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ACCUMULATION OF ADVANTAGE AND DISADVANTAGE IN RESEARCH GROUPS

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This articles presents a test of the accumulation of advantage (AOA) hypothesis applied to differences in duration of research groups. Data are presented on the collaboration within groups both before and after the implementation of a policy measure. An extensive discussion of the findings is given as well as an elaboration of the AOA hypothesis.

Introduction

Research groups play an important role within science. Not only in terms of distribution of research funds, access to publication outlets, attraction of promising graduate students, attainment of rewards and visibility of members, but also in terms of emergence, elaboration, and dissemination of ideas.

Research groups emerge, grow, and eventually disintegrate. Any moment in time evidences research groups in different stages of their respective life cycles. Some groups exhibit the first signs of formation, others flourish, and still others appear to be fading out. Yet, not every group flourishes. Some groups disappear shortly after their foundation, without leaving a trace in the development of science. Other groups are unable to continue their initial success, even though they were considered promising. Only a few attain recognition for their work that makes them famous. And even fame may have a short history; some celebrated contributions to knowledge are soon forgotten while others survive in textbooks for generations. However interesting this stretch of fame might be, here the focus is on the actual collaboration between scientists. The differences in the duration of the existence of research groups and the differences in reputation give rise to the following question: which factors determine the emergence and development of research groups?

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The accumulation of advantage hypothesis

The explanation of the development of research groups requires a dynamic analysis indicating how later stages in the development depend on former stages. The accumulation of advantage literature provides a powerful way of describing how differences between groups emerge, leading to the growth of some groups and to the disintegration of others.[1-4] The accumulation of advantage (AOA) hypothesis aims at accounting for differences in performance that have slowly arisen over time between individuals and between groups of individuals.

> "Advantage in science, as in other occupational spheres, accumulates when certain individuals or groups repeatedly receive resources and rewards that enrich the recipients at an accelerating rate and conversely impoverish (relatively) the nonrecipients. Whatever the criteria for allocating resources and rewards, whether ascribed or merocratic, the process contributes to elite formation and ultimately produces sharply graded systems of stratification".[3]

When it is applied to research groups in science, the AOA hypothesis states that differences between research groups do not only arise from aggregate or specific differences in talent of their members, nor from one particular decisive event, but rather from a 'sequence of events'.[5] Each event produces outcomes that create competitive advantages or disadvantages between groups. This may result in a concentration of research opportunities in a small number of research groups. These opportunities offer the possibility of rewards for achievements which in turn may be transformed into resources of further achievement. In this way even the meritocratic distribution of resources creates inequality among scientists and groups of scientists that extend the initial differences in talent or capacities by far. Essential is that differences tend to grow over time, and that the cycle of performing and receiving rewards and resources may be reinforced in one case and interrupted in another.

At the same time different outcomes in competitive success between groups create different opportunities for individual scientists that belong to those groups with respect to gaining scientific reputation. Reputation of individual scientists is a key to scientific positions, research funds and students. Concentration of scientists with high reputation implies and results in an unequal distribution of scarce resources over research groups.

In this article we focus on the emergence and continuation of collaboration in relation to the availability of resources. More specific, the interest is with the distribution of research resources by the government. In the Netherlands the central government decides on the annual budget for university research and to a certain degree on the distribution of resources. This distribution indeed affects the development of research groups. In the next paragraph one specific Dutch government policy measure in the field of social sciences will be discussed. We will investigate whether a process of accumulation is at work.

Centers of Excellence in the social sciences in the Netherlands; empirical research on the AOA-hypothesis

In the beginning of the 1980s the Ministry of Education and Science in the Netherlands took the initiative to implement the government program on Task Differentiation and Concentration (TVC). By this program the Ministry aimed to improve the quality and efficiency of university education and research. In 1983 the Disciplinary Advisory Committee on the Social Sciences (DAS) was established to advise the Minister on the possibility and desirability of creating 'Centers of Excellence' (in a limited number of variations) in the field of research for every discipline and for every theme within the social sciences. Furthermore, the committee had to advise the Minister on the distribution of three million dollars for stimulating research carried out at these Centers over a period of six years. All universities with a social science faculty could apply for funding.

