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A New Action Model

– Deducing an 'Ideal Type Path Dependent' for Scenario Simulation

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Abstract: Path dependency is a phenomenon that can make agents act without regarding their own present values or preferences. Instead of deciding rational-calculative they decide as following a path which can be monitored on macro perspective. Paths are e.g. watched in economics or linked to climate change problems. But existing action theory based on rational choice theory is not applicable in cases of path dependency. Therefore a new action model frame will be given and an ‘ideal type path dependent’ deduced from macro perspective in applying issues from social psychology. Results can e.g. be applied when simulating groups confronted with climate change and potential resulting security risks.

Keywords: New Action Model, Path Dependency, Climate Change, Security

Introduction

How does climate change influence society? Do actors or groups of actors react in social stress or even violent conflict? And how can it be predicted, prevented or what intervention strategies can be used during occurrence?

This paper does not answer these questions, but it provides a model to address them. When faced with something new there are different ways agents could make action decisions. They could either act automatic-spontaneously which means no thinking at all but simply acting. Another option is optimizing decision criteria in a rational-calculative way which perhaps as for complexity reasons or the fact of bounded rationality (Simon 1976) can not be perfectly realized but maybe approached. Especially related to climate change issues on macro level a third way can be monitored: actors stick to paths, thus decide and act path dependently. A simple description of this may be that no matter what they say their decision criteria has been, on macro level it looks as if they more or less ‘simply’ have done what they did before.

To explain that this is not only a political discrepancy of action and justification it can be said that the notation ‘path dependency’ was coined in economics. On markets e.g. technology

selection seemed to follow self-reinforcing processes or continuity assuring mechanisms forming ‘paths’ more and more agents stayed on in their decisions instead of deciding substantial rationally as assumed on perfect markets. For example watching the evolution of the typewriter nowadays key placing on computer keyboard or smartphone seems more a matter of chance than optimally realized ergonomics. Its name QWERTY-keyboard is due to the placing in the topmost row of keys. The salesmen of the first typewriters should be able to write the product name ‘typewriter’ quickly in presentations which was tried to guarantee by placing its entire letters in that one row. While it is still argued whether or not there is chance that this key placing simply is the most efficient one and therefore stays the best choice wherever applied or it perhaps is a proof of market failure on macro level there obviously can be monitored a path where the key placing actors usually use stays the same. The path of QWERTY-keyboards does supposedly not directly affect climate change but other paths as e.g. using automobiles for travelling or transport, oil or coal for heating and industry might demonstrate the connection.

So considering the problem of climate change its impacts on and reactions inside society a model frame might be useful that allows considering ‘path dependent’ decisions. To address the question about reactions of social stress or violent conflict scenario modelling could be interesting. And for considering intervention strategies a micro level adjusting to case conditions and an evaluation of occurrence probability might be requested. Therefore this paper provides a new action model.

The first chapter outlines why especially path dependency theory is valuable to address climate change problems. And existing path dependency theory will be presented relating to different fields of application.

Afterwards scenario modelling will be considered demonstrating that addressing the phenomenon of path dependency only on macro level, might not be sufficient for concluding on single action behaviour and intervention successes in detail. So basics from action theory

will be needed and discussed that models from literature, based on rational choice theory, can not be applied in the case of path dependency.

Motivated like this a new action model frame will be presented that allows describing path dependent decisions. And including issues from social psychology an ‘ideal type path dependent’ will be deduced. Thus the more an agent tends to act path dependent the more his decision processes resemble ‘ideal type path dependent’. And, for testing it, from the gained ‘ideal type path dependent’ it can be concluded back that whenever agents tend to act resembling ‘ideal type path dependent’ there can be paths monitored on macro level.

In the last chapter before concluding remarks it will be outlined how and where the new model can be applied on problems of agents deciding in political structures, agents affected by climate change, scenario modelling for predicting the probability reactions like social stress or violent conflict or considering adjusted interventions. This is followed by this paper’s conclusion making a call for further research embedding the new action model and especially ‘ideal type path dependent’ in existing models and theory of different disciplines for assuring applicability in cases of path dependency.

1. Path dependency (macro level)

Path dependency is a phenomenon which basically means that present decisions depend on former decisions or events made in history. So on a macro perspective these sequences of decisions and resulting action can be viewed as lined up and forming a path. There are different fields of society, technology or science where path dependency can be monitored. While in technology respects authors argument that the selection of some technologies opposed to other options is due to efficiency criteria and result of perfect market selection mechanisms in other fields as e.g. in politics it is less denied that path dependency occurs and is likely to manifest paths preventing correcting mechanisms and thus lowering chances for different action in future (Liebowitz and Margolis 1995).

