Policy Learning as Complex Contagion: Comparing Policy Networks in Brazil, Indonesia, and Vietnam

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Abstract

Policy learning, as the acquisition of new factual and normative beliefs is important, because it can potentially lead to policy choices being made based on the changed beliefs. The Advocacy Coalition Framework contends that such learning can be a key driver of policy change. This is because policy learning alters the perceptions of the seriousness and causes of a policy problem, thereby altering also the perceived need to do something, and allows for the informed weighing of different policy options. Taking a policy network perspective, we argue that there is one source of policy learning that has so far been overlooked in the literature: network connections between actors in a policy domain. Centola and Macy have shown that normatively-laden belief changes occur through complex contagion — a process whereby an actor receives social reinforcement from more than one contact in its network. We test this idea using node-level network regression models on a unique longitudinal survey data set on the policy domain around the REDD+ initiative in Brazil, Indonesia and Vietnam. The REDD+ initiative aims at reducing greenhouse gas emissions from deforestation in the Global South. The REDD+ policy subsystems are good cases for analyzing the role of social reinforcement in policy learning, because actors' beliefs are more likely to change in such new subsystems than in more mature ones. We find that network connections indeed explain policy learning in Indonesia and Vietnam, where the policy subsystems are collaborative, but not in Brazil where level of conflict is higher. This suggests that policy learning is more likely to take place as a result of complex contagion in collaborative than in conflictual settings.

Introduction

Policy learning as the acquisition of new ideas is an area of study that has received the attention of many scholars. For example, policy learning has been explored in the context of environmental policy (Gerlak et al. 2018; Wagner & Ylä-Anttila 2018), collaborative governance (Leach et al. 2013), and the European Union (Zito & Schout 2009). It has even been suggested that policy learning has developed into an analytical framework of its own (Dunlop & Radaelli 2018a). Most scholars agree that policy learning can alter the perceptions of the seriousness and causes of a policy problem, thereby altering also the perceived need to do something for the problem (Weible et al., 2016, 10). For example, the Advocacy Coalition Framework (ACF) contends that major policy learning, which refers to changes in the core beliefs of policy actors, can lead to changes in the actual policies being implemented (Sabatier 1998). In addition, policy learning can also happen as a result of exogenous shocks to the policy subsystem. An example of a shock could be the Fukushima nuclear disaster in Japan which made the anti-nuclear positions more relevant not just in Japan but also in Germany. According to the ACF, policy learning is more often associated with incremental changes in policies (Heikkila et al. 2014). Most researchers tend to assume either explicitly or implicitly that policy learning is always a desired state of affairs. An instance would be when policy actors learn that science clearly shows climate change is a problem that urgently needs to be dealt with, and that forests can play a major role in mitigating it. However, policy actors can also learn in a way that merely strengthens the existing state of affairs. This is the case, for example, if they change their beliefs concerning climate change so that inertia and the continuation of business-as-usual (e.g. of deforestation and resulting emissions) seems to be justified. In either case, one would want to know what the possible sources of policy learning are – that is, why belief change and policy learning takes place.

We suggest that there is one source or trigger of policy learning that has so far been overlooked by many researchers: the structure of the network of connections between policy actors. This is somewhat surprising given that the ACF and other policy process theories often employ concepts and ideas derived from policy network analysis, which focuses on the connections between policy actors. We suspect that one reason for neglecting the social ties of policy actors as a source of policy learning in the ACF is the presupposition that coordination of action results primarily from similarity of beliefs – the so called belief homophily thesis (Weible & Ingold 2018). The logic of collective action underlying the belief homophily thesis is that policy actors join forces to advocate for policies that fit their beliefs. Thus, the actors' pre-existing beliefs also determine their

collaboration ties with other actors. Empirical studies have repeatedly shown that shared beliefs do indeed lead to increased likelihood of collaboration (e.g. Gronow & Ylä-Anttila 2016), suggesting that the order of things is that beliefs come first and collaboration ties follow. If this is the order of things, it is natural for researchers to focus on explaining the determinants of collaboration ties.

In this paper, using the example of a forest-based mitigation mechanism, we argue that the direction of causality can also be reverse: the collaboration ties between policy actors can have an effect on their beliefs. This is not to deny that beliefs can have an effect on the coordination of political action. Mechanisms of *social selection*, i.e. actors choosing to connect with those whose beliefs are similar to their own are, indeed, a recurrent phenomenon in all kinds of social networks (Lewis, Gonzales & Kaufman 2012). But we suggest that research on policy learning expressed as changes in belief over time should also pay attention to another well-documented mechanism in social networks, *social influence.* In the case of policy learning through policy networks, social influence denotes the mechanism by which the social ties of a policy actor now have effect on the beliefs they hold at a later point in time. This means that studying the effect of social network ties of policy learning requires longitudinal data, which is probably one of the reasons why so little research on it exists. Furthermore, nascent policy subsystems, which are not yet fully mature, can be a good choice for testing the effects of social influence because in these case policy actors' beliefs are not set in stone and are therefore more likely to change. In addition, we argue that the effect of network ties on belief changes might also differ due to the more conflictual or collaborative nature of the ties in the overall policy domain. In conflictual domains, people can be less likely to change their beliefs based on the beliefs that their contacts happen to have. Posing these questions requires a comparative approach and a longitudinal dataset, which is probably why so few previous studies are to be found.