The committee defined Centers of Excellence as follows: "at a center a large group of scientists concentrate their research for an unspecified period at a well demarcated area and are thus expected to contribute in an important way to the growth of scientific knowledge. The center not only has a longstanding research programme, but also specialized educational facilities of high quality with a central place for Ph. D. training of researchers. One or more chairs belong to the center".[6] This definition explicitly refers to a large group of researchers. The TVC-DAS-program can thus be regarded as a direct stimulus for the formation of research groups in the social sciences in the Netherlands.

From the submitted 38 proposals 33 were evaluated by the committee in 1983. Out of these proposals 13 were nominated for financing. However, the Minister of Education and Science decided differently; only 4 from the 13 were indeed subsidized. Reasons for not following the advice of the committee were:

- in some proposals the relation with a prior policy document (Beleidsnota Gedrags- en maatschappijwetenschappen) was lacking;
- the intended well-balanced distribution over the disciplines within the social sciences was missing.

Recently, results from our evaluation study on the goal-achievement of the policy intervention became available.[7] The goal of this study was to investigate the results of this specific policy measure. The evaluation study concentrated on the continuation of cooperation among the social scientists applying for funding. It was directed to 22 of the 33 groups; interviews were held with applicants of all 13 nominated groups and with 9 other applicants (those relevant for sociology) of non-nominated groups. One of the questions within the evaluation study was whether or not a Center of Excellence had been realized in 1991. Criteria needed on behalf of answering this question were the existence of an institutionalized post-graduate teaching and training system as well as a research programme (conditionally financed research programme (VF)). It turned out that in 1991 only two groups had fully realized these conditions. Both groups ("Mathematical Models for Cognitive Performance' and 'Explanatory Sociology'), however, had not received the government subsidy, although both were nominated. The post-graduate teaching and training system which are part of these groups are respectively the Nijmegen Institute for Cognition research and Information-technology (NICI) and Interuniversity Center for Social science theory and methodology (ICS). Five other groups realized a longstanding research tradition, without establishing a post-graduate teaching and training system. Remarkably, only one of these groups was not nominated. The extent to which the 22 groups realized a Center of Excellence is summarized in Table 1.

Table 1
Groups that realized an institutionalized post-graduate teaching and training system and/or a research programme

- both research programme and t&t system	2
- research programme and partially a t&t system	1
- only a research programme	4
- only a t&t system	1
- only partially a t&t system	2
- none	12
Total	22

The symbolic reward of nomination seems to have a favourable effect on the continuation of collaboration. It can be concluded that the TVC-DAS-program, which is generally considered to have had a great impact on social science in the Netherlands in the eighties, is an important event in the history of some research groups, but it was not decisive, since groups flourished that were not financed. The 'haves' did not always prosper, the 'have-nots' did not always disappear.

On the basis of the AOA-hypothesis we decided that aside from looking at the *consequences* of this specific event, nomination and (in four cases) receiving funding, it was also worthwhile to know how the decision by the DAS-committee on nominating and funding these centers was related to the *history of the groups prior to 1983*. The AOA hypothesis predicts that groups with a longer history already had opportunities to acquire resources and rewards for their work. These outcomes of earlier events influence decisions on subsequent events. Thus, the hypothesis predicts that groups with members already having established cooperative relations, will have had a higher change to be nominated than groups that were established at the occasion of TVC-DAS- program. Indicators we used to measure collaboration were: 1. co-authorship of articles and/or books; 2. editorship of publications; 3. shared supervision in Ph. D. projects; 4. writing of research proposals for funding; 5. participation in the same VF programme; 6. shared organization of conferences, symposia and the like.

From the seven groups in which collaboration existed before 1983 six were nominated by the committee. From the 15 groups that did not collaborate as a group before 1983 seven were nominated (see Table 2). This relation between prior cooperation and nomination supports the AOA hypothesis. However, three of the

Table 2
The relation between collaboration before 1983 and nomination in 1983

		Nomination in 1983		
		Yes	No	Total
Collaboration before 1983	yes	6	1	7
	no	7	8	15
Total		13	9	22

four groups that were financed did not have a history of collaboration. This contrasts with the expectation based on AOA hypothesis that groups with prior collaboration would have a higher change of attaining resources than newly founded groups. Particularistic reasons of the government for financing only four of the nominated 13 that were given above may be related to this anomalous finding.