1.1. Climate change and path dependency

Paths in fields which can be considered as relevant in the context of climate change are for example automobile industry (Urry 2004), coal or oil heating, farming in monocultures etc. "Global environmental problems are commonly understood to possess at least four characteristics that make them difficult to address. First, many are complex, stemming from multiple activities and interactions across social and natural systems. Second, owing in part to this complexity, proposed solutions may produce unintended and perverse impacts. Third, environmental problems are often clouded by scientific uncertainty, both in terms of their cause and their future environmental impacts. Finally, impacts are often cumulative. Thus, addressing them effectively may require significant interventions long before the most severe consequences of the problem manifest." (Levin, Cashore, Bernstein, and Auld 2009)

Levin, Cashore, Bernstein, and Auld show that the problem of climate change can be considered a 'super wicked' problem. That implies in particular that it is very complex, impossible to totally describe and especially not solvable when addressed with single linear models because it is not sufficiently distinguishable in partial problems (while it more consists of linked problem families). For trying to address the problem of climate change they suggest considering path dependency theory to deal with 'cumulative impacts' or 'interventions long before consequences'. For addressing this powerful phenomenon it seems helpful to address it on the same level which is what the approach of path creation allows to try (Garud and Karnøe 2001). Monitoring existing paths gives chances to create new paths to interact with the first ones in future so that first path dependency might be interfered and perhaps reduced (Levin et al. 2009).

Another approach is trying to figure out how the interference takes place in the actor who makes action decisions that can even contradict his own beliefs (when asked in a different context). So this alternative is the path dependency approach which is considered in the next chapters.

1.2. Path dependency

First, existing path dependency theory is extracted from literature.

1.2.1. The story of QWERTY, an example of the phenomenon of path dependency

Although the origin of the idea of path dependency might not be determined, the notation goes back on Paul A. David and W. Brian Arthur (cp. e.g. Beyer 2005). In their criticism on efficiency fundaments of neoclassical economics they point out that in a positive feedback process of increasing returns not necessarily the more efficient technology wins (cp. e.g. Arthur 1989, 1994; David 1985, 2000, 2007). David supports the thesis by research on the evolution of the typewriter and the lock-in of the QWERTY-keyboard (David 1985). The name of the keyboard consists of the letters printed on the keys of the topmost row of letters on the keyboard. This key placing is more a matter of chance. E.g. not the first inventor of a typewriter reached success but due to David's historical research it was the 52nd inventor of the typewriter which got patented in 1867. It was created by Christopher Latham Sholes together with his friends Carlos Glidden et al. Different problems had to be solved before readiness for start of production. Thus e.g. in a revision the visibility of the present written line could be guaranteed and the tendency of type bars to clash and jam when stuck in rapid succession or to hammer strings of repeated letters was reduced by repeated optimization. As an optimal placement of letters and numbers on keyboard there resulted a four line version of keys. The final design of key placement was fixed by the production company in 1873. It showed the even in nowadays present keyboard line QWERTYUIOP: Especially this placement should help future salesmen to impress their customers by quickly writing the brand name: "TYPE WRITER".

1.2.2. Potential inefficiency, path dependency in broad understanding as 'history matters'

"The agents engaged in production and purchase decisions in today's keyboard market are not the prisoners of custom, conspiracy, or state control. But while they are, as we now say, perfectly "free to choose," their behavior, nevertheless, is held fast in the grip of events long forgotten and shaped by circumstances in which neither they nor their interests figured." (David 1985: 333)

Even when there is no risk for present electronic keyboards to stuck, clash or jam and there is no longer a reason to place letters in one row for being able to type them quickly (especially since inventing the touch system), the placement of keys on the keyboard remains quite unchanged. This especially is surprising, because other efficiency criteria, as e.g. the letter frequency in language and thus the resulting hammering frequency optimized together with ergonomic aspects, like e.g. the convenience of different positions, would come out in a preference of a different positioning of keys (cp. David 1985; Beyer 2005).

While David more describes the happening of path dependency as something which somehow makes actors choose alike although they are perfectly free to choose he described their behaviour as "held fast in the grip of events long forgotten". This is a basic understanding of path dependency as 'history matters': It is not the present actors' interests or present efficiency criteria that shapes behaviour but instead past events that still impact choices of present actors. With that description of present decision making processes it is obvious that if the present situation is not totally like the former one, but the actions still are the same there is a potential for inefficiency, because there is a great chance that actions are not accidentally perfectly designed to match efficiency criteria of present goals.