We make several original contributions to the literature on policy learning. First, we operationalize policy learning as change over time in policy actors' beliefs, and focus on the role of the actors' collaboration ties as a driver of this change. Second, following Centola and Macy (2007), we argue that changes in normatively laden beliefs occur through complex contagion — a process whereby an actor receives social reinforcement from more than one contact in its network. This is to our knowledge the first time that the complex contagion hypothesis is tested in a policy network setting and conceptualized as a driver of policy learning. Furthermore, we add to Centola and Macy's original idea by arguing that it is not the absolute number of an actor's network connections that give social reinforcement that matters for belief change but rather, their share in relation to all

contacts that an actor has. Third, by focusing on a recently emerged policy subsystem, which aims at reducing emissions from deforestation and forest degradation (REDD+), where policy learning (and belief changes) arguably occur more often than in established domains, we can shed light on the dynamics and underlying influences on belief change and learning. Last but not least, we use a longitudinal network survey dataset that enables us to show the direction of causality in the processes we study. Finally, our dataset also covers three different countries, which enables us to test our hypothesis in different settings and suggest that policy learning is more likely to occur in collaborative policy contexts (represented here by Indonesia and Vietnam) than in conflictual ones (represented here by Brazil).

Theoretical framework and the research hypothesis

Policy learning as belief change

Drawing from the Advocacy Coalition Framework (ACF), we conceptualize policy learning as change in an actors' policy core beliefs. The ACF assumes that the relevant level of analyses of policy processes is a policy subsystem (Sabatier 1998). Subsystems consist of all the policy actors that have a stake in a certain field of policy. For example, climate change policy can be analyzed as a policy subsystem, which consists of all the organized interest groups (e.g. governmental agencies, NGOs, businesses) that have organized themselves into advocacy coalitions (Gronow & Ylä-Anttila 2016), and the same can be applied to forest based climate policy, e.g. REDD+ (Babon et al. 2014).

The ACF makes a three-fold distinction into different kinds of beliefs: deep core, policy core and secondary beliefs (Weible & Sabatier 2009). Deep core refers to broad and stable normative beliefs such as general liberal and conservative outlooks. Policy core beliefs span the subsystem in question and are usually the ideational basis of political coalitions, whereas secondary beliefs are narrower and relate to a part of the subsystem. For example, a general belief concerning the viability of REDD+ in tackling deforestation would constitute a policy core belief and a more specific belief concerning a technical policy solution would count as a secondary belief. While we do not systematically test for the effects of social influence on different kinds of beliefs, the beliefs that we focus on would count as policy core beliefs in the ACF sense of the term.

A central assumption of ACF is that shared beliefs unite advocacy coalitions. Coalitions are formed when actors begin to coordinate their action to advocate for policy goals that reflect these beliefs. ACF scholars argue that belief homophily (the fact that like-mindedness drives collaboration) leads to the biased assimilation of new information because organizations are more often than not

exposed to information that confirms their existing beliefs (Henry 2011). The ACF presupposes that major policy learning – changes in policy core beliefs – can take place but this usually happens only when there is an exogenous shock to the policy subsystem, which can result in the redistribution of the resources in the system. It does indeed seem intuitive that organizational actors are hesitant to change their beliefs and only do so when they are faced with changing circumstances. However, following Heikkila et al. (2014), we argue that changes in policy related beliefs can also occur incrementally, through policy learning. A key driver of such incremental belief change, we argue, is the structure of social networks that the policy actors are embedded in.

Complex contagion in networks as a driver of belief change

We adopt a policy network perspective, viewing policy domains as networks of interactions between policy actors. The ACF and other policy process theories often employ concepts and ideas derived from policy network analysis, but somewhat surprisingly, ACF scholars studying policy learning have not, so far, looked into the role of network connections as drivers of policy learning.

If the connections or social ties of actors have an effect on changes in policy beliefs and policy learning thus takes place, how would this come about? There are instances when social influence can take place because a single contact acts as a source of novel information or social pressure. For example, a single source is sufficient for the transmission or diffusion of information concerning a new job opportunity (Guilbeault, Becker & Centola 2018). Thus, upon hearing this information from a single person, one is likely to believe that the information is credible. Centola and Macy (2007) call such instances simple contagions.

Spreading of diseases or bits of information in a social network are examples of simple congations. Even large networks are susceptible to simple contagions, because they often exhibit so-called small world properties, meaning that short paths connect distant parts of the network (Watts 1999). This means that there are dense local clusters that are linked by single bridging connections and these bridges provide “shortcuts” across the network. A small world topology can make large networks susceptible to the spreading of information or infectious diseases. There have been attempts to generalize the small world model to the diffusion of collective behavior. For example, Hedström, Sandell and Stern (2000) suggest that even though the network of agitators in the Swedish Social Democratic Party was very sparse, it helped in the diffusion of the early party. In their model, single party agitators connect worker communities with each other.

Centola and Macy (2007), however, argue that the diffusion of normatively laden beliefs and collective behavior differs from the diffusion of information and diseases. In the latter case, a single contact is enough for diffusion to take place and thus a disease can spread from a relatively isolated community to another through single bridging connections. Normatively laden beliefs and collective behaviors are different because their diffusion often requires processes of complex contagion, that is, social reinforcement from several sources in the actor's social network. There are several reasons for why this is the case. One is that with novel ways of doing things and with innovative ideas "[n]onadopters are likely to challenge the legitimacy of the innovation, and innovators risk being shunned as deviants until there is a critical mass of early adopters" (Centola & Macy 2007, 708). Another reason is that many public goods depend on there being enough prior adopters – a critical mass – before adopting makes sense for the individual. Previous research has shown, for example, that getting social movements off the ground requires social reinforcement from multiple peers; otherwise a critical mass is not possible (Centola 2013).

