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### THE CLIMATE CHANGE ISSUE PERSPECTIVES AND INTERPRETATIONS

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#### ABSTRACT.

Based on the results of 1,000 survey questionnaires distributed to scientists involved in the climate sciences in Germany, USA and Canada, we explore similarities and differences that exist within the scientific communities. In this paper we limit our exploration of the data to between group differences. We found the German scientific community to have more confidence in the ability of climate models to predict future climate possibilities, to express to a greater degree the belief that climate change will have a negative impact for the host society and the perception of a greater need for immediate policy decisions regarding climate change. Differences among the groups were also found in matters pertaining to the science-policy relationship. The data indicates that the German sample, in terms of the percentage of scientists, has the least involvement with both the media and with policy makers, perhaps suggesting a greater degree of the bureaucratization of science and or a hierarchical tendency within the science. In spite of relative lack of external participation, German scientists reported to be the most knowledgeable of the social impacts of climate change, an area beyond the expertise of climate scientists. Scientists from all countries reported a relative high degree of dissatisfaction with the current science-policy relationship. We conclude that the differences that exist are possibly the result of the socio-historical context of the science community and the nature of climate science general. This leads to the socio-scientific construction of the climate issue.

Key words: global climate change, survey questionnaire, perspectives, interpretations, socio-scientific construction.

#### 1. INTRODUCTION

Global climate change, or even the prospects of global climate change, have been presented as the impetus for global policy and global action. Such a level of policy is unprecedented and has the potential to impact on the day to day reality of people in all cultures. If such international policy is the goal we feel it is necessary to see what scientific influences are at work in shaping such policy. In this paper, however we limit the analysis to differences among the three climate science communities of the USA, Germany and Canada, leaving the differences found *within* groups and the inclusion of other countries for future ventures.

Socio-historical characteristics, beyond full discussion in this paper, might play a role in the shaping of the operational reality of the scientific community, in this case, limited to the climate sciences. For example, the cultural acceptance of different levels of bureaucratic intervention may influence the process by which science is transferred into policy. In short, we feel that cultural influences impact on the interpretations and perspectives of science and the process which knowledge is transferred from the expert to the consumer, a process that no doubt has policy implications. Furthermore, the relative infancy of climate sciences and its political-by-nature tendency might influence the manner in which the science is conducted. Consequently, while there might be consensus regarding, for example, the *tools* of the science, the interpretations of their products might well be influenced by other cultural processes and or traits. In short, based on the results of a survey questionnaire we address the subjective interpretations and perspectives of climate scientists pertaining to both their areas of scientific expertise and beyond. The basic tenet of the paper is that reality, scientific or otherwise, contains an element of social construction. Here we attempt to document some similarities and differences resulting from the process of the social construction of the climate issue as they exist in the climate science communities of the USA, Canada and Germany. Such a study demonstrates implications that warrant the investigation of a much broader scope of climate science communities and for the rising number of phenomena that are both global and political by nature.