1.2.3. Different perspectives of path dependency

"A *path-dependent* sequence of economic changes is one of which important influences upon the eventual outcome can be exerted by temporally remote events, including happenings dominated by chance elements rather than systematic forces. Stochastic processes like that do not converge automatically to a fixed-point distribution of outcomes, and are called *non-ergodic*. In such circumstances "historical accidents" can neither be ignored, nor neatly quarantined for the purpose of economic analysis; the dynamic process itself takes on an *essentially historical* character." (David 1985: 332, emphasis by David)

To describe the phenomenon of path dependency David compares it with stochastic processes. This is an approach that Arthur considers, too (Arthur 1994). He uses stochastic processes to model path dependent processes in hope for predicting which one of two technologies wins on a market. But the aspects of contingency in the beginning of the process and its non-ergodic character restrict predictability of the outcome. For transferring the concept of path dependency to political research Pierson summarizes Arthur's characterization of path dependent processes as follows (relating to Arthur 1994: 112-3):

„1. *Unpredictability*. Because early events have a large effect and are partly random, many outcomes may be possible. We cannot predict ahead of time which of these possible end-states will [be] reached.

2. *Inflexibility*. The farther into the process we are, the harder it becomes to shift from one path to another. In applications to technology, a given subsidy to a particular technique will be more likely to shift the ultimate outcome if it occurs early rather than late. Sufficient movement down a particular path may eventually lock in one solution.

3. *Nonergodicity*. Accidental events early in a sequence do not cancel out. They cannot be treated (which is to say, ignored) as "noise," because they feed back into future choices. Small events are remembered.

4. *Potential path inefficiency*. In the long-run, the outcome that becomes locked in may generate lower pay-offs than a foregone alternative would have.

To this one can add a general point of particular interest to social scientists: These are processes in which sequencing is critical. Earlier events matter much more than later ones, and hence different sequences may produce different outcomes. In these processes, history matters." (Pierson 2000: 253)

Different authors use this characterization in variable ways:

In the field of political science Pierson states that every institution is path dependent against which Alexander argues later that politicians do not decide totally rational so the economic definition of path dependency is not applicable without restrictions (Pierson 2000, Alexander 2001). Mahoney transfers the context of path dependency in social sciences and points out that the phenomenon can not be sufficiently explained with economic approaches like utility theory, because it is paradox trying to explain inefficiency with a concept that does not allow any other result than efficiency (Mahoney 2000). In organizational sciences Sydow, Schreyögg and Koch suggest a 3-phase-model for describing a path dependent process, where in phase 1 contingency is present, in phase 2 self-reinforcing mechanisms more and more restrict actions till the lock-in occurs and action changes at least incrementally in phase 3 (Sydow, Schreyögg, and Koch 2005, 2009). Extracting from different fields of science Beyer lists seven mechanisms which can be characterized as containing logic of assuring continuity (Beyer 2005).

Liebowitz and Margolis present a three-type characterization of path dependency phenomena differentiated in the grade of inefficiency it produces (Liebowitz and Margolis 1995).

And Page analyzes different clustering of mechanisms affecting processes in becoming path dependent and characterizations of path dependent processes in modelling them mathematical expanding Arthur's models based on stochastic processes (Page 2006).

These approaches have in common that they more or less describe path dependency from the phenomena side: trying to discover paths on which path dependency acts in emperies, characterizing path dependency with the attributes ‘unpredictability, inflexibility, non-ergodicity and potential inefficiency’, distinguishing paths in phases, clustering mechanisms around them, comparing and clustering path dependent phenomena and trying to picture them with mathematical models.

But as Garud and Karnøe point out, although the agent is central to the process of path dependency a theory of agency is still not available for characterizing him (Garud and Karnøe 2001).

3. Modelling scenarios

There are two ways to approach a macro phenomenon during modelling it: One approach is trying to rebuild the macro picture of it using existing models thus staying on macro level for modelling it. Another approach is addressing it in an analytic way thus trying to characterize the elements, which such a phenomenon consists of, on micro level for gaining the macro phenomenon when putting a group of these elements together.

For example, phenomena of swarming or herding: very simple ways of behaviour can result in such a group phenomenon, thus very simple minded animals or robots can behave in the named way. But that does not imply that every herding group has to only consist of simple minded participants. Instead this sort of behaviour can also be monitored e.g. on financial markets (Scharfstein and Stein 1990).

So a difficulty is to transfer conclusions from only on macro level rebuilt phenomena to alternative scenarios or interventions. Thus for transferring experience from one situation to the other or concluding intervention approaches from modelled scenarios it is necessary to also approach the phenomenon analytically on micro level and consider combining elements. This thrives for an action theoretical approach.