It has been argued that transitive network structures, where friends of friends are also friends, is not conducive for coming up with novel ideas and practices because the information that travels in such structures tends to be redundant (cf. Burt 2009). Being embedded in transitive structures contrasts with brokerage where an actor connects otherwise disconnected parts of a network. Brokerage is thought to be conducive to getting acquainted with novel ideas because an old idea in one group is potentially a new idea in another group. A broker thus has to act as the conduit for the idea to travel through. Brokering ties are often weak in the sense that connections between actors can be infrequent and relatively rare. However, Granovetter (1973) argued that such ties can in fact be "strong" in the sense that they make the diffusion of information possible. This property can make even big networks into so called small worlds if local clusters are connected by bridging ties, thus connecting different parts of the network with short distances (Watts & Strogatz 1999). However, "when activation requires confirmation or reinforcement from two or more sources, the transitive structure that was redundant for the spread of information now becomes an essential pathway for diffusion" (Centola & Macy 2007, 709). This means that small world properties do not necessarily make networks susceptible to complex contagions. Information on job openings can be received through single network links, as suggested by Granovetter's strength of weak ties thesis, but complex contagions occur only if an actor receives the same "message" from more than one contact. For example, information on finance for forest-based mitigation can be spread through single, weak ties, but complex contagion would relate to the feasibility of REDD+ as a policy process (see Brockhaus and Di Gregorio 2014).

The original evidence for the idea of complex contagions provided by Centola and Macy (2007) is based on simulations. Subsequently, complex contagions have been studied, for example, in the empirical context of behaviors driven by online sharing (Sprague & House 2017) and political echo chambers (Boutyline & Willer 2017). As far as we are aware, the idea of complex contagions has never been tested in the context of policy networks or policy learning, even though explaining the causes of policy learning is essential for public policy (Heikkila & Gerlak 2013) and for tackling environmental problems (Gerlak et al. 2018).

Adding to Centola and Macy's original conceptualization of complex contagion, we argue that the absolute number of social contacts that hold beliefs different from the actor's own beliefs may not be the most important thing driving belief change. Instead, we suggest that what counts is the share of one's connections that think differently. Consider a case where someone – an ego in network parlance – has connections to ten actors, and three of these differ in their beliefs from ego. In Centola and Macy's view, this would count as a possible scenario for complex contagion because more than one actor is different from ego. However, ego would still be left with seven ties to actors that reinforce ego's current beliefs. Now compare this scenario to a situation where ego has five ties and three of these have different beliefs from ego. There are again three ties with different beliefs but the felt social pressure is probably much stronger than in the first case because the actors with different beliefs now constitute the majority of connections that the actor has. Thus, we suggest that *the share*, not the absolute number of different social ties, is what matters here.

Building on the considerations above, the hypothesis we test in this paper is:

Belief change is more likely to occur when an actor's contacts hold beliefs that are different from the actor's own.

Case selection

REDD+ stands for Reducing Emissions from Deforestation and Forest Degradation and includes the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries. REDD+ was adopted at the UNFCCC Climate Conference in Bali 2007 with Indonesia, one of our country cases, being the host country. Forest based mitigation was introduced earlier in the climate negotiations, under the clean development mechanism (CDM) as forestation and reforestation projects (Backstrand and Lovbrand 2006). The link to forest carbon markets and offsetting led to an earlier rejection of the REDD+ idea in some national policy domains, for example in Brazil, while other countries such as Indonesia but also Vietnam embraced

this idea to a large extent. In the case of Vietnam embracing the REDD+ was related with country – traditionally a communist stronghold – opening to markets in general. Despite diverse country contexts, and earlier struggles and failures of forest based mitigation (e.g. within the CDM), emissions from land use change are considered the second leading cause of global warming. According to Goodman and Herold (2016), 24-30 percent of the total mitigation potential could be provided by halting and reversing tropical deforestation. Hence, national REDD+ policy domains are an important climate change policy subsystem.

Most policy network research focuses on mature subsystems where one can easily identify the key participants, the substantive topic, and the territorial boundary of the subsystem (Ingold, Fischer & Cairney 2017). This can be detrimental for policy research for the reason that "by focusing only on mature subsystems, we miss an important piece of the puzzle: we do not know how and why particular subsystems form" (ibid., 2). For this reason, Ingold, Fischer and Cairney (2017) call for more research that would focus on nascent subsystems that are not yet mature. We respond to this call by focusing on the REDD+ subsystem in three countries. We argue that social reinforcement is especially important for belief changes in the case of nascent subsystems because in these cases both the subsystem itself and policy actors' beliefs are prone to change. Actors may not have permanent policy beliefs in nascent subsystems and are therefore also more likely to change their beliefs if they are exposed to different beliefs through their social contacts.

In addition, it has been argued that policy learning is more likely to occur in collaborative compared to adversarial subsystems (Weible & Sabatier 2009). This is because collaborative cases are associated with moderate rather than extreme beliefs and thus also agreement between actors is in general more likely. While it has been shown that convergence of beliefs between competing advocacy coalitions does take place in collaborative subsystems (Weible & Sabatier 2009), we suggest that one reason explaining *why* this is the case – actors are more susceptible to social influence in collaborative contexts – has not been explored by previous literature. Of our cases, Indonesia and Vietnam are more collaborative than Brazil. We expect this to reflect in our results concerning policy learning so that policy learning has less to do with social influence in an adversarial context, that is, in Brazil.

