

**Understanding the Communication of Climate Change Risk:
Climate Scientists' Perspectives of Media Sources and Policy Makers**

James W. Stoutenborough
Robert Nicholas Fette
Arnold Vedlitz*
Carol L. Goldsmith

The Bush School of Government and Public Service
Texas A&M University
4350 TAMU
College Station, TX 77843-4350, United States

* Corresponding Author: avedlitz@tamu.edu, Phone: (979) 845-2929 Fax: (979) 862-8856

ACKNOWLEDGEMENT

The authors would like to acknowledge and thank Yefeng Wang for her contributions to the analysis of the survey results used in preparation of this manuscript.

Research Support

This material is based upon research conducted by the Institute for Science, Technology and Public Policy in The Bush School of Government and Public Service at Texas A&M University and supported under Award No. NA03OAR4310164 by the National Oceanic and Atmospheric Administration (NOAA), U.S. Department of Commerce. The statements, findings, conclusions, and recommendations are those of the authors and do not necessarily reflect the views of the National Oceanic and Atmospheric Administration or the Department of Commerce.

Understanding the Communication of Climate Change Risk: Climate Scientists' Perspectives of Media Sources and Policy Makers

Abstract: Despite the volumes of research that climate scientists produce examining the causes, effects, and history of global climate change, there continues to be an acceptance gap between these scientists and the public and government officials. While climate scientists share a consensus that climate change is occurring and is primarily caused by human activity, many people and officials remain skeptical about climate change. One cause of this gap could be the nature of scientists' communications of their work to the media, the public, and decision makers within the government. Are climate scientists, through their actions or lack thereof, putting us in greater risk? We conducted a survey of climate scientists to find out how they view this gap, its causes, and potential solutions. We focus our analysis on the scientists' assessments of three intervening factors – knowledge, media relations, and trust.

Key words: climate change; environmental communication; scientists' perception of public; political trust; scientific trust

The public, media, and governmental officials have discussed few issues pertaining to global climate change (GCC) more than the supposed competing beliefs among climate scientists. The assertion among some that there are noticeable inconsistencies in the thoughts and findings of climate scientists is a central part of the GCC debate. Those individuals who support the belief that GCC exists and human beings indeed contribute to it are likely to claim that most climate scientists are in agreement (e.g. Cook et al., 2013; Doran & Kendall Zimmerman, 2009; Farnsworth & Lichter, 2012; Rosenberg et al., 2010). Similarly, GCC skeptics like to point out what they say are inconsistencies and disagreements between climate scientists (Hulme, 2009). Consensus, or lack thereof, among climate scientists could affect public understanding of risk and subsequent policy preferences regarding GCC, as may be the case following the “Climategate” scandal (e.g. Stoutenborough, Liu & Vedlitz, 2014).

It is often easy to blame the media for the public’s lack of understanding on GCC (e.g. Antilla, 2005, 2010; Boykoff & Boykoff, 2004, 2007). At some level, the media must be contributing to the lack of congruence between governmental decision makers, the public, and climate scientists on policy solutions (Stoutenborough & Vedlitz, 2012), which highlights the differences between the climate scientists and non-experts. Indeed, Rosenberg et al. (2010) find that only 51% percent of climate scientists even believe that climate experts like themselves have played an important role in transforming GCC into a public policy issue. Others suggest that scientists have become more overtly political in recent decades (Martin & Richards, 1995), which may have resulted in a loss of prestige and a reduction in belief that scientists are objective participants in the GCC debate.

This raises serious questions regarding what is actually causing the acceptance gap that appears to exist. Looking from the scientists’ perspective, is the problem simply a lack of

technical understanding within the public and/or government officials? Is the news media failing to get the story right? Are climate scientists failing to properly communicate their findings to decision makers and the public?

Each of these possible explanations for climate scientists being out of sync with the public and/or government officials carries fairly substantial implications for the likelihood of effectively interpreting the science surrounding GCC and the subsequent mitigation of risk. Before differences can be bridged, we must have an understanding of the nature of the problem. Ultimately, do climate scientists bear some responsibility for the state of public opinion and government action on GCC? This project seeks to begin the process of constructing that metaphorical bridge by examining the potential causes of the gap from the perspective of climate scientists. We use a survey of climate scientists in the United States that addresses each of these issues. In the end, we find that scientists believe there are many explanations for this lack of agreement on important aspects of the GCC discussion, and they are clearly not immune from some responsibility for the current state of things.

Research Methods

We conducted a multi-modal survey¹ of US climate scientists between the months of March and September in 2005.² Our sample frame used for identifying scientists included both the lead and co-author of all published research articles on climate change from 1995 and 2004

¹ We attempted to complete surveys with the scientists over the Internet, through the mail, and over the phone. The survey was developed with the assistance of climate scientists and pre-tested on climate scientists and their graduate students.