3.1. Action theoretical models

Usually, in economics, action theoretical models are based on rational choice theory thus the actors are modelled as deciding and acting substantial rational or rational-calculative (homo economicus, Wolf 2005). But at least since it is known that rationality is bounded (Simon 1976) it is obvious that this economic approach only is perhaps sufficient to remodel macro phenomena to some degree but not entirely useful for predicting action on micro level. Therefore some authors defined action models in more detail for theories on some precise subject (e.g. Wolf 2005).

But although these theories are more complex and thus perhaps better picture real decisions in more detail all these theories[1] are based on rational choice theory (Wolf 2005). Esser tried to get away from the pure rational choice approach: He defined a 'model of frame selection' in which the considered actor chooses on different levels towards action in which modus he decides this step: either automatic-spontaneous or rational-calculative (Esser 2005, Kroneberg 2005). That way he tries to integrate an element of irrationality in the modelled decision process towards an action. But in this model he needs to define in which way the modus for the first decision level towards action is decided. Because this describes a preconscious step information can not easily be gained from empirical data and therefore needs to be defined in the model. Thus Esser models decisions on the preconscious level as if they were decided in a rational-calculative modus. But this way of modelling it again includes the assumption that 'in the end' every decision for every action is made rationally. And although he states that it is just the modelled way and not an assumption on real decision processes, it generates the problem that again only decision processes and actions can be modelled which are supposed to be 'rational in the end' and no conclusions can be gained from using the described model

[1] Wolf summarizes Becker, Coleman, Kahneman and Tversky, Lindenberg, North, and Savage as all presenting models of cost-minimizing agents (Wolf 2005: 260).

on how phenomena can arise and be deliberately changed that are supposed to be not totally ‘rational in the end’.

Mahoney states that it seems paradox to try to entirely describe path dependency with utilitarian theory, because it would mean to describe a phenomenon of non-efficiency using only efficiency theory (Mahoney 2000). Therefore he clarifies that path dependency can not be totally explained with rational choice theory for a path dependent decision process need not be totally ‘rational in the end’. Thus for approaching the phenomenon of path dependency on micro level a new action model is needed that allows decisions to be different grades of rational or made in alternative (non-rational) ways.

Garud and Karnøe state that although agents are central subject of path dependence theory the agency level is not sufficiently described yet (Garud and Karnøe 2001). For partly addressing this problem they present a theory of path creation which allows considering agents mindfully triggering later path dependent processes instead of only focussing on paths as main objects of path dependency theory. So they switch the usual macro-perspective when considering paths to an agent-level from where paths are supposed to be created. This perspective allows considering deliberate creation of paths for interfering existing path dependent structure and thus a way of intervention in path dependent phenomena.

But it still does not describe the phenomenon of path dependency in an agency theory which might allow switching from micro to macro level and back when considering scenarios of modelled path dependency for interfering future or present situations.

So a new model frame and a new model need to be created for combining action theory and path dependency theory.

4. Ideal type path dependent deduced in a new action model (micro level)

4.1 The new model frame

In social psychology (e.g. Chaiken and Trope 1999) it is usually assumed that a real executed action is preceded by an activated cognitive action draft. Therefore level 1, the level of drafts in the new action model, as presented in Figure 1, is the level of action drafts on which immediately before real action exactly one draft needs to be chosen and activated at the latest. Thus for describing an automatic-spontaneous action with this model frame the lower two rows would be sufficient (Figure 2).

Entrance in the action decision process therefore is on level 1, the level of action drafts.

If on this level more than one draft can be chosen as being comparable practicable or no single draft can be chosen as perfectly matching, a further decision process is needed for solving this inner conflict (compare Chaiken and Trope 1999). One model assumption therefore is: Only when an automatic-spontaneous decision is felt as not possible or not sensible other decision criteria will be added to the decision process and thus a decision process different from ideal type ‘automatic-spontaneous’ will be started.

For mapping such a decision process different from the ideal type automatic-spontaneous one there are two more levels provided in the model frame, level 2 and level 3. Level 2, the level of patterns, contains decision criteria like e.g. moral values, goals, norms, abstract models, prejudices, other knowledge or information which as felt relevant for each decision process can be evoked, rejected or enriched. Mentioned separately, level 3 contains meta-patterns which control the inner process of decision making and as to the level of inner stress, routines or agent individual decision making, let the decision process run e.g. shorter or more slowly,

expanded or flattened, more or less substantial rational, controlled by anxieties, goals or values.