Data and methods

Our longitudinal data focuses on emerging climate and land use policy subsystems in three countries. The data comes from two rounds of national level policy network surveys in the REDD+ subsystem (Brockhaus, Di Gregorio & Carmenta 2014). Our case countries are Brazil, Indonesia and Vietnam. These three countries have in common that they engaged with REDD+ early on, even though in different ways. In Brazil, it was a conflictive issue related to the underlying offsetting idea in REDD+ and to fears of violating the rights of indigenous people. In Vietnam, REDD+ started as a concerted policy effort in an authoritarian regime and in Indonesia as an emerging policy domain with numerous international (e.g. UNREDD, FIP etc) and bilateral (Norway) partners, but with domestic power struggles of two central actors (Angelsen and McNeill 2012, Brockhaus et al and Brockhaus and Di Gregorio 2014, Korhonen-Kurki et al. 2019, 2014, Brockhaus et al. 2017).

Vietnam is both an interesting and a problematic case for political research due the fact that it is a single-party socialist republic. In a non-democratic country it can be difficult to get people to voice their actual opinions. Furthermore, it is possible that people take their cues from governmental actors and try to follow the official party doctrine. However, Vietnam can be an interesting litmus test for the idea of complex contagions (at least in the context of policy networks). In a single-party state, it is likely that what matters more than the opinion of one's direct ties is the opinions of those in power. Thus, it is possible that we do not find evidence for the local network effects that complex contagion should produce, unless, of course, those in power are those that people are also connected with (that is, people follow the party line also in their network connections). However, if complex contagion can be witnessed even in Vietnam, this would be powerful evidence for the idea since it indicates that complex contagion can take place irrespective of the political regime type.

In the first round of data collection survey responses were collected for 55 policy actors in Brazil (response rate 86 %), 65 in Indonesia (response rate 64 %), 52 in Vietnam (response rate of 100 %), and in the second round 72 in Brazil (55 %), 84 in Indonesia (64 %), and 48 in Vietnam (87 %). The first round of data collection was conducted between 2010 and 2012 and the second between 2015 and 2016. For the longitudinal analyses we included only those organizations that participated in both rounds, leaving us with 27 responses in Brazil, 43 in Indonesia, and 27 in Vietnam. However, when constructing our independent variables representing organizational attitudes in the first round of data collection, the whole data from the first round was used.

The respondents were representative of organizations that are involved or relevant in the national REDD+ policy subsystems. ACF is often categorized as a theory of political processes which aims to explain policy change rather than structures (Karapin 2016). However, lack of longitudinal data has limited investigations of processes of change over time. Longitudinal data is, after all, a more appropriate approach for investigating changes than the use of cross-sectional data. Due the longitudinal nature of our data, we are able to focus on investigation changes over time in policy processes and assess the role of policy learning.

The respondents were asked their level of agreement/disagreement with several opinion statements related to REDD+ using a five-point Likert scale (1 = Strongly disagree, 2 = Disagree, 3 = Neither agree nor disagree, 4 = Agree, 5 = Strongly agree). This analysis focuses on eight opinion statements that were asked in both rounds (although the wordings of four of them was slightly different because of changes in the policy domains over time). We suggest that these questions reflect underlying policy core beliefs because they all assess the viability of REDD+. In addition, our choice of questions was based on a factor analysis (principal component analysis) which resulted in a composite variable of four questions. The Cronbach's Alpha for these questions on the first round was 0.723 and on the second round 0.707. Using only three questions instead of four on the second round would make the Cronbach's Alpha slightly better (0.714), but the difference is small and it would mean that one question would have to be left out of the first round of analysis as well for the sake of comparability. Therefore we decided to base the composite variable on four questions. The questions of the composite variable are listed in Table 1. Agreement with any of these four opinion statements also indicates a positive assessment of REDD+ as a policy instrument and together they cover four crucial outcomes of REDD+, related to Effectiveness, Efficiency, Equity (also known as the 3Es) (Angelsen et al. 2012) and governance outcomes.

Table 1. Questions of the composite variable for round 1 and round 2

Round 1	**Round 2**
REDD is an effective option for reducing greenhouse gas emissions globally	REDD+ is an effective option for reducing greenhouse gas emissions globally
REDD is a financially affordable way to mitigate climate change	REDD+ is a financially affordable way to mitigate climate change
REDD will assure fairness in the international distribution of environmental costs and benefits	REDD+ is an equitable mechanism for balancing the burdens of climate change

REDD schemes will provide incentives and resources to improve forest governance (e.g.illegal logging and rule of law)	REDD+ leads to improved forest governance (e.g. illegal logging, access to justice and rule of law)

The dependent variable in our analyses is egos' change in the composite variable between rounds. The dependent variable is approximately normally distributed, and the values range from -1,75 to +1,5. To capture the social structure of the REDD+ policy network, the respondents were presented with a full roster of the organizations that were part of the national REDD+ policy domain and they were asked to indicate the ones that they regularly collaborated with. On the basis of these answers, network graphs for collaboration were constructed. Since we are interested in analyzing the effect that alters' belief have on ego's beliefs, we calculated how many of ego's alters' in the collaboration network were more negative and more positive than ego in their attitude towards REDD+ in the first round of data collection. To construct our main independent variable, we then calculated the overall ratio of more negative versus more positive alters. For example, if ego had three alters that had more negative beliefs on REDD+ than ego, and one alter with more positive beliefs, the overall ratio of ego's alters' would be -2 (-3 + 1). In constructing this variable we only considered outgoing ties since we believe that only alters that the organization themselves consider to be in collaboration with would have an effect on their beliefs.