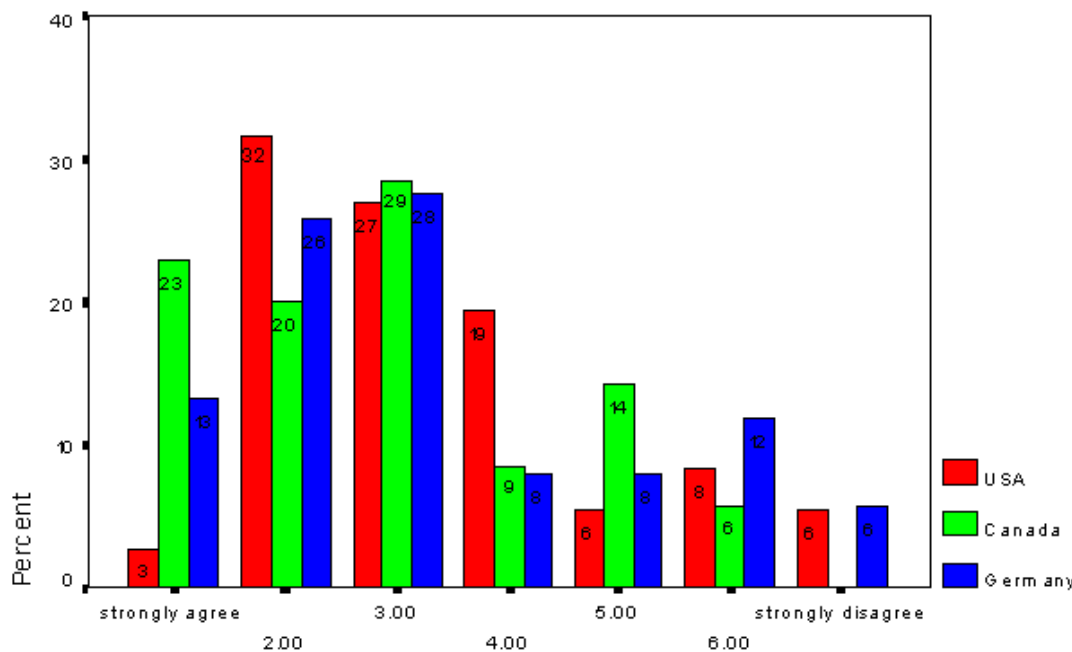
## 2. METHOD

The samples chosen for inclusion in this study were largely a result of available funding. Our initial intent was to limit the study to the perceptions and interpretations of the German climate science community. Upon the suggestion funding agency the project was redesigned as a comparative study of the German and North American climate communities. An anonymous self-administered questionnaire was distributed by post to samples of US climate scientists, Canadian climate scientists and German climate scientists. The content of the questionnaire, consisting of seventy-four questions, was derived from themes raised in a series of approximately fifty in-depth interviews conducted with climate scientists in North America and Germany (see Bray and Storch, 1996). The survey was pre-tested with scientists at the Max-Planck-Institut für Meteorologie, Hamburg. The sample for the North American component was drawn from the *EarthQuest* mailing list. Due to the fact that the mailing list contains people other than those affiliated with climate research, a true random sample was not employed. Rather, subjects were selected according to institutional and disciplinary affiliation. This resulted in a final sample of 460 American scientists and 40 Canadian scientists. The sampling of German scientists, due to reasons of confidentiality, was beyond our full control. A random sample of German scientists was drawn from the mailing list of the *Deutsche Meteorologische Gesellschaft* by its administration, resulting in the distribution of 450 surveys. A further 50 questionnaires were distributed to members of the Max-Planck-Institut für Meteorologie, Hamburg, and members of the University of Hamburg. Returns for the German sample proved to extend beyond Germany and included thirteen respondents reporting to be other than German. For the sake of analysis these persons were included in the German sample since they came from a German mailing list. The mailout was one time only and no follow-up letters of reminder were distributed. The number of completed returns were as follows: USA 149, Canada 35 and Germany 228. Here, due to space, we will discuss only some of the more prominent findings. Typically, responses are based on a Likert scale with a range of 1 to 7, for example, 1 = always and 7 = never, or 1 = a great deal and 7 = not at all, although some questions were open ended and required a written response.

## 3. RESULTS

One of the immediate concerns was to determine if, indeed, climate scientists were convinced that global warming is a process already underway. We asked to what "degree" the respondent would agree for certain that global warming, regardless of cause, is a process underway (Figure 1, means USA 3.4, Canada 2.9, Germany 3.3).

**Figure 1.** Global Warming Is A Process Already Underway

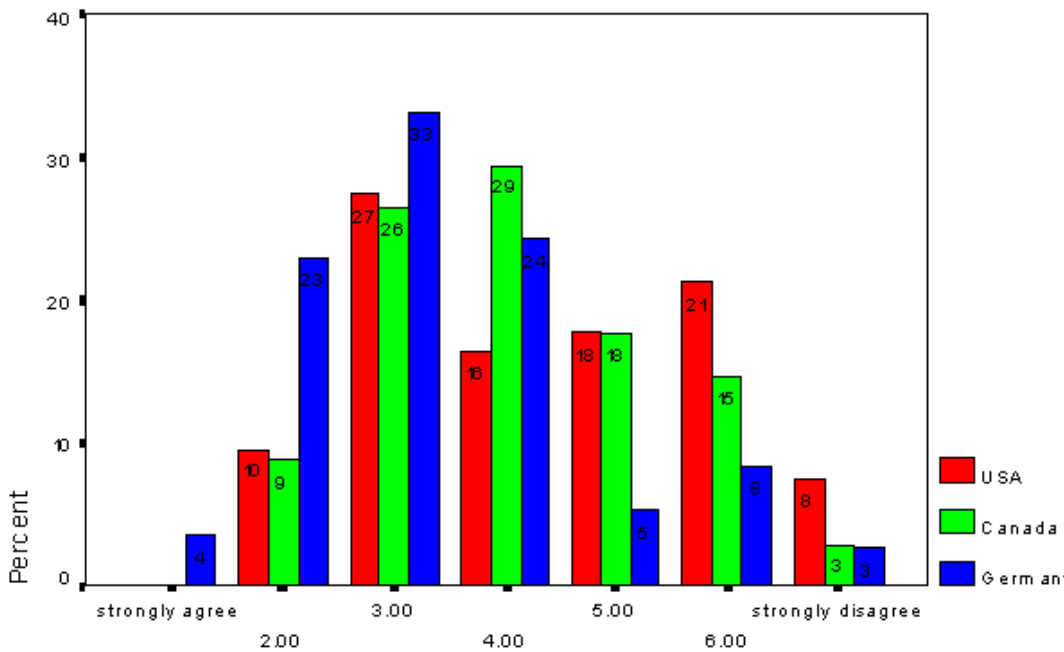


The results indicate very little difference among the communities. It would seem however, that the scientific community as identified by country, although all in agreement that global warming as a process already underway, does exhibit some differences in the strength of the consensus, particularly in the number of respondents 'strongly agreeing' with the statement as indicated by 3% in the USA, 13% in Germany and 23% in Canada. (Note that the left bar in Figure 1 represents the USA, the center bar, Canada and the right bar, Germany. This configuration is maintained throughout the paper.) We can however, assume a scientific consensus exists and that global warming

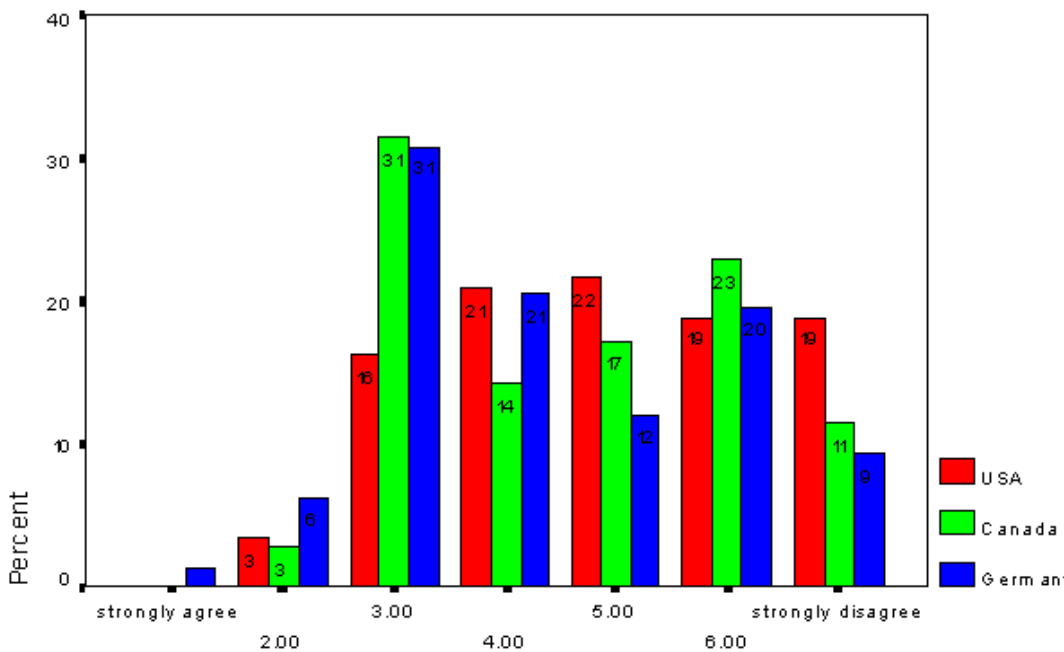
indeed, perceived as a process underway.