But as the dashed lines indicate the usage of levels can be interactively flexibly combined. The differentiation in level 2 and 3 only allows a clear arrangement and indication of two fields of analyses, one concentrating on the content (level 2) and one on the process (level 3), two ways which impact the decision process and possibly also the decision result and thus the resulting action. Therefore the suggested model just offers a framing for later analyses.[2]

Using the new model framing (Figure 1) ideal type rational-calculative can be described or indicated as shown in Figure 3. But as a specialty of the new model frame also other ideal types different from the automatic-spontaneous or the rational-calculative one can be mapped, e.g. one following the decision-process Simon describes when considering someone buying a car (Simon 1983).

In his book 'Reason in human affairs' Simon asks his reader to "introspect a bit about how you actually make decisions" and to check Simon's assertions against own introspections (Simon 1983: 17). The next paragraph Simon makes assertions of how in a real decision situation (on the example of buying a car) a decision process can take place which might be summarized in the following aspects:

1. Localization: focusing on special elements, separation from different dimensions of life
2. general idea of individual life style and own prospects
3. focusing attention on decision relevant aspects of own life and special own values
4. collecting information for calling up relevant values

"Once facts of this sort have been assembled, and preferences evoked, the actual choice may take very little time." (Example of buying a car, Simon 1983: 17-19)

[2] It is tried to use least assumptions possible, especially less than rational choice models.

Simon asserted that for compensating bounded rationality, decisions are made stepwise larger problems are parted, localized in space and time respects, and worked off as to necessity (Simon 1983). And also this alternative of decision making as well as combinations as to activation of different components can be mapped with the model frame as shown in Figure 4. Thus the presented model frame allows alternative decision processes to just ideal type ‘rational-calculative’, ideal type ‘automatic-spontaneous’ or combinations of both. Simon’s example shows that also decision-making processes can be framed that assumably are not based on rational choice theory in real life. So the new model frame allows mapping or modelling closer to reality which can be useful for scenario modelling, problem solving processes or consideration of interventions in real life.

4.2. Breaking down path dependency from macro to micro level

What does it mean for an agent to ‘decide path dependently’?
Because path dependency can not entirely be explained by utility theory (thus based on rational choice theory), it can be concluded that a ‘path dependent decision’ can not be described as ‘totally rational’ or ‘ideal type rational-calculative’ (Mahoney 2000).
Therefore a path dependent decision process needs to contain something else which lets the agent decide that way, which makes the agent to stay on the path no matter what his preferences thus his decision criteria would be he would use when deciding rationally.
If the decision (and action) is not necessarily ‘perfect’ as to rationality-criteria there must be some ‘difference’ and some cause of this difference in the decision process or decision criteria (level 1-3). Because the action does not change randomly but there is a path observable it can be concluded that the ‘difference’ needs to contain or consist of some routine or constancy.

This means the agent follows some sort of routine (level 3 other than substantial rationality) or uses the same decision criteria in the same way[3] (level 2). The agent could also act automatic spontaneous and therefore intuitively chooses the same draft and action which seems as following a path (staying on level 1). But the increasing persistence of the path shows that there are at least some routines created then that manifest him in keeping up the behaviour.

Whatever causes alike actions which can be monitored as following a path, the way of acting like that becomes more and more a habit. So it is possible to shorten a possible decision process in just following the habit without more thinking (on level 2 or 3) or evoking further (or any) decision criteria. Because of the least-effort principle (social psychology; Moskowitz, Skurnik, and Galinsky 1999) this shortening of decision processes is what happens during following a path for a longer time. Thus the more 'path dependent decisions' an actor makes, the more his 'decision-making' is just 'following the routines' or 'following the rules', because having habits or routines again gets a habit (as to the least-effort principle again; Moskowitz, Skurnik, and Galinsky 1999).

So what happens when this path dependently acting agent is confronted with a 'new' situation? He either simply keeps on following 'the same' routine, does what he usually does when confronted with a 'new' situation (what again is sort of a 'routine' on level 3) or needs a new routine to match the 'new' situation. Quicker (or more successful) than self-generating a routine is adapting (successful) routines, rules, and standards from other decision instances.[4] So again according to the least-effort principle the agent more and more tends to prefer this external adaptation of routines instead of generating them himself which again gets

[3] without updating it when the external situation changes as to the persistence of the path

[4] These effects can be monitored in complementary effects of path dependency or conformity tendency in e.g. organizational fields (Sydow, Schreyögg, and Koch 2009).

manifested in the inner decision process and decision criteria. And even quicker than adapting full routines is adapting drafts which only need to be executed.
Resulting from this analysis an ‘ideal type path dependent’ can be defined which means that the more an actor tends to decide and act path dependently, the more his decision-making process tends to resemble this ideal type shown in Figure 5.