In the long run it turned out that groups with a longer tradition of de facto collaboration before the applications were submitted to the TVC-DAS review committee, came much closer to realizing both policy goals simultaneously (an institutionalized post-graduate teaching and training system and a research programme) when compared to other groups. This should, according to the AOA hypothesis, be even more the case for groups that had earlier collaboration *and* nomination. This indeed led to a higher change of continuation of collaboration and to gaining rewards for their work. In 1991 it turns out that six of the 22 groups of social scientists still (intensively) collaborate; all six are nominated groups, while five groups used to collaborate before 1983. This supports the AOA hypothesis. Four respondents answered that in 1991 there is collaboration between some of the members that belonged to the group in 1983. The relation between nomination and collaboration in 1991 is summarized in Table 3.

Table 3
The relation between nomination in 1983 and collaboration in 1991

		Collaboration in 1991			
		Intensive	Some	None	Total
Nomination	yes	6	3	4	13
in 1983	no	0	1	8	9
Total		6	4	12	22

In 1991 twelve of the 22 groups have completely ceased collaboration, if they ever existed as research groups. Eight of these groups can be considered as occasional groups; they joined forces to write the proposal for financing, but the negative outcome immediately ended their collaboration. Thus not only the selection process of the committee and the Ministry is at work; the strong relation between not being nominated and the end of collaboration indicates that also a process of self-selection is at work.

From the four groups that received financing two collaborated only in the period of subsidy 1985–1990. The other two groups still collaborate intensively on the theme of the original proposal. Both groups that ended collaborating in 1990, did not have a tradition of collaboration in 1983. In only one of the remaining two groups there was collaboration before 1983. As was stated before, financing alone is not a sufficient condition for the establishment of a Center of Excellence. The two groups that met both criteria (a longstanding research tradition and an institutionalized post-graduate teaching and training system) had not received financing; they did collaborate before 1983 and they still collaborate intensively in 1991.

The relations between existing collaboration (prior to 1983), nomination and continuation of collaboration show that accumulation of advantage as a mechanism is at work. Disadvantage might accumulate, but for most groups that were not nominated and thus did not receive funding, decision-making with regard to TVC-DAS proved to be decisive. So far we have seen that the expected relations did indeed occur. However, in some cases our expectations were falsified. Some financed groups disappeared, and at least two non financed groups flourished in 1991. These two groups that realized the Center of Excellence status ('Mathematical Models for Cognitive Performance' and 'Explanatory Sociology'), however, received financing in 1986 to establish a post-graduate teaching and training system (NICI and ICS). Both respondents of these groups indicated that the nomination in 1983 had influenced the attribution of resources in 1986. Clearly the advantage of nomination accumulated in 1986 for those groups. Still, seven of the thirteen groups nominated in 1983 did not realize such a system and three only partially.

This gives rise to further questions. Why do some financed groups stop collaborating after some time, while others continue or even flourish? Why do some non-funded, although nominated groups receive financing on a later occasion and others don't? Putting it more general: can conditions for collaboration be formulated that can account for this distinctive process? In the next paragraph we will outline some structural elements in the organization of research groups that are expected to have major influences on the dynamics of these groups. These elements are general; they are not induced from the interviews, but deducted from structural sociological theory (developed a.o. by *Burt*).[8]

Structural contexts: Opportunity structures and network composition

In the paragraph above we showed that competition between groups resulted in outcomes that accumulated for some groups. We interpreted the collaboration prior to the TVC-DAS-program and the nomination as factors that underlie the process of accumulation. We also expected that receiving financial resources would bring research groups closer to establishing Centers of Excellence. Although there was collaboration during the period of funding, it rarely induced continuation of collaboration after this period. Why would funding alone not suffice for the continuation of collaboration? Two other factors that are often mentioned as influencing the process of the development of research groups are their size (it should have a critical mass) and their institutional affiliation. However important these factors might be, they are not central to understanding the dynamics of research groups. It is argued here that the social structure of the group and the interaction processes within the group are central points for the analysis of the development of those groups. And that these factors underlie the accumulation process.

Now we will seek to understand how different outcomes from competition arise. Government subsidy is referred to as an opportunity for research. But opportunities for research also include scientific information, access to publication media and attraction of promising students. Often relations between scientists are important for assessing which topics are important, how to solve specific problems, where to publish and who to hire for a job. Scientists inside research groups have relations with all kinds of others outside the group, thus the groups are embedded in the social structure of science. As opportunities seem to flow through this structure, we will refer to it as the opportunity structure. The opportunity structure includes access to all resources that facilitate the performance of research groups. Rewards are also considered opportunities. At once, a description of the social structure of research groups is also a specification of their opportunity structure.