On the basis of the above consensus one would suspect a considerable amount of agreement as to the *tools* used to detect climate change as to whether they were "very adequate" or "very inadequate" This proved to be true in most cases when respondents were asked to comment on the likes of hydrodynamics, vapor, and atmospheric convection, for example. Due to space limitations, these results are not reported in any detail here. However, when respondents were asked if climate models accurately verify the climatic conditions for which they are calibrated (Figure 2, Germany 3.4, Canada 4.1, USA 4.4) and whether or not climate models can accurately predict climatic conditions of the future (Figure 3, means Germany 4.3, Canada 4.6, USA 4.9) some differences can be noted.

**Figure 2.** Climate Models Accurately Verify Climatic Conditions For Which They Are Calibrated



**Figure 3.** Climate Models Can Accurately Predict Climatic Conditions Of The Future



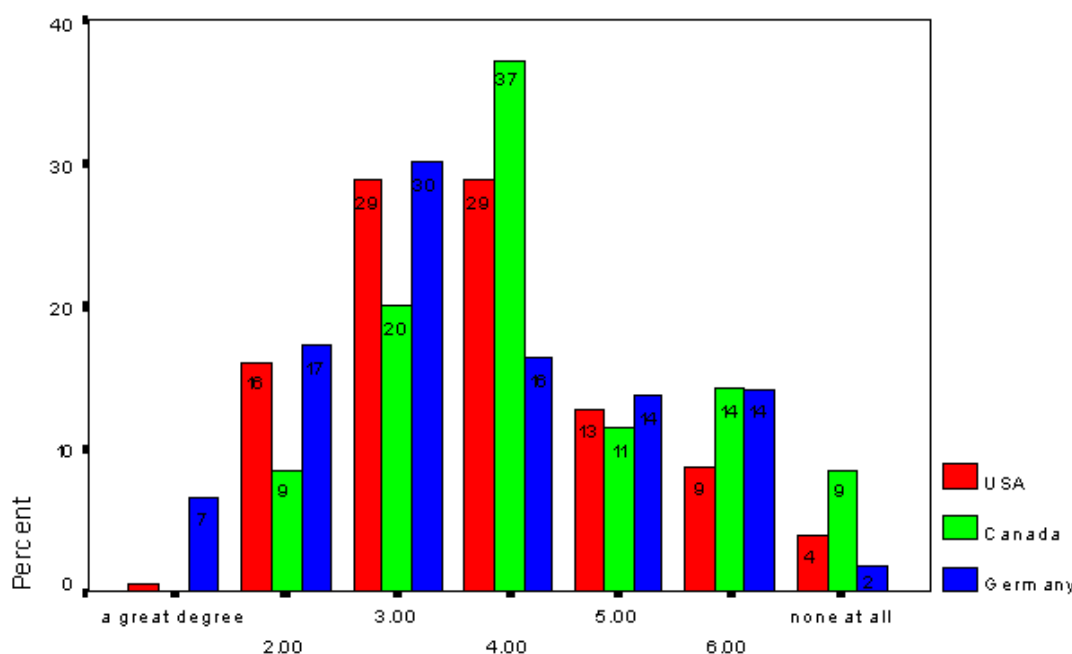
The data indicate that the German climate science community expresses the most confidence in the use of climate models. The relative confidence of the German sample and the relative skepticism of the US sample was again repeated when respondents were asked if climate models could accurately predict climate conditions of the future.

Concerning the impact of climate change, the results indicate that the German sample has the highest percentag

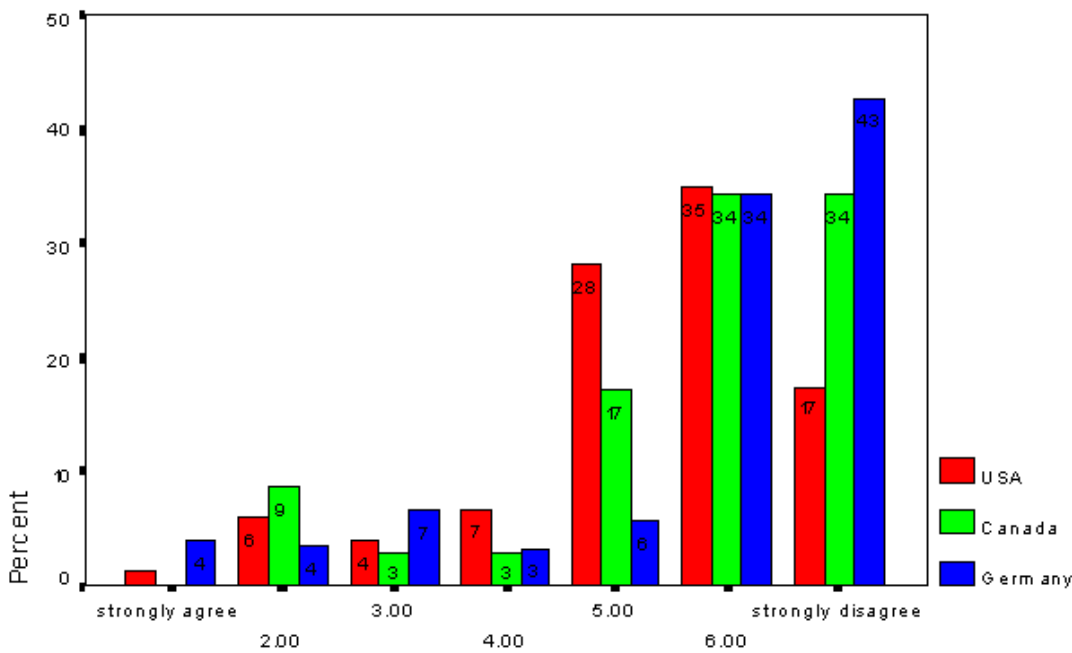
scientists reporting that climate change will have a detrimental effect for the society in which they live. It might be that in Germany the stakes are perceived as being somewhat higher and or critical thresholds closer and these perceptions reside in the cognitive apparatus of the German climate scientist as part of his or her daily belief system (Figure 4, means: Canada 4.3, USA 3.8, Germany 3.6). On the other hand, this may reflect hierarchical and bureaucratic tendencies within the science community and represent an expression, conscious or otherwise, to maintain both the current status of the science and or the current status of career patterns. Much of the remainder of the discussion addresses just such a possibility.