4.3. Making the test

When, the other way round, an actor assimilates processes of ideal type path dependent in his action decision processes, he would apply routines or standards or execute drafts from chosen decision instances. According to the least-effort principle he would tend to use the same (or comparable) routines or standards and choose the same (or comparable) decision instances again and again for executing their provided drafts. Resulting actions can be considerably monitored as events in chronological order. So then for each applied routine or standard, chosen decision instance or used draft there can be single-paths monitored along which the actor moves. Choosing one cluster of situations it can be concluded that the actor more and more tends to produce the same (or comparable) action when facing it. Thus he can be monitored as following a path. The more his decision processes converge to ideal type path dependent ones the more stabilized his action gets on the path thus the more path dependent the actor seems.

5. Climate change, social stress and violent conflict

Applied to the topic there are agents who decide how to address climate change, agents who act stressed in a social configuration when affected by climate change and agents who might react in producing violent conflict. In each situation an agent makes a decision and/or ‘acts’ there are certain circumstances which makes him act the way he does. If path dependency is present, these influencing circumstances need not figure the agent or his special interests.

Thus it can cause inefficient decisions compared to present preferences, social stress does not have to reflect agents' interests and violent conflict need not be caused deliberately and goal oriented by present actors.

So within a problem solving process of relating problems there are different places where path dependency needs to be considered: analysis and interpretation of the situation, modelling the situation, intervention, and the entire political decision-making process.

Starting with the last point first, political decision processes depend on the structure they represent, consist of routines and standards, and actors that have to decide and execute decisions relying on them. So the outcomes of political decision processes can be considered to be path dependent and thus perhaps do not totally represent the 'most efficient', as to objective thinkable preferences, solution. Perhaps, when analyzed the 'grade' to which the actors act path dependent (as to resembling the ideal type path dependent), the 'error' between the decision outcome and the (thinkable) 'perfect outcome' can be evaluated and thus a risk of disadvantage concluded. This could be used for changing structures, correcting outcomes or resembling perfect outcomes through political decision-making processes when integrating an 'error'-correcting component (as to the criterion of path dependency).

Considering the situation of climate change, there already is path dependency recognized which can be considered as probable cause for worsening effects in present and especially future (e.g. Urry 2004). So when analyzing possible interventions in climate change these path dependencies need to be included. Path dependency consists of or at least is shaped by or comparable with (depending on the definition of path dependency one uses) self-reinforcing processes which means that it contains an inner dynamic (or external stability, depending on the point of view) and calls for more a hyperbolic instead of linear way of thinking (Levin et al. 2009). If the climate system is considered as a global dynamic system then 'climate change' can be considered as 'imbalance' of this system. With strong path dependency being present in relevant issues the mere intensity of this path dependency can increase or at least

keep up this imbalance. Thus one chance for reducing relevant increases of climate imbalance might be reducing path dependency for helping the system get balanced again.
For interventions in situations of social stress or even violent conflict it might be interesting to model the situation of what happens when climate change increases and these groups of agents are affected in a special way. If these agents in usual situations are highly influenced by routines or habits, standards or institutions they are likely to decide path dependent thus have a high tendency to decide and act comparable to the 'ideal type path dependent'. Thus a model of a group which agents are based on the ideal type path dependent can be created, enriched with details about which institutions they rely on most (in comparable new or problematic situations) etc. and used to predict their behaviour with the occurrence probability of their intensity of path dependency in decision processes and action.
Thus for analyzing or interpreting present or future situations wherever path dependency is present it needs to be included in analyzes of outcomes of decision-making processes, situational causality, the influence of present or historic events and the way agents decide and interact.

Conclusion

In the beginning of this paper authors were cited who characterized the problem of global climate change as a super wicked one. And therefore usual models using a sort of linearity for approximating reality fail because of addressing only single problems while interdependencies and problem clusters or combining structures are less considered. They discovered that path dependency theory allows addressing complex problems in a different way. Especially their suggested application of path creation allows solving problems without the necessity of entire problem descriptions first. Another path is created in some close respects to an existing one to gain an alternative choice if necessary in future.

But it can not be predicted for sure whether this second path would be the perfect choice needed when facing future problems. This leaves the risk of total failure of long time investment in case of an unpredictably changing future or simply mismatching of created paths.

And another aspect is left out of consideration: building more paths still leaves agents act path dependent thus following paths instead of executing rational-calculative decision optimized upon own decision criteria. But how do agents' decision processes change during following paths? In the previous chapters it is shown theoretically using social psychology that the more an agent keeps following paths the more his decision processes assimilates 'ideal type path dependent'.