To study the association further, we also tested for other attribute-related factors that may make belief change more likely. It is possible that political actors are more attentive to the opinions of the similar organizations that they themselves represent. Organization type categories include governmental organizations, domestic environmental NGOs, domestic NGOs with other interests, foreign government agencies, intergovernmental organizations, international businesses, international environmental NGOs and networks, international NGOs (non-environmental), international research institutes, national business organizations, and national research institutes. In addition, it is possible that governmental actors are considered more influential than others (perhaps especially in Vietnam) and therefore we test whether they are more important than others in triggering policy learning. We used two distinct measures of influence: centrality in the collaboration network, which is the count of incoming collaboration ties for each actor, and centrality in the influence network, which counts how many other actors indicated an actor as being particularly influential in the REDD+ policy domain. The latter is taken as a measure of

reputational power. Both measures were constructed for the ratio of more negative and more positive alters (connections that ego gas) that are in the most central or powerful top quintile in the first round of data collection. Social network analysts have repeatedly found that central actors play key roles in diffusion processes in policy networks. Actors that are perceived to be influential by others (high reputational power) also likely have a bigger effect in influencing others. Thus, we test for both effects.

We used node-level regression in UCINET to analyze the change in ego's beliefs between rounds. Node-level regression in UCINET calculates the coefficients using a standard OLS linear regression but the estimation of standard errors is done by simulation, thus taking into account the fact that the observations are not independent (Borgatti, Everett, Johnson 2013). In addition, interdependencies of the actors are already considered in constructing the independent variables. We present nine different models for each country, all modeling the change in policy actors' beliefs about REDD+. Due to strong multicollinearity, the independent variables are added to the models one by one (models 1-5), and then together with the main independent variable which measures the overall share of outgoing ties with alters that are different from ego's beliefs (models 6-9).

Results

First we take a look at overall changes in beliefs between time points in order to see changes are indeed taking place. There are changes taking place and these do not have to do with organizational type in any of the countries. Thus, it is not the case that, for example, only NGO's would start to think of REDD+ in more positive terms and others would stay put in their beliefs. Figures 1., 2. and 3. report the changes in policy core beliefs in the case countries between the data collection rounds. Some of the policy actors do not change their beliefs (this is why there are no lines in the middle of the figures) but there are changes in both negative and positive directions. The change of the actors that were in the top most powerful quintile in the first round of data collection are marked with red bars.

In Indonesia, there are slightly more organizations that come to think of REDD+ in a more positive than in a negative light, whereas in Brazil and in Vietnam the opposite is true. However, according to analysis of variance there are no significant differences in the mean change between these countries ($F=0,762$, $p=0,47$). If everybody would be following the official government line in Vietnam, one would probably find no change taking place. However, this is not the case which is an indication that other factors than pure party doctrine are probably at stake.