The results of the above, we suspected, would play a role in the perceived immediacy for policy resolutions. This again proved to be the case. While there is little difference among the means (Figure 5, means: Germany 5.8, Canada 5.7, USA 5.3) it should be noted that the greatest percentage of respondents who strongly *disagreed* that there is *no* need for immediate policy decisions is again, drawn from the German sample. Considering what appears to be a concern beyond the realms of scientific inquiry, that is, to the application of science, as exhibited by all participating countries, we questioned to what degree climate scientists felt that climate scientists were attuned to the sensitivity of human social systems to climatic impacts, a question of particular importance when one considers that it is well beyond the professional realms of climate scientists and that, in light of this, their calls for policy implementation might rely on subjective and speculative knowledge as much as scientific 'fact' (Figure 6, means: Germany 3.1, USA 4.8, Canada, 4.9).

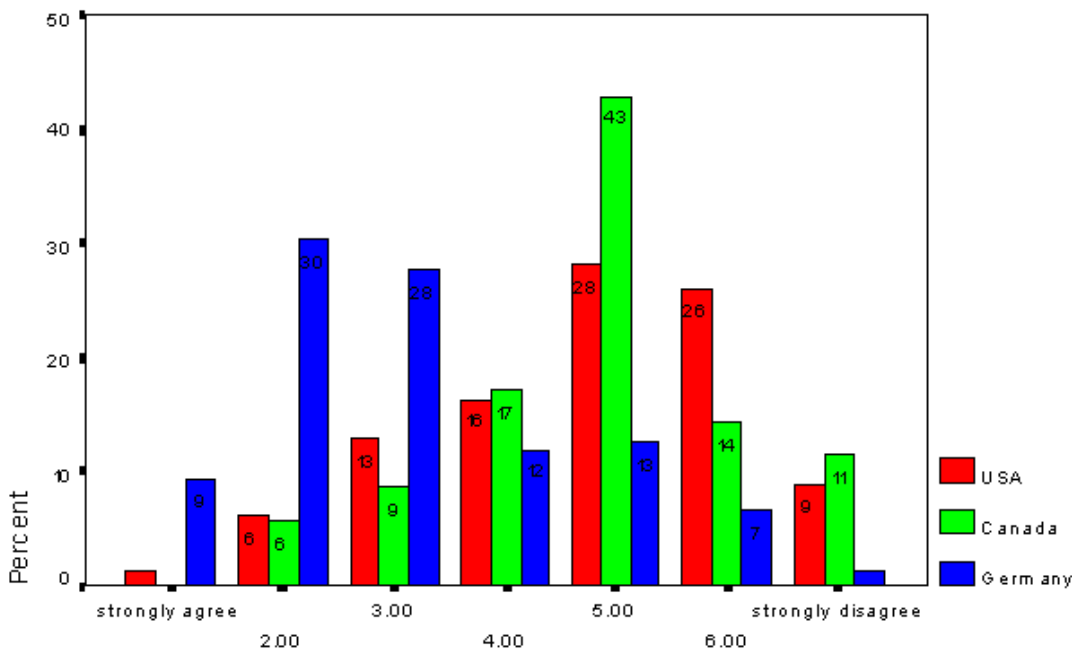
**Figure 4.** Climate Change Will Have A Detrimental Effect For The Society In Which You Live



**Figure 5.** There Is No Need For Immediate Policy Decisions



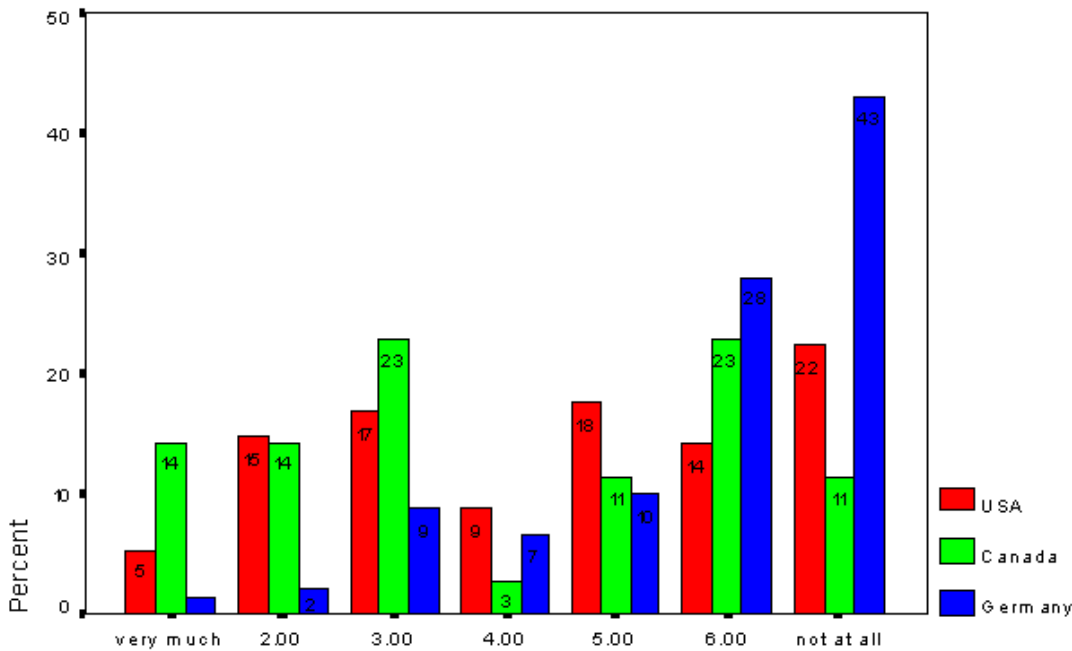
**Figure 6.** Climate Scientists Are Well Attuned To The Sensitivity Of Human Social Systems



The climate science community making the strongest claim regarding its knowledge of social issues was Germany. We speculated that this might be a reflection of the ratio of scientists that are involved in policy making decisions. We pursued this line of reasoning by asking the respondent to indicate how much he or she has been involved with people who make climate related policy decisions (Figure 7, means: Canada 4.0, USA 4.5, Germany 5.8).