² National Academy and International Panel on Climate Change scientific reports on GCC have remained virtually unchanged on the major dimensions of the scientific position on GCC from the time of this survey to present. Additionally, given the current state of public attitudes toward GCC and the continued lack of government response in the United States, it is unlikely that scientific perceptions on these issues have changed much in that time. Thanks in part to the Climategate scandal, public attitudes have not changed much since this survey was conducted (e.g. Stoughton, Liu & Vedlitz, 2014). Indeed, the Climategate incident increases the relevance of this project by providing insights into the attitudes of climate scientists that are currently not found in the literature.

in 13 internationally renowned, peer-reviewed scientific journals.³ These included: *Global Environmental Change*, *Journal of Climate*, *Journal of Atmospheric Sciences*, *Journal of Geophysical Research*, *Climatic Change*, *Journal of Applied Meteorology*, *Monthly Weather Review*, *Journal of Atmospheric and Oceanic Technology*, *Weather and Forecasting*, *Journal of Hydrometeorology*, *Earth Interactions*, *Bulletin of the American Meteorological Society*, and *Meteorological Monographs*.

During the article selection process, 986 US climate scientists were identified, but 57 were removed from further consideration due to a lack of contact information. The few authors in the sample who were social scientists (e.g. economists, political scientists, etc.), along with those missing academic training, were also removed. Social scientists were dropped so that the analysis could focus on those in the biological and physical sciences. The remaining 883 contacts were used to calculate our response rate ($468/883 = 53\%$).

Over half of the respondents were employed at a university and a third worked for the US government. Roughly, two-thirds were experienced in conducting applied research while less than a quarter conducted theoretical research. The scientists' years of experience in the subject of climate science averaged 16.68 years. In the five years prior to participating in the survey, the average respondent had authored or co-authored 11.82 publications on GCC in refereed journals.

Key Research Questions

Our objective is to analyze the climate scientists' view of several key sources of the acceptance gap between scientists, the public, and government officials on GCC issues. As noted, there are three basic explanations that have been offered to explain why the public and decision makers do not understand GCC: 1) public and decision maker technical understanding,

³ Journals were selected based upon discussions with climate scientists, impact factors, meteorology association publications, and other relevant data.

2) news media coverage, and 3) scientific communication. This analysis will examine these from the perspective of climate scientists.

As the group that should best understand GCC, scientists' perspectives are essential to identify the core element of the knowledge deficit. Bridging the knowledge deficit is important because information/knowledge is a necessary component for problem solving (e.g. Delli Carpini & Keeter, 1996; Hmelo-Silver, 2004) and policymaking (e.g. E. Ostrom, 2007; Sabatier & Weible, 2007). If the public and policy makers do not understand this issue, they cannot properly evaluate risk (e.g. Stoutenborough & Vedlitz, 2014), increasing the likelihood that they will reach less than efficient or optimal conclusions about that topic (V. Ostrom, 2007). This appears to have manifested itself in the significant differences between the public/policymakers and climate scientists in their support for policies to address GCC (Stoutenborough & Vedlitz, 2012). Accordingly, we expect that:

H1: Climate scientists believe the public and policy makers do not understand the technical issues of global climate change.

The media is the primary vehicle available to spread scientific research regarding GCC. This is argued to be a two-stage process: 1) scientists develop knowledge; 2) it is simplified and spread to the public (see Hilgartner, 1990). The media's ability to convey this information is essential for creating an informed public. However, it appears the media largely fails in this aspect (Antilla, 2005, 2010; Boykoff & Boykoff, 2004, 2007; McCright & Dunlap, 2003), which distorts the science (Hilgartner, 1990) and makes it increasingly unlikely that the public or decision makers will understand GCC. Part of the problem is that reporters generally do not understand GCC (Wilson, 2000). As a result, the public communicates and discusses many complex issues in ways that have nothing to do with the science (e.g. Irwin, Dale, & Smith,

1996). Consequently, scientists may feel that the reporting is too sensational or speculative (e.g. Gunter, Kinderlerer, & Beyleveld, 1999). Furthermore, the reporting of the computer models used by climate scientists have substantially declined and are primarily used by climate skeptics when they are reported (Akerlof et al., 2012). The primary manner in which the media can fail in its presentation of this scientific information is to incorrectly report what the research has found. Consequently, we anticipate the following:

H2: Climate scientists believe the media inaccurately reports on scientific research regarding global climate change.