Figure 1. Changes in policy beliefs in Indonesia

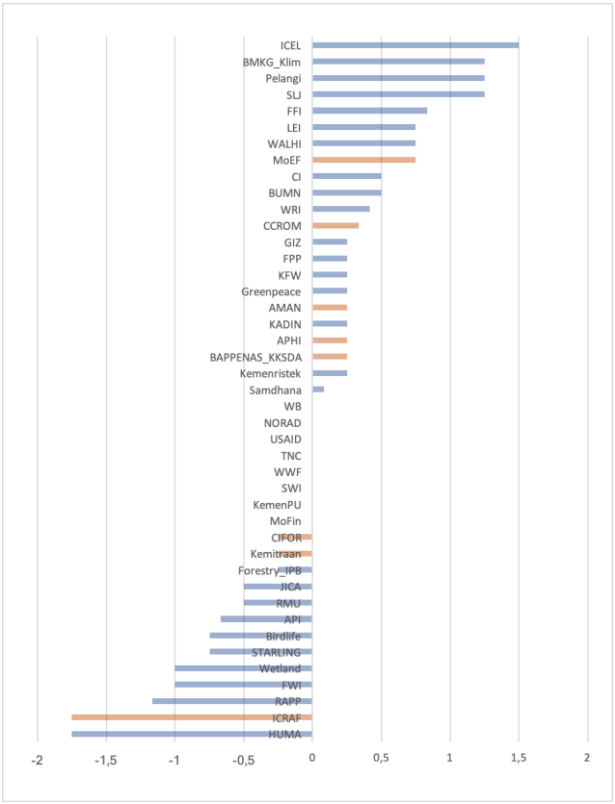


Figure 2. Changes in policy beliefs in Vietnam

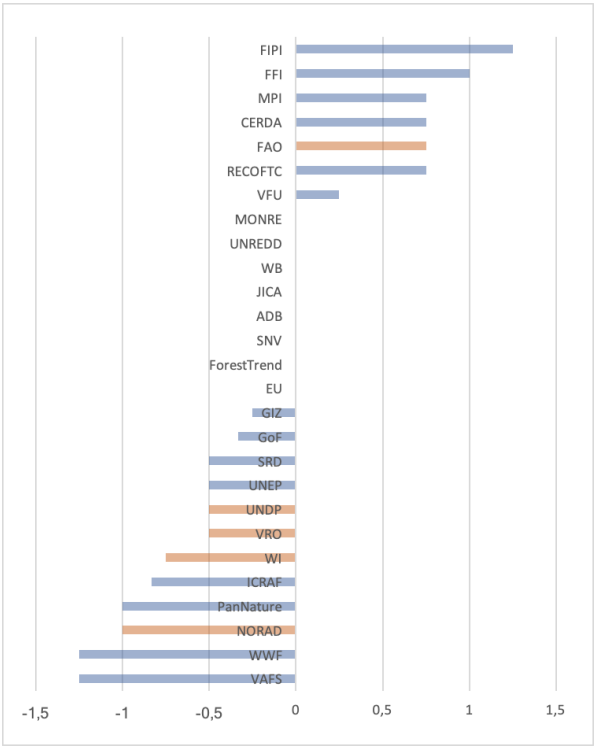
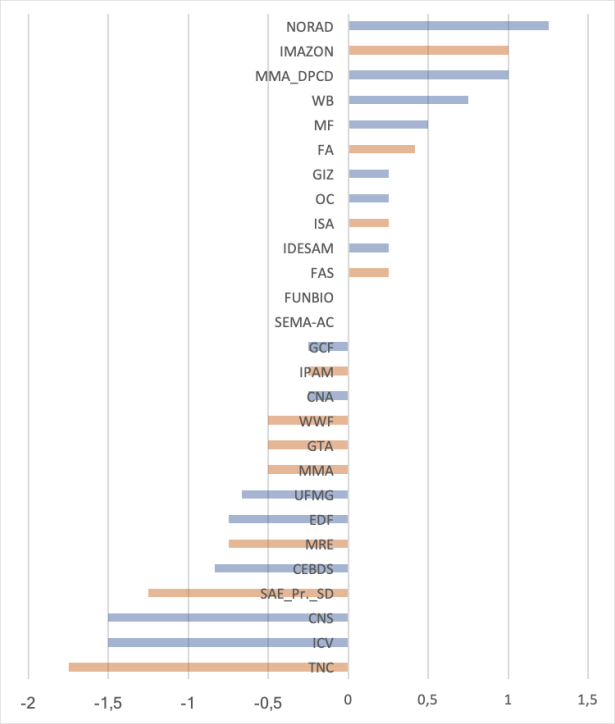


Figure 3. Changes in policy beliefs in Brazil



Pearson correlation coefficients of all variables used in the analyses are presented in Table 2 below. All independent variables are more correlated with the change in organizational beliefs in Indonesia and Vietnam than in Brazil. However, the significance of these correlations remain unknown, since the correlation procedure in UCINET does not provide significance levels. All independent variables correlate positively with each other in all countries, particularly strongly in Brazil. Additionally, in all countries the correlation between all alters, governmental alters, alters that are among the most powerful ones, and alters that are among the most central ones are very high.

Table 2. Pearson correlations of variables used in the analyses					
Indonesia	1	2	3	4	5
1 Change in beliefs about REDD+					
2 Ratio of negative and positive alters	0.456				
3 Ratio of negative and positive alters with same organization type	0.448	0.407			
4 Ratio of negative and positive alters that are governmental organizations	0.381	0.841	0.283		
5 Ratio of negative and positive alters that are among the most powerful	0.385	0.929	0.300	0.917	
6 Ratio of negative and positive alters that are among the most central	0.391	0.935	0.314	0.923	0.992
N	43	43	43	43	43
Vietnam	1	2	3	4	5
1 Change in beliefs about REDD+					
2 Ratio of negative and positive alters	0.468				
3 Ratio of negative and positive alters with same organization type	0.308	0.564			
4 Ratio of negative and positive alters that are governmental organizations	0.356	0.823	0.484		
5 Ratio of negative and positive alters that are among the most powerful	0.496	0.879	0.372	0.742	
6 Ratio of negative and positive alters that are among the most central	0.484	0.906	0.642	0.706	0.897
N	27	27	27	27	27
Brazil	1	2	3	4	5
1 Change in beliefs about REDD+					
2 Ratio of negative and positive alters	0.208				
3 Ratio of negative and positive alters with same organization type	0.265	0.626			
4 Ratio of negative and positive alters that are governmental organizations	0.108	0.877	0.627		
5 Ratio of negative and positive alters that are among the most powerful	0.307	0.949	0.598	0.780	
6 Ratio of negative and positive alters that are among the most central	0.250	0.909	0.524	0.798	0.927
N	27	27	27	27	27

The node-level regression models suggest that in Indonesia and Vietnam alters' beliefs about REDD+ have an effect on the way organizations change their own beliefs. Thus, if the policy actor has many social contacts that have a different opinion about REDD+ , the actor's beliefs change in the same direction. This effect, however, is not found in Brazil. Results of these analyses are presented in tables 3-5.

In Indonesia, all independent variables are significant when added to the model individually (table 3). The parameter estimate is the highest for alters of the same organizational type (model 2) but the model fit among one independent variable models is the highest for all alters (model 1). The highest adjusted R^2 among all models is for the model combining these two (model 6). The estimate for both all alters and alters of the same organization type are significant in this model. This indicates that in addition to the effect of the beliefs of all alters, alters of the same organization type have an additional effect. Thus, actors find similar actors to themselves more credible sources of social influence.