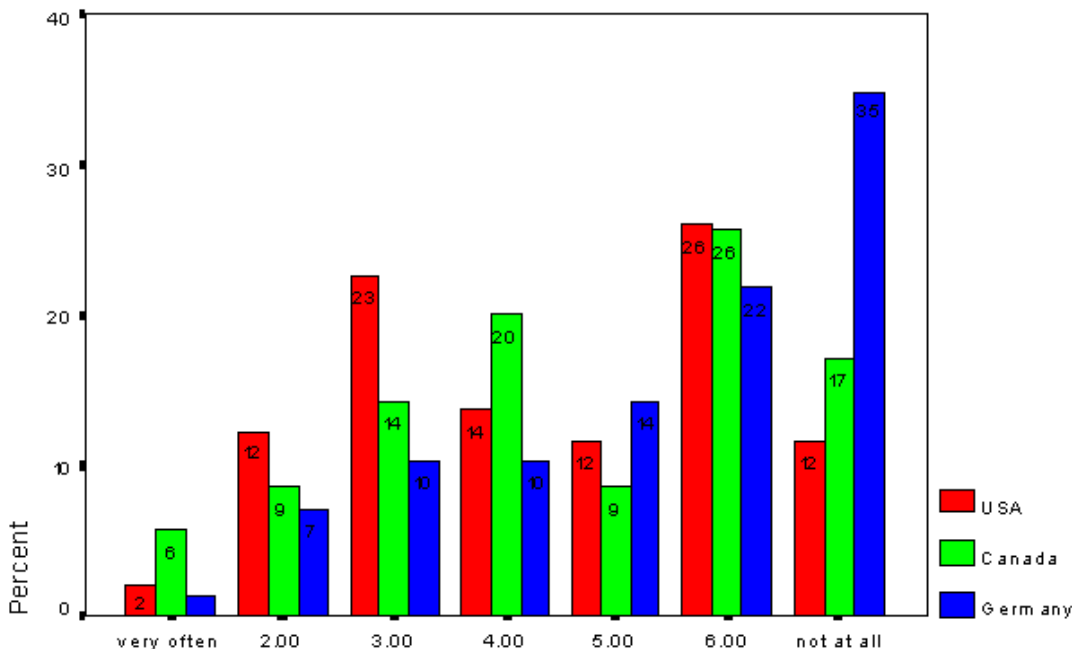
Quite surprisingly, the responses were opposite to what would be expected, with the German sample reporting the least involvement with policy makers. We can only speculate that the knowledge claim of the German sample regarding social impacts is derived from other sources and most likely their social concerns find expression in other outlets. It may represent a reflection of cultural differences in the way science is integrated into the socio-political process.

**Figure 7.** Degree Of Involvement With People Who Make Climate Related Policy Decisions



To this end, we thought it might be possible that science might also act through the media to influence voting patterns, which, in turn, influences policy decisions. This would indicate a more direct involvement with the public, and in the case of Germany, would indicate, perhaps, a greater expression of social awareness that would be compatible with claim to knowledge of the social world. To determine such patterns the survey contained a series of questions pertaining to interaction with the media and its implications. To begin, we asked "How often are you contacted by media for information pertaining to climate change?" (Figure 8, means: USA 4.5, Canada 4.6, Germany 5.3.) (scientists reported to be the least contacted by the media.

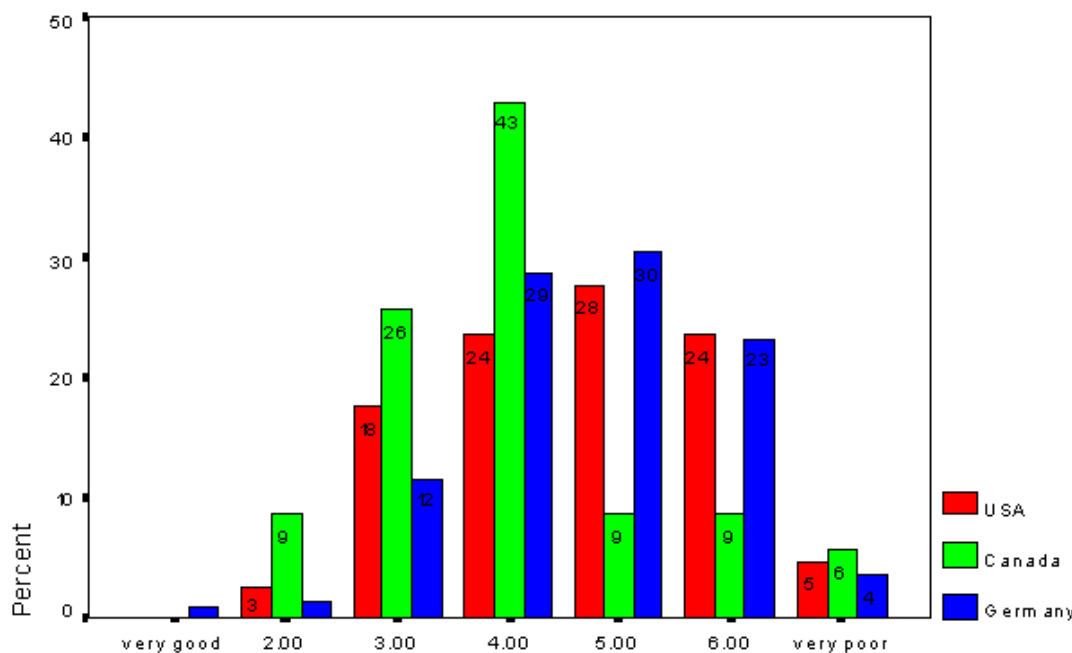
**Figure 8.** How Often Are You Contacted By The Media?