Opportunities are transmitted through the contacts scientists have. Scientists within groups have relations with each other but they also have relations with people outside their groups. To explain differences in competitive success between research groups we look beyond the competing scientists themselves to the relations of these scientists within the groups and to the positions of these groups in the social structure of science. Those relations are considered to be the social capital of scientists. Scientists differ not only in social capital, but also in the amount of cultural and

economic capital. Cultural capital includes the scientific knowledge and capabilities. Economic capital includes research funds, computers and office space. Social capital has a special relation to the other two forms of capital, providing opportunities to use the economic and cultural capital.

As was stated before financing (economic capital) on its own is not a sufficient condition for the establishment of a Center of Excellence or, more general, a research group. Financed groups must be able to transform their material capital into research and publish results (cultural capital) in order to gain recognition and new resources which make the continuation of the research group possible. On the one side the most capable scientists are able to produce and test the most brilliant ideas (material capital provides facilities to utilize their cultural capital), on the other side given a certain quality of scientist, the groups with more social capital will be better off. Here we will further elaborate on the latter. The question is which network structures are more favourable than others.

It also holds in science that scientists develop relations with people like themselves. Strong, mutual relations tend to develop between scientists with similar cultural capital. Disciplinary associations are most frequent. Even within a discipline scientists within a certain specialty spend most of their time with people from the same specialty, or scientists using the same theory or being concerned with similar problems. However, given this homogeneous background, there must be some specialisation to make communication attractive.

Communication with other scientists is stimulating if valuable information is exchanged. This information can strengthen the ongoing research. Given the restricted information processing capacities of scientists, they can only sustain relations with a limited number of other scientists, can only read a limited number of publications and can only supervise a limited number of Ph. D.-students. *Size* of scientists' network is important. At first glance larger networks yield better opportunities for achievement and higher returns from the same contribution to the development of knowledge. However, *composition* of the network is at least as important. Who constitute the favourable networks?

Working with capable scientists is important. Favourable is a "cognitive microenvironment composed of colleagues at the research front who are themselves evokers of excellence, bringing out the best in the people around them" and "being located at strategic nodes in the networks of scientific communication that provide ready access to information at the frontiers of research".[2] Collaborating scientists stimulate each others research; the mutual enforcement of research resulting from

intellectual interactions between scientists is called the *synergetic effect* of collaboration.[9] Not every composition of scientists, however competent they may be, leads to research environments with the same access to possible information. The synergetic effect is optimal if there is a balance between what is different and what is common to researchers within the group. Interaction of scientists with scientists like themselves leads to homogeneous groups in which contact with any other leads to the same information.

To be effective networks require a balance between diversity and commonality, between heterogeneity and homogeneity. We distinguish the following indicators concerning the homo- versus heterogeneity of research groups:

1. Multidisciplinary composition is more heterogeneous than monodisciplinary composition;
2. Presence of a theoretically-oriented research programme is more homogeneous than absence;
3. A group in which scientists differ in expertise (especially theoretical versus methodological) is more heterogeneous than a group in which scientists have the same expertise;
4. A group working on different research fields/topics is more heterogeneous than a group working on one field.

There can be more or less diversity in disciplinary composition, formulation of the research programme, expertise and number of research fields. Research groups are characterized by 'multiform heterogeneity'[10] i.e. the simultaneous differentiation of a group on the afore mentioned dimensions. Many different combinations are theoretically possible and two extremes are discernable: extremely heterogeneous research contexts which are multidisciplinary, have no research programme, there are many differences in expertise and work is done on many fields; extremely homogeneous groups are monodisciplinary, have a strict research programme, have similar expertise and work on one field. The possibility of occurrence of the synergetic effect diminishes if the context for research moves to one of these extremes. And occurrence is directly tied to what is called a favourable structure for scientific research.

Answering the question which structures are more favourable than others for acquiring competitive advantage does not only involve composition of the research group, but also the contacts the 'members' of the research group have with scientists and policy makers outside the group. Getting information on available sources for funding, on who to hire for a job, on where to submit for publication is important for

the continuity of the existence of the group. Also important is knowing people who have access to important decisions on for example publication and research funding. It is not only a question of *openness*, being the number of contacts research group members have with others outside the group, it is also a matter of the distribution of those contacts over the group: do they all have relations with the same people or with different ones. Here the question is who do you know outside the group and who do the others know.