Table 3. Parameter estimates and model fit for node-level regression models explaining change in beliefs about REDD+ in Indonesia

	Model 1		Model 2		Model 3		Model 4		Model 5	
	B	p.sig	B	p.sig	B	p.sig	B	p.sig	B	p.sig
Intercept	-0.000	1.000	-0.034	0.558	0.003	0.996	-0.011	0.926	-0.004	0.987
Ratio of negative and positive alters	**0.097**	0.003								
Ratio of negative and positive alters with same organization type			**0.328**	0.002						
Ratio of negative and positive alters that are governmental organizations					**0.119**	0.012				
Ratio of negative and positive alters that are among the most powerful							**0.104**	0.012		
Ratio of negative and positive alters that are among the most central									**0.105**	0.009
Model fit	Adj. R^2	Prob > F	Adj. R^2	Prob > F	Adj. R^2	Prob > F	Adj. R^2	Prob > F	Adj. R^2	Prob > F
Value	0.188	0.002	0.181	0.003	0.124	0.012	0.127	0.011	0.132	0.010
			Model 6		Model 7		Model 8		Model 9	
			B	p.sig	B	p.sig	B	p.sig	B	p.sig
Intercept			-0.041	0.398	-0.000	1.000	0.015	0.848	0.009	0.955
Ratio of negative and positive alters			**0.069**	0.033	0.099	0.086	0.156	0.065	0.155	0.077
Ratio of negative and positive alters with same organization type			**0.229**	0.037						
Ratio of negative and positive alters that are governmental organizations					-0.004	0.959				
Ratio of negative and positive alters that are among the most powerful							-0.081	0.435		
Ratio of negative and positive alters that are among the most central									-0.078	0.451
Model fit			Adj. R^2	Prob > F	Adj. R^2	Prob > F	Adj. R^2	Prob > F	Adj. R^2	Prob > F
Value			0.253	0.001	0.168	0.009	0.181	0.007	0.179	0.007

In Vietnam, the beliefs of all of ego's alters, the most powerful alters, and the most central alters are significant when added to the model alone (table 4). Adjusted R^2 is the highest in model 4 (0,215) indicating that the beliefs of most powerful alters explain the variation in the dependent variable the best, although also the most central actors seem to have an effect. According to these results, governmental organizations' beliefs do not have an effect on belief change and the most influential actors are not solely governmental actors either.

Table 4. Parameter estimates and model fit for node-level regression models explaining change in beliefs about REDD+ in Vietnam

	Model 1		Model 2		Model 3		**Model 4**		Model 5	
	B	p.sig	B	p.sig	B	p.sig	B	p.sig	B	p.sig
Intercept	-0.096	0.949	-0.093	0.946	-0.127	0.037	-0.161	0.004	-0.074	0.993
Ratio of negative and positive alters	**0.072**	0.013								
Ratio of negative and positive alters with same organization type			0.215	0.117						
Ratio of negative and positive alters that are governmental organizations					0.140	0.072				
Ratio of negative and positive alters that are among the most powerful							**0.169**	0.009		
Ratio of negative and positive alters that are among the most central									**0.144**	0.011
Model fit	Adj. R^2	Prob > F	Adj. R^2	Prob > F	Adj. R^2	Prob > F	Adj. R^2	Prob > F	Adj. R^2	Prob > F
Value	0.188	0.014	0.059	0.118	0.092	0.069	**0.215**	**0.009**	0.203	0.011
			Model 6		Model 7		Model 8		Model 9	
			B	p.sig	B	p.sig	B	p.sig	B	p.sig
Intercept			-0.092	0.858	-0.090	0.770	-0.143	0.211	-0.080	0.889
Ratio of negative and positive alters			0.067	0.061	0.084	0.100	0.022	0.694	0.026	0.691
Ratio of negative and positive alters with same organization type			0.045	0.773						
Ratio of negative and positive alters that are governmental organizations					-0.036	0.774				
Ratio of negative and positive alters that are among the most powerful							0.126	0.325		
Ratio of negative and positive alters that are among the most central									0.099	0.438
Model fit			Adj. R^2	Prob > F	Adj. R^2	Prob > F	Adj. R^2	Prob > F	Adj. R^2	Prob > F
Value			0.157	0.049	0.157	0.049	0.188	0.032	0.175	0.038

In Brazil, none of the independent variables have a significant effect on the way organizations' change their beliefs about REDD+ (table 5).

Table 5. Parameter estimates and model fit for node-level regression models explaining change in beliefs about REDD+ in Brazil

	Model 1		Model 2		Model 3		Model 4		Model 5	
	B	p.sig	B	p.sig	B	p.sig	B	p.sig	B	p.sig
Intercept	-0.177	0.889	-0.222	0.092	-0.173	0.704	-0.157	0.942	-0.145	0.894
Ratio of negative and positive alters	0.032	0.300								
Ratio of negative and positive alters with same organization type			0.130	0.196						
Ratio of negative and positive alters that are governmental organizations					0.031	0.596				
Ratio of negative and positive alters that are among the most powerful							0.106	0.117		
Ratio of negative and positive alters that are among the most central									0.084	0.210
Model fit	Adj. R^2	Prob > F	Adj. R^2	Prob > F	Adj. R^2	Prob > F	Adj. R^2	Prob > F	Adj. R^2	Prob > F
Value	0.005	0.298	0.033	0.183	-0.028	0.592	0.058	0.120	0.025	0.209
			Model 6		Model 7		Model 8		Model 9	
			B	p.sig	B	p.sig	B	p.sig	B	p.sig
Intercept			-0.213	0.265	-0.208	0.305	-0.119	0.982	-0.133	0.808
Ratio of negative and positive alters			0.011	0.785	0.076	0.245	-0.130	0.171	-0.017	0.820
Ratio of negative and positive alters with same organization type			0.108	0.394						
Ratio of negative and positive alters that are governmental organizations					-0.094	0.440				
Ratio of negative and positive alters that are among the most powerful							0.381	0.073		
Ratio of negative and positive alters that are among the most central									0.117	0.474
Model fit			Adj. R^2	Prob > F	Adj. R^2	Prob > F	Adj. R^2	Prob > F	Adj. R^2	Prob > F
Value			-0.004	0.404	-0.011	0.434	0.094	0.117	-0.014	0.450