The new presented model frame allows gradually increasing complexity or adjusting it to empirical cases. Thus ideal types of rational-calculative decision processes can be pictured as well as automatic-spontaneous ones or alternatives as a localizing approach (Simon 1983) or the new deduced ideal type 'path dependent'.

This agent based analytical approach of path dependency phenomenon gives chance for implementation in existing models allowing them to also address or picture problems caused, increased or simply accompanied by path dependency.

Using this agent based path dependency perspective on climate change problems and its affect on society as e.g. in potential social stress or violent conflict there are many aspects mentioned where path dependency is likely to relevantly influence outcomes.

Thus for analyzing or interpreting present or future situations wherever path dependency is present it needs to be included for improving predictions or perfect matching of interventions.

Therefore further research is needed in various disciplines to integrate the concept of 'ideal type path dependent' in different fields of application.

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Figures

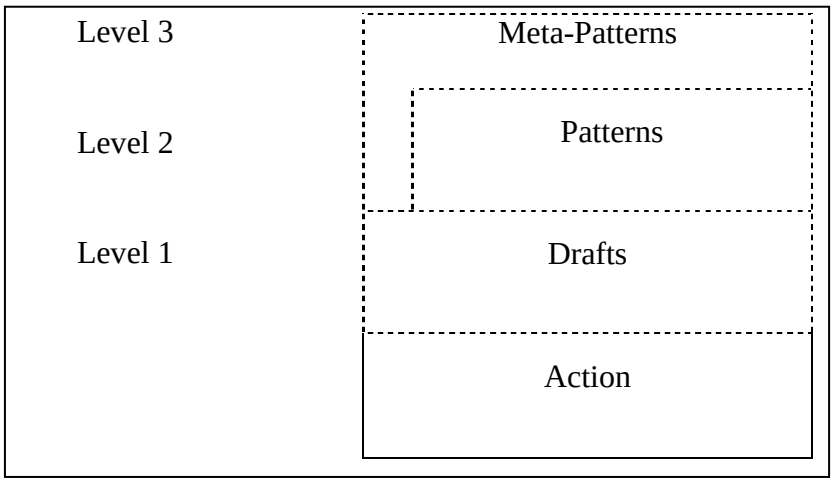

Figure 1: Model frame of the new action model.

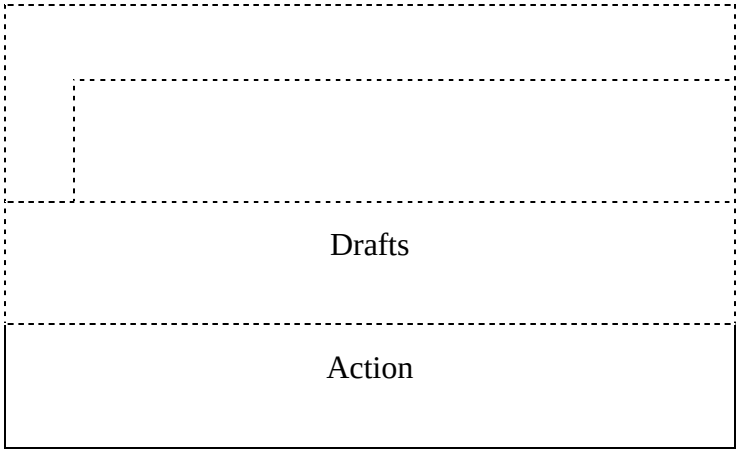

Figure 2: Decision frame of an ideal type ‘automatic-spontaneous’.

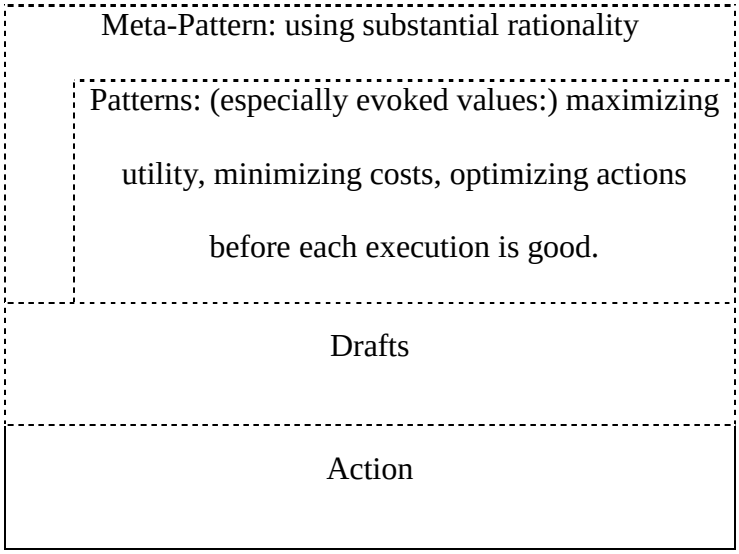

Figure 3: Exemplary decision frame of ideal type ‘rational-calculative’.