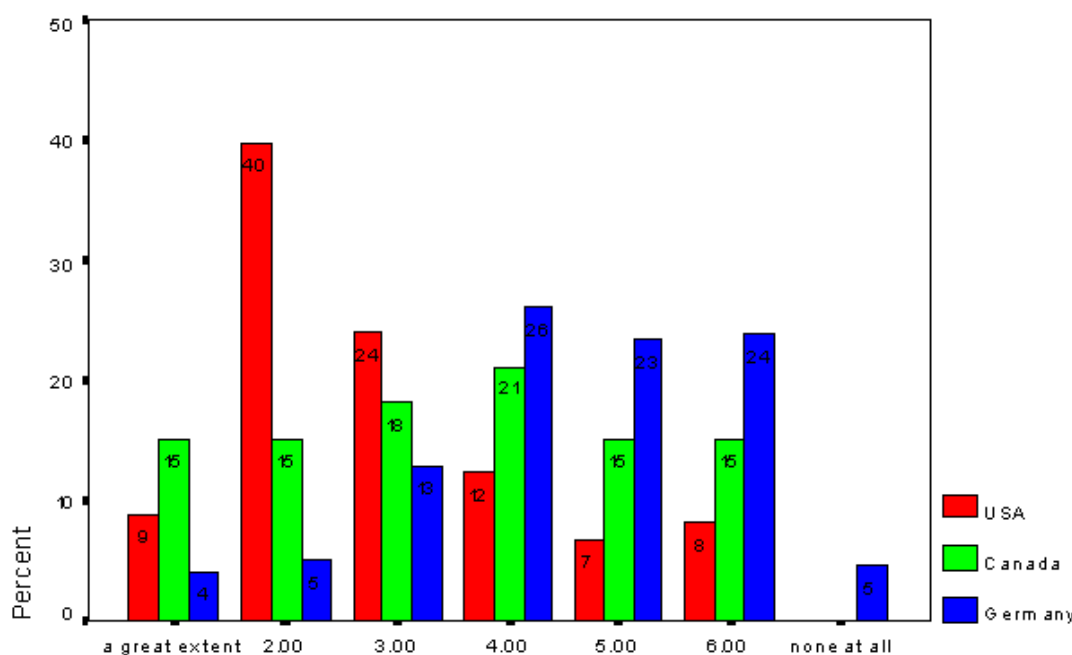
As the above two figures indicate, German scientists, in general, are least likely to have contact with policy makers and the least likely to have contact with the media. However, to unpack the within group differences, that is, who in the samples, are making such claims of social awareness and who are the scientists that are involved with the media and the policy makers is beyond the scope of this paper. It remains to be determined if it is the same people who report that climate scientists are well attuned to the sensitivity of human social systems to climate change are the same people who reported a high degree of involvement with the media or with policy makers. The limited amount interaction of the majority of scientists may be representative of differing degrees of a hierarchical tendency within the various science communities, however, at this point, this is merely speculation. As an effort to assess if scientists

indeed, perceive their efforts as being used in the best manner for policy contributions we asked their perceptions of the working relationship between climate scientists and policy makers (Figure 9, means: USA 4.7, Canada 4.0 Germany 4.7). The data would seem to suggest that the German sample is the least satisfied with the relationship between science and policy, perhaps coinciding with their seemingly lack of full participation. To this extent, attempted to find out who the climate scientists thought policy makers were listening to, and this became partic relevant considering the small numbers of scientists who seemed to participate in the political process. While 1 questions was considered "loaded" by some of the respondents and raised some controversy, we asked "To what extent are those who present the extremes of the climate debate, for example, those presenting the worst case scenario or those claiming that climate change is a hoax, the people most likely to be listened to by those involved in maki policy decisions?" (Figure 10, means: USA 2.9, Canada 3.5, German 4.5.) In other words, does science, in sor instances, adhere to the old adage "It is the squeaky wheel that gets the most grease".

**Figure 9.** Perceptions Of The Working Relationship With Policy Makers



**Figure 10.** To What Extent Are The Extreme Opinions The Most Listened To In The Climate Sciences?

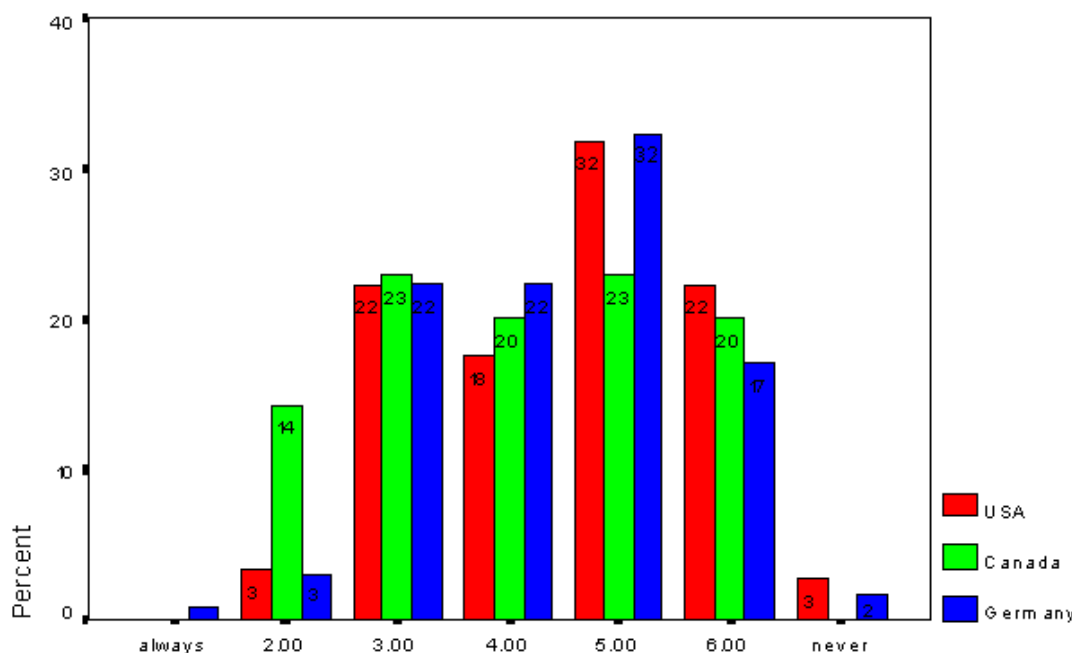


This could be interpreted as one measure of a level of satisfaction with the hierarchical structure of the science- process. In spite of the relative lack of participation in the public and political forum, the German sample was the most