Choosing with whom a scientist interacts is a matter of strategic importance. There is an optimal balance between the network size and the composition of the network. Being in contact with a large number of others with different capital, who can supply various benefits, is a matter of increasing access to opportunities for the network. Contacts between research groups are primarily maintained by the leaders of those groups; an "elite of mutually interacting and productive scientists within a research area".[11] These interrelated research groups are what *Price* called 'invisible colleges'.[12] Empirical research on the interconnectedness of those groups sometimes shows that there exist numerous nonintersecting subgroups and sometimes that dense interactions do exist.[13] Clusters differ from each other as far as they have contacts with other scientists or groups of scientists in different research areas or in different disciplines. To the extent that they are different they can get different information benefits and access to other resources. Differences depend on the social capital of the members of research groups.

Internal composition of the group is likely to be related to the pattern of relations with scientists or clusters of scientists outside the group. As far as people hold relations with people like themselves, theorists hold relations with theorists and methodologists with methodologists, collaboration between a theorist and a methodologist in one group opens for each the door to the world of the other. Members from heterogeneous groups are likely to have relations with different scientists, while members from homogeneous groups are likely to have relations with the same other scientists. If members in a group hold relation with the same others outside the group they are primarily competitors, because they draw reputation and probably students and funding from the same sources. Collaboration or continuation of collaboration is unlikely to happen. If scientists only hold relations with different others than there might be little commitment to the group.

Also concerning the relations with scientists outside the group there is an optimum; there should be some common ties to others and there should be some ties to different others outside the group. This optimum between common and different

ties formulates conditions under which collaboration is likely to continue, which not necessarily overlap with the conditions inside the group. A homogeneous group, for example, a monodisciplinary group of health care theorists might still have an synergetic effect if members of the group hold relations with different scientists outside the group. A very heterogeneous group might still work because they can refer to a third scientists who can overcome the cleavages. Often heterogeneity within the group will be correlated with different ties outside the group. Scientists within homogeneous groups will probably have relations with the same people outside the group, which makes occurrence of the synergetic effect less likely, and thus the continuation of collaboration. Scientists within heterogeneous groups will often have relations with different others outside the group, who are likely to become their group of reference if specialization continues. This makes likely the disintegration of the group, due to a lack of bonds or cohesing factors.

The problem of the tension between collaboration and competition finds a solution here in specifying structural conditions that either facilitate or hinder the emergence of collaboration under competitive circumstances. These are also conditions for the continuation of the existence of research groups. The structure of science networks and the location in the scientific community create competitive advantage. Scientists with well-structured networks have better opportunities to use their material capital, to transform it into cultural capital, and, in turn, receive reputation and new resources for their work. Hypotheses on the influence of network structure on the continuation of collaboration, that can be derived from this theory, can not be tested on the groups that applied for the TVC-DAS-subsidies, because requested data are not available. However, in ongoing research, data are collected on the history of ten research groups in Dutch sociology. These data will be used to test hypotheses derived from an elaborated version of the above theory.

In conclusion, better understanding of the occurrence of accumulation in research groups is possible when group internal structural conditions are taken into account. Based on a specification of these conditions it is possible to develop hypotheses indicating under which conditions certain events will have cumulative effects and under which conditions these effects will not occur.

These insights can be useful for the evaluation of government policy on science and higher education. When evaluating pros and cons of government policy, it is not only necessary to find out to what extent the *direct* goals of 'tools of government' are realized, but also to find out how effects or non-effects can be explained. Why, for example, is it assumed that a stronger research management will lead to higher

scientific outputs and outcomes? And: why is it believed that by stimulating the existence of graduate schools of a certain size and structure, growth of knowledge will increase in these fields? These and similar questions can only be answered adequately when the *mechanisms at work* are understood. In order to do that, elaboration and utilization of propositions like the AOA-hypothesis is necessary. The reason is that science policy either explicitly focuses on the distribution of resources or has such an impact as an unintended side effect. This is not only the case with regard to tools of government of a financial nature (like grants or subsidies, as we discussed earlier), but it also is the case when non-monetary policy instruments are at stake, like regulations on behalf of an institute's research management, the knowledge infrastructure or the ways in which scientists are held accountable for their products (peer review vs scientometric review).

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