Before the media can report on this information, they must be introduced to the research. Since members of the media are unlikely to have advanced degrees in the sciences, they must rely upon others to explain the meaning of the research. This should necessitate having contact with climate scientists. This contact should be a two-way street. The media should contact climate scientists to learn about GCC. Similarly, climate scientists could be proactive and contact members of the media to inform them about GCC research. However, as Bauer, Allum, and Miller (2007) explain, there is a paradigm of research that suggests scientists may not engage with outsiders if they believe these outsiders are largely ignorant of the issue (e.g. Holliman et al., 2009; Seargent & Steele, 1998). Furthermore, Trench (2009) argues that information summaries provided by scientific journals and higher education, often in press release style, have caused journalists to use a reactive news process as opposed to an investigative approach that would encourage dialogue between the journalist and the scientists. Combine these realities with the realization that there is a gap between scientific knowledge and quality of the information reported by the media (e.g. Boykoff & Boykoff, 2004, 2007; McCright & Dunlap, 2003), and one might expect fairly little contact between scientists and non-scientists. We expect that:

H3: The media rarely contact climate scientists to learn about global climate change.

H4: Climate scientists rarely contact members of the media to inform them about global climate change.

Similarly, policy makers should have an incentive to develop an understanding of an issue prior to developing legislation. Legislative bodies are in a unique position to obtain this information using committee hearings that can bring experts to testify about the current state of GCC research. Similarly, since scientists agree that GCC is occurring and the majority of the research suggests that this is a bad thing, scientists could also feel compelled to contact policy makers to inform them about their research to encourage policy makers to act upon the information. Complicating this relationship, we also know that the majority of commissioned scientific reports are never actually read (e.g. Boswell, Geddes, & Scholten, 2011), which suggests limited communication between the two groups. Again, existing research indicates that the two groups are not on the same page in their support of policy (Stoutenborough & Vedlitz, 2012), which suggests that:

H5: Policy makers rarely contact climate scientists to learn about global climate change.

H6: Climate scientists rarely contact policy makers to inform them about global climate change.

It is also possible that climate scientists avoid interactions with policy makers because they do not like or trust government officials. If they do not have a good working relationship with policy makers or believe that they will not use their research, scientists may be less willing to trust that policy makers will not use them as pawns. This may cause scientists to avoid contact

with policy makers. Again, judging from the lack of congruence between policy makers and climate scientists on policy preferences (Stoutenborough & Vedlitz, 2012) and the belief that climate scientists have barely influenced policy making (Rosenberg et al., 2010), we expect that:

H7: Climate scientists do not believe that they have a strong working relationship with policy makers.

H8: Climate scientists do not believe that policy makers use scientific information when legislating on global climate change.

If these expectations hold, then it is unlikely that climate scientists will trust government officials on policy choices vis-à-vis GCC. Trust, though, is a function of social value similarity and competence (Cvetkovich & Nakayachi, 2007). Ullmann-Margalit (2004) suggests that this social value similarity can be thought of in terms of whether the entity intends to act in your best interests. When that entity, in this case the government, does not intend to act in your best interest, because the two of you do not share the same social values, you are more likely to distrust. We know that American governmental institutions have largely avoided legislating GCC (Matisoff, 2008), which suggests that government officials and climate scientists likely do not share similar values. Indeed, the second Bush administration had been accused of attempting to suppress federal climate research (e.g. Rich & Merrick, 2007; Union of Concerned Scientists, 2007). Similarly, their inability to adopt legislation speaks to their competence.

However, it is unreasonable to assume that scientists will view all governmental institutions the same. For instance, federal agencies that are most closely related to GCC research ought to be viewed as more trustworthy than agencies that do not specialize in GCC. For instance, the National Oceanic and Atmospheric Administration (NOAA) is a worldwide leader in GCC research, while the Department of Commerce is primarily concerned with business

interests, which are not likely to be on the same side of the issue as climate scientists. Similarly, because they are often used as political pawns (Boswell, 2009), scientists ought to view legislative institutions differently than they view agencies. On the other hand, agencies also have a habit of ignoring research that it commissions (Boswell et al., 2011), which suggests that there is unlikely to be a strict agency versus legislative body divide. From this, we expect:

H9: Climate scientists will trust federal agencies more than legislative bodies on global climate change policy development and choices.

H10: The more closely an agency's emphasis is toward global climate change, the more likely climate scientists will trust that organization on global climate change policy development.

Research Results

We present our results in the following section. We begin with climate scientists' views about how knowledgeable climate scientists, media, policy makers, and the public are about GCC. We then detail the scientists' contact with and perceptions of various groups, beginning with the media, proceeding to government officials, and concluding with different government institutions.