convinced that it was not only the most extreme positions that were being heard. Pursuing a similar line of reasoning we asked if scientists felt that policy makers tended to draw from the state-of-the-art of climate knowledge (Figure 11, means: USA 4.6, Canada 4.1, Germany 4.4). This we interpreted as another measure of satisfaction with the current state of the socio-scientific context of the climate sciences. Here, however, the samples from all countries seem consider this a part of the process in need of improvement. One possible reason for this belief that the best of knowledge is not being transferred could have to do with how knowledge is 'released' from the scientific community. To this end, we asked "To what degree do climate scientists have control over what information gets transferred to policy makers?" again, pointing the degree of public and political exposure of the scientist (Figure 12, means: USA 4.4, Canada 4.4, Germany 3.3).

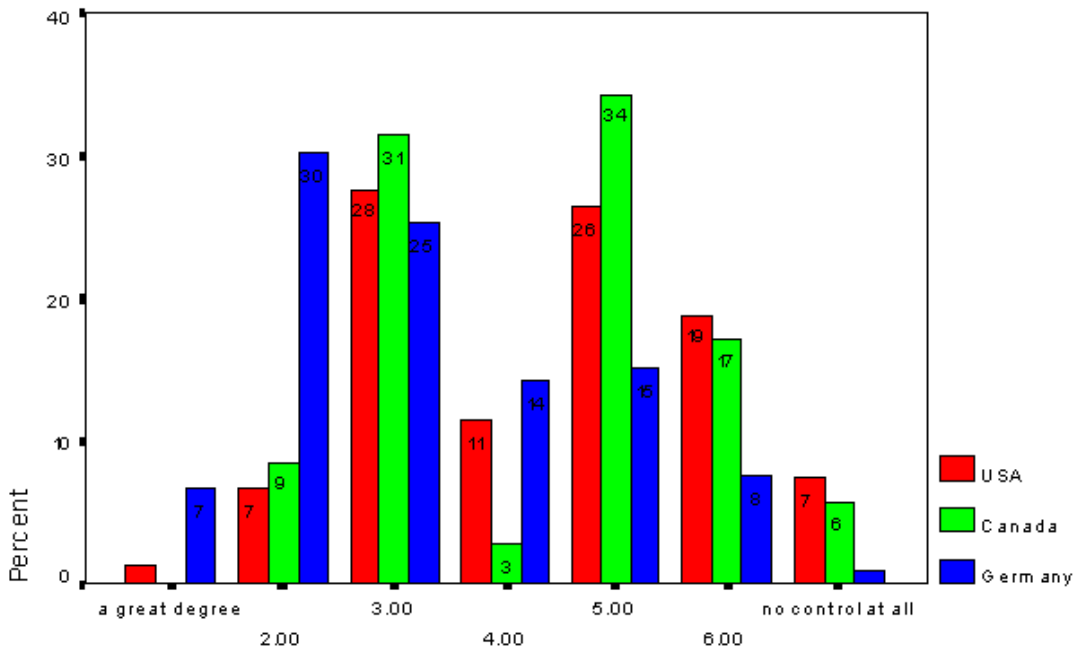
It would seem that in the German structure scientists tended to believe more than scientists from the other samples that there is a greater degree of control over the knowledge that gets transferred. This again might be suggestive idiosyncracies of each scientific community. Although, if one considers the results presented in Figure 11, we could not conclude that it is the best efforts of science that are put forward, raising the question of if scientists feel they have control over the knowledge that gets put forward, why is this knowledge the not best that science has to offer?. To this end, we asked if scientists felt that climate sciences have remained a value-neutral science (Figure 13, means: USA 4.3, Canada 4.4, Germany 4.0).