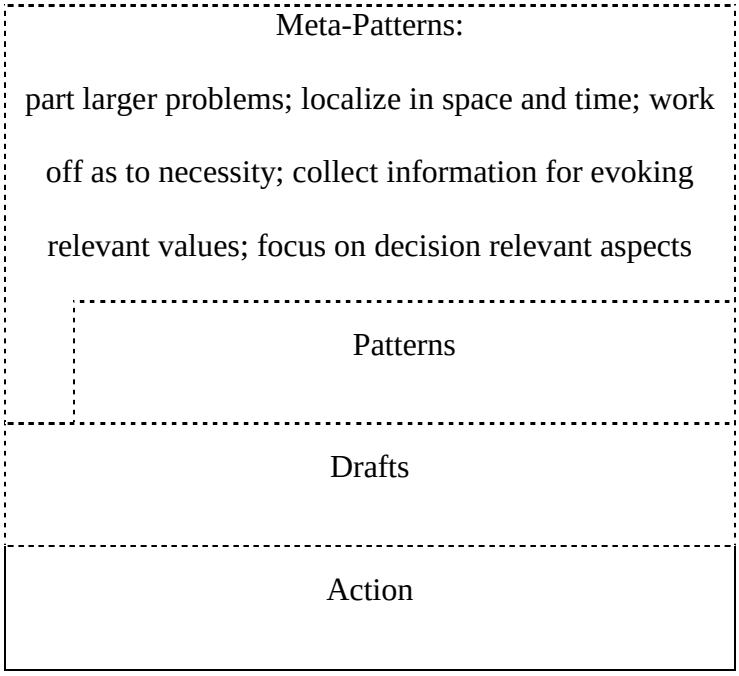

Figure 4: Frame for a decision process which differs from ideal type ‘automatic-spontaneous’ and ideal type ‘rational-calculative’ (following Simon 1983, example of buying a car).

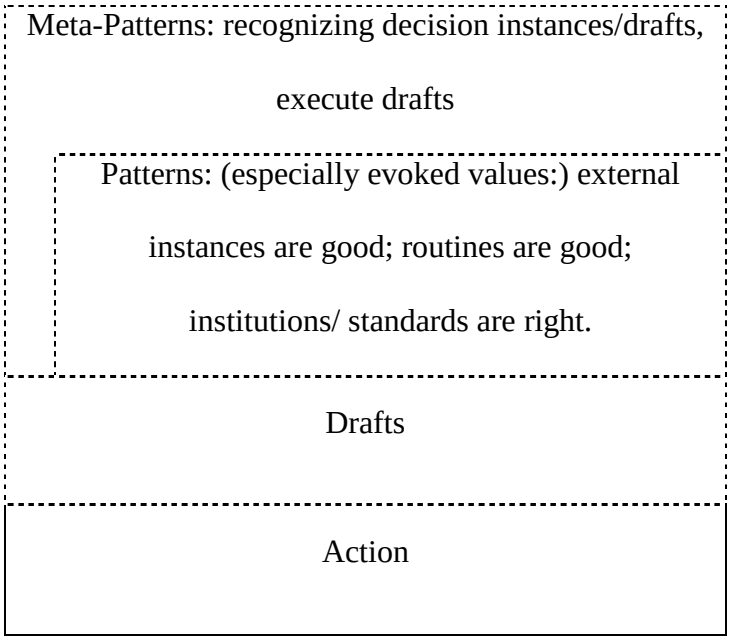

Figure 5: By path dependency (created and) activated components in an actor’s decision-making process of ‘ideal type path dependent’.

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Scheffran, J. (2009): *Climate change, Human Security and Societal Instability: Conflict or Cooperation?*, Paper presented at the Synthesis Conference of the Global Environmental Change and Security program, Oslo, Norway, 22-24 June, 2009. Working paper **CLISEC-1**, Research Group Climate Change and Security, University of Hamburg.

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Scheffran, J., Link, P.M. & Schilling, J. (2009): *Theories and Models of the Climate Security Link,* Paper presented at the Conference "Climate Change, Social Stress and Violent Conflict", Hamburg, Germany, 19-20 November, 2009. Working paper **CLISEC-3**, Research Group Climate Change and Security, University of Hamburg.

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