Perceptions of knowledge

Knowledge is an important, foundational element in reasoned decision making (e.g. Delli Carpini & Keeter, 1996). With this in mind, it is necessary to understand how climate scientists' assess the knowledge of several key players in the GCC policy debate; these are presented in Table 1.⁴ Fifty-six percent believed their fellow climate scientists understand GCC very well. However, only 0.8% of the respondents indicated that the media understand GCC very well, and

⁴ Respondents rated GCC understanding for four groups using a four-point scale (1 = not at all, 2 = not well, 3 = moderately well, and 4 = very well).

none of the respondents thought either policy makers or the public understand very well. On the opposite end of the scale, only 0.4% of the respondents believed that climate scientists do not understand GCC at all, but 8% held this opinion about the media, 18.2% for policy makers, and 21.1% believed the public does not understand at all. Perhaps, not unexpectedly, nearly two-thirds of all of the scientists chose “not well” as their assessment of the media, policy makers, and the public. These results provide support for H1, which expected that climate scientists do not believe the public and/or policy makers understand GCC. This may be ground zero for the gap between the public and/or government officials and those who actually understand the problem, climate scientists (see e.g. Holliman et al., 2009).

[Insert Table 1 about here]

Contact with and perception of news media and various groups

We turn our attention to the scientist/media relationship. An obvious way to close the knowledge gap is for scientists to contact directly those who are in a position to spread scientific information. This contact is a necessary, if not sufficient, condition to help bring media coverage more in sync with actual scientific findings and allow the public and policy makers to more accurately evaluate risk. We examined the climate scientists’ views of their relationship with newspapers, television, radio, national officials, state and local officials, businesses, environmental interest groups, and other types of interest groups. First, we obtained a count of the number of contacts climate scientists report with these groups over the previous five years. Second, we asked with which groups they had contact. Finally, we asked about any direct efforts by the scientists to initiate contact with any of these groups.

As shown in Figure 1, 36.2% of climate scientists fielded the lion’s share of requests for information, and greater than 50 % were contacted only once or less in the five-year period. This

is consistent with the findings of Trench (2009), which indicated that journalists may be less likely to contact scientists due to scientific journals simplifying the results in press release styled summaries. On the other hand, climate scientists are not proactive in their efforts to help educate non-experts. Less than 10% of climate scientists initiated contact with any of these groups at least twice per year. Moreover, 65.2% of all climate scientists made no effort to reach out to any of these groups, which may reflect their low expectations of policy makers and journalists actually understanding GCC (see e.g. Holliman et al., 2009). Interestingly, only a small group of climate scientists, 7.6%, identified that they were contacted *and* initiated contact at least twice.

[Insert Figure 1 about here]

As illustrated in Figure 2, we found the newspapers are much more likely to contact climate scientists than any of the other groups, but this rate was still less than 60% of the sample. Conversely, television and radio news are far less likely to contact climate scientists. Importantly, at the time of the survey, the public relied most upon television and fairly heavily on newspapers and radio for information about GCC (Stoutenborough, Liu & Vedlitz, 2014). In short, two of the three primary media mechanisms used by the public had relatively little contact with climate scientists. This helps to explain part of the risk perception and policy support differences between climate scientists and the public/government that has developed and provides partial support for H3. However, as illustrated, climate scientists make little effort to contact the media, supporting H4.

[Insert Figure 2 about here]

Additionally, it appears that the separation between scientists and government officials on policy preferences is possibly due to a lack of communication between the two groups, which supports H5. Only 26.4% of the respondents had been contacted by a national official, and

25.9% had been contacted by a state or local official. While policy makers rarely contact climate scientists, climate scientists are significantly less likely to contact government officials, supporting H6.

Communications between the media and climate scientists are not particularly common. Since climate scientists do not believe that the media understands GCC (see also Wilson, 2000), is this lack of communication influenced by the accuracy of media coverage? If the media covers GCC poorly, this might help to explain the differences between the public and/or policy makers and climate scientists. Figure 3 illustrates the extent to which climate scientists believe the news media communicates an accurate picture of GCC.⁵ The average response given for general accuracy of GCC reporting was a 4.16 on the scale from 0 to 10. On this scale, a 5 represents the mid-point, which means that climate scientists generally do not believe that media coverage of GCC is particularly accurate, supporting H2. This should contribute to the discrepancies in the perceptions of risk.

[Insert Figure 3 about here]

This provides only a portion of the story about the relationship between climate scientists and the media. When asked about their interactions with the media, 76.8% of the scientists surveyed revealed that aspects of their research had been reported in the media even though as noted in Figures 2 and 3, there had been little direct contact between them. This suggests that media sources are looking at published studies, or at the very least journals' press release summaries (see Trench, 2009), but are not necessarily contacting the authors for comment or clarification. Figure 3 also illustrates climate scientists' perceived accuracy of the media's reporting of their research. While climate scientists generally think that media is doing a poor job covering GCC, they believe that the media more accurately represents their own research, with

⁵