**Figure 11.** Policy And The Use Of The State-Of-The-Art-Climate Knowledge

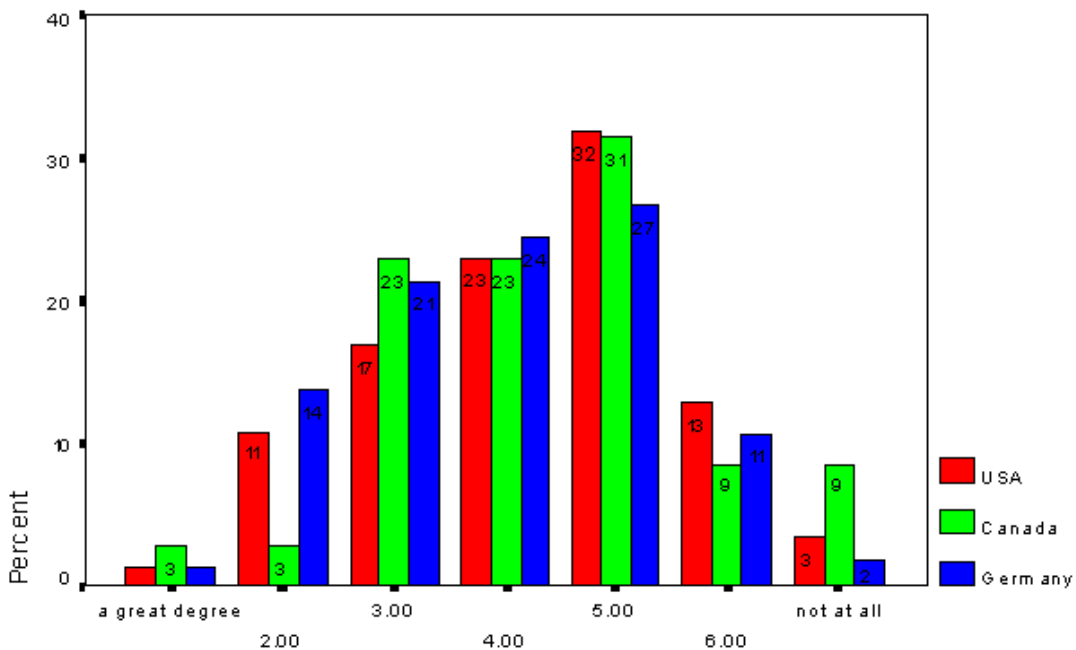


**Figure 12.** Scientist Have Control Over Knowledge Transfer



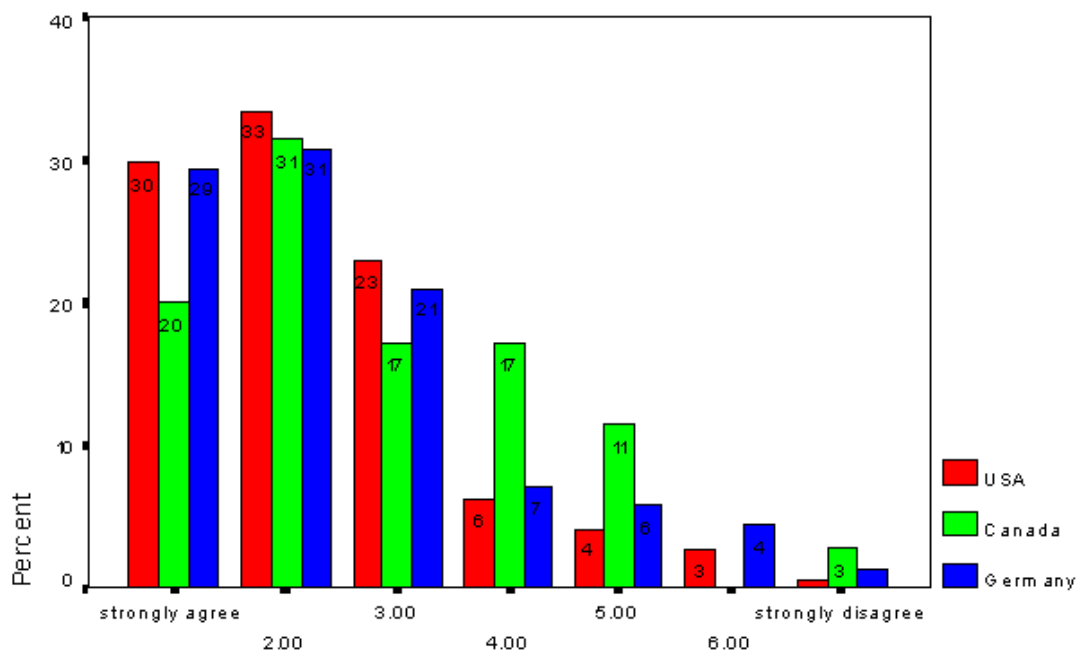


**Figure 13.** Has Climate Science Remained Value-Neutral?



Here it would seem that in spite of the different perspectives as to who controls the flow of knowledge, and who forward the knowledge, there is an overriding tendency to think that climate sciences are influenced more by values than by scientific objectivity. To address this suggestion, we asked how climate scientists perceived the nature of science in which they are involved, since it might be that the relative infancy and its political-by-nature character (in this particular socio-historic context) are the reasons for the noted areas of contention. To this end, we asked to what extent the respondent would agree that "Climate change is an extremely complex subject, full of uncertainties, and this allows for a greater range of assumptions and interpretations than many other scientific endeavors." (Figure, 14 means: USA 2.3, Canada 2.8, Germany 2.5.) In short, we asked scientists to what degree they felt social constructions enter into the climate sciences, and data indicate they perceive that social constructions do, indeed, enter 'objective science to a considerable extent.

**Figure 14.** Climate Science Is Full Of Uncertainties and Assumptions



#### 4. CONCLUSION

In the few variables presented we have attempted to touch on the process of the social construction of the climate issue. Briefly, the data indicated a consensus in the belief that global warming is a process already underway. However, there was a noticeable variability in the degree of confidence in the ability of the existing models to predict future climatic conditions. Nonetheless, in spite of the perceived inability to predict future climatic conditions, scientists were convinced to varying degrees that whatever the climatic state would be, it would result in detrimental effects in his or her host society. In all three samples there was a tendency to agree on the immediate need for decisions. It would appear, however, that only a few scientists get representation in policy matters or in access to public discourse. Many considered the relationship between science and policy as quite poor and felt that climate science has strayed from the objectivity of a value-neutral science. This we speculate, might be associated with the socio-cultural context within which the scientific community is located, the political-by-nature character of the science, and perhaps the relative infancy of the science. Furthermore, if, as reported, the science has a relatively large number of uncertainties and assumptions, and that climate sciences, as reported, are not considered to be value-neutral, then much of what gets transferred from the knowledge producers to the knowledge consumers could be as much a social construction as it is scientific 'fact'. These socio-scientific constructions may be the result of the historical and cultural contexts in which they came into being, which unfortunately, is a discussion beyond the scope of this paper. Nonetheless, this raises a number of hypotheses:

1. Socio-historical and cultural contexts influence the *shape* and *process* of science.
2. The *voice* of science is not necessarily representative of the 'local' scientific community and differs according to broader social contexts.
3. Lay philosophy plays a major role in the interpretation of the scientific 'facts' of global phenomena.
4. Sciences dealing with the newly evolving category of 'global' issues are more susceptible than 'established' sciences to manipulation with other than the best interest of science in mind.

All of the above have the potential to influence both the direction and application of research, which, in turn, has the potential to hinder the development of acceptable global policy. It might be that these suggestions made in this paper merely represent symptoms of a science in its infancy. On the other hand, it might be reflective of a new development within 'science' as we attempt to address rising *global phenomena* that, by necessity, enmesh both natural and social sciences. If the latter is the case, then all the more important that we begin to address both inter and intra group perceptions and interpretations, and the magnitude of their implications.

#### ACKNOWLEDGMENTS:

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