Discussion and conclusion [this section is very preliminary!]

Our paper has concentrated in finding out whether policy learning, operationalized as policy belief change, takes place as a result of complex contagion when there is a bigger share of contacts of actors that differ in their policy beliefs from one's own beliefs. Our results give preliminary support for this idea. In Indonesia and Vietnam, the beliefs of one's contacts have an effect on the way policy actors change their own beliefs. The more the merrier, it seems, when it comes to social influence in policy networks in these countries. Since we also found a homophily effect in Indonesia (similarity of organizations) and an effect based on perceived influence in Vietnam, it is likely that there are other, context dependent factors at play in addition to the effect of complex contagion. However, we did not find the complex contagion effect in Brazil.

We suggested earlier that the conflictual nature of policy subsystems may play a role in the extent that policy learning takes place. It is therefore possible that the lack of complex contagion in Brazil is due to the fact that the REDD+ policy subsystem is more conflictual there than in Indonesia and Vietnam. However, an additional reason for the different results of Brazil could be that the forest offsetting debate is actually much older and more established there. It is therefore also possible that policy beliefs are more established in Brazil and the policy subsystem is in fact not as nascent as in Indonesia and Vietnam. In Brazil, REDD+ linked with existing and strongly ideological forest offsetting debates, while in Indonesia and Vietnam these ideological foundations were not that prominent. Furthermore, Vietnam was keen to embrace anything having to do with markets and Indonesia was enthusiastic over being a world leader in climate action. In neither case were there any deeply established carbon offsetting ideologies. This could also make policy beliefs less likely to change through social influence in Brazil than in Indonesia and Vietnam.

This research has been the first one to test whether the mechanism of complex contagion plays a role in policy learning in the context of policy networks. Even though ACF and other policy network approaches are in principle attuned to the important role that networks play in policy subsystems, it is surprisingly rare to find tests of the actual effects of networks on beliefs. Furthermore, the idea of complex contagion has been around for some time now, but this idea has not really been tested in policy network research, even though it has obvious implications for issues of interest to policy network researchers (such as policy learning). We have also added the caveat to the original complex contagion idea that it is not only the amount alters that give social reinforcement that matters but their share in relation to all contacts that a policy actor has.

Like all research, our study has some limitations. One limitation is that we cannot control for all possible sources of belief change. For example, it is in principle possible that all actors whose belief change seems to have been affected by their contacts' beliefs were reacting to some exogenous event. However, in all countries we find changes in both directions, positive and negative, in addition to actors that do not change their beliefs. If all changes in beliefs would be in the same direction - everybody starts thinking of REDD+ either in more negative or positive terms - then it would be more likely that some exogenous factors would be the explanation for these changes.

A limitation related to the data is that the share of respondents that were present on both rounds of data collection did not include all actors. However, the sample was not biased in the sense of representing a certain subset of the total population (for example, only NGOs). In addition, getting answers from the exact same respondents is a challenge that all longitudinal survey research faces. Furthermore, our main results are statistically significant. Future research should nevertheless try to replicate the results in other contexts. For example, we did not systematically control for the effect of nascent versus mature subsystems and futures studies should try to test whether policy actors are indeed less susceptible to social sources of policy learning in more mature policy subsystems. We also argued that collaborative subsystems are also more prone to complex contagions. The fact that we find no evidence of complex contagion in the case of Brazil, which is the most adversarial of our case countries, suggest that there might be truth to our assertion. However, future research should analyze the effects of the collaborative/adversarial nature of policy subsystems on complex contagions in more detail.

Another issue which merits attention in the future is entangling the effects of social reinforcement on different kinds of policy beliefs. We focused on a subset of policy beliefs which relates to the policy core of REDD+. Policy core beliefs are important for the formation of advocacy coalitions (Weible & Sabatier 2007) and policy core beliefs are probably more susceptible to social influence than so called deep core beliefs which refer to more or less stable and general political outlooks. However, it is possible that secondary beliefs, which refer to more technical solutions for realizing policy core beliefs, are even more probe to change because of social influence and this topic merits attention in the future.

One important theoretical issue which we did not systematically address is the topic of biased assimilation. According to Henry (2011, 19), biased assimilation means that "ego will give disproportionate weight—or even a polarizing weight—to persuading agents who share her core beliefs." This suggestion implies that policy actors assign different weights to their social contacts as credible sources of social influence if their general policy orientation is similar to the one that

they have. The actors that share the same basic orientation would thus be more important as sources affecting belief changes than those that are too different. We suggest that also biased assimilation be taken into account by future researchers.

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