (e.g., Herweg et al., 2017, pp. 35–39) as well as in the outline of prospects of further research (e.g., Herweg et al., 2017, pp. 43–46). The MSF program thus has certain methodological rules and procedures that indicate which direction research should take (positive heuristics) and which research directions to avoid. Positive heuristics define the problems that allow scientists to engage in constructive research. The result of this constructive research is a positive shift in the problem.

It was performed in particular by Zahariadis (e.g., 2003, 2007, 2014), who developed the problem of MSF into a full-fledged framework of the public policy-making process. The works of Herweg et al. (2017), Herweg et al. (2015,) made another step forward. These works aspire to a set of theoretically progressive theories. Some deal with empirical contexts (e.g., Cairney & Jones, 2016; Jones et al., 2016). Others take the form of case studies, such as Meijerink (2006) Ackrill et al. (2013), Carter and Jacob (2014), Copeland and Scott (2014), Ridde (2009). These works belong to the set of empirically progressive theories and, at the same time, are among the most cited works on MSF.

MSF positive heuristic also contains a set of troubleshooting techniques. These are mainly qualitative methods and case studies as explanatory tools. Rather exceptionally, regression analysis, QCA, and modelling with data sets are used (cf. Jones et al., 2016; Cairney & Jones, 2016; Herweg et al., 2017). This finding is consistent with the nature of MSF as a "semi-strong" program.

In the studies examined, we did not take note of any obvious anomalies in the discussion. This is probably also due to the fact that most of the papers are in the form of a case study, where the authors do not work with robust models that could be empirically tested. There are few empirical quantitative studies. Weible (2008) is the most cited.

Our analysis of MSF studies registered in the Web of Science database suggests that MSF is a successful research program. We have recorded a positive shift in the development of MSF since the first conceptualizations and reconceptualizations (Zahariadis, 1999, 2003, 2007 and 2014), and the latest version from 2017 aspires to it (Herweg et al. 2017). Publications dedicated to MSF also show that this research program continues to have positive research potential. Therefore, MSF can be considered a successful research program. This program would be unsuccessful if there was a degenerative shift in the problem.

The problem-shift in the MSF program can be interpreted from the perspective of Lakatos idea of a progressive and degenerative shift of the problem (see Lakatos, 1978. pp. 33-34). We believe that the MSF program fits this research logic. There is a problem stream or political stream at the input of the model. It is followed by individual streams, while the final output is a successful proposal for change. The key to this change is displayed in the model as "the size of the change to the original proposal during decision making." This magnitude of the change in the original design that occurs during decision making can be examined from the perspective of the criteria of Lakatos' methodology for scientific research programs. It is a change that we can evaluate as a change that is either progressive or degenerative. Lakatos' words apply to it: "This demarcation between progressive and degenerating problem shifts sheds new light on the appraisal of scientific – or, rather, progressive – explanations" (Lakatos, 1978a, p. 34).

The initial premise of a positive change is the ideological anticipation of this change. The anticipation of this change is related to a new theoretical reflection, as given by the MSF program in solving a certain policy problem. A new theoretical reflection can take the form of a new hypothesis. If such a hypothesis gives "some excess content over its predecessor", such a change can be considered a progressive shift of the problem. This demarcation between a progressive and a degenerative shift in the problem sheds new light on the assessment of scientific (progressive) explanations (Lakatos, 1978a, p. 34). The new explanation (new hypothesis) brings new information for scientific explanation. The content of the protection belt of the original theory can then be re-evaluated from the point of view of new facts.

We call this process "a progressive problem shift if it is both theoretically and empirically progressive, and degenerating if it is not" (Lakatos, 1978a, p. 34). It is a demarcation between a progressive and a degenerating shift in the problem. Therefore, with some metaphorical simplification the progressive MSF framework can be conceived as a useful tool for evaluating proposals for solving problems from the point of view of agenda setting and decision making. This demarcation between a progressive and a degenerative shift in the problem sheds new light on the MSF framework and the research based on it.

Lakatos mentions that the traditional empirical criterion for building a satisfactory theory (based on compliance with observed facts) is unsatisfactory. According to Lakatos, the production of new facts is an empirical criterion for a series of theories. No experiment, no observational statement, or a well-corroborated low-level falsifying hypothesis can in itself lead to a falsification: "There is no falsification before the emergence of a better theory" (Lakatos, 1978a, p. 35). Thus, the decisive element in falsification is not whether the new theory offers any new information (excess information compared to the previous theory) or whether some part of this surplus has been corroborated. We are not even interested in thousands of trivial verifying examples or hundreds of easily accessible anomalies. The determining factor is that "the few crucial excess-verifying instances are decisive" (Lakatos, 1978a, p. 36).

These are crucial for verifying the excess information.

The MSF framework (Herweg et al., 2017) has the character of a theory and a hypothesis. The theories and empirics contained in them are inextricably linked. This is the explanatory potential of MSF. As already stated by Leibnitz in his famous letter to Conring in 1678: "it is the greatest commendation of a hypothesis (next to [proven] truth) if by its help predictions can be made even about phenomena or experiments not tried" (Lakatos, 1978a, p. 38).

4. Conclusion

We examined the Multiple Streams Framework from the perspective of Lakatos' methodology of scientific research programs. Based on our research, we conclude that MSF has key characteristics of a scientific research program. It has a hard core given by basic assumptions, core hypotheses, and key structural elements. Around the hard core there is a protective belt that represents auxiliary hypotheses developing the main features of the framework's key elements. It has a negative heuristic (prohibition of the use of the modus tollens on the hard core and given by assumptions and their discussion – limitations) and a positive heuristic, which is represented by acknowledged applications and prospects of MSF research that further develop the MSF research program. As MSF depicts the changing "fluid" reality of the policy process, it allows these changes to be assessed as a progressive or regressive shift within the MSF scientific research program. From this more rational than empirical considerations point of view, MSF serves as an innovative tool for identifying opportunities in public policy and a better understanding of public policy practice under conditions of ambiguity, such as the current covid pandemic.

It is a different but complementary perspective to dominant, review-based, approaches studying MSF (e.g., Jones et al., 2016). The results of our research show that the MSF conceptualization, anchored to Lakatos' paradigm, opens a new window of innovations for research in public policy, particularly for the policy process research (Weible & Sabatier, 2017). As a scientific research program, MSF has significant research potential and practical application in public policy. Considering the explanatory potential, MSF represents a semi-strong program which uses explanation in the form of subsumption under theory and which is mostly backed by case studies. We see this as the key theoretical and methodological significance of our study. This perspective opens a new important field for public policy theory. It also offers new knowledge and stimuli for perceiving the development of the policy agenda and for innovating decision making in public policy.

MSF thus represents an innovative scientific research program, which, however, needs to be further developed and specified in the spirit of the methodology of scientific research programs. It is a challenge for interdisciplinary research. We

consider our contribution to be an initial attempt at a new perspective on MSF. It is certainly an experiment that requires further research, scientific criticism, and further elaboration.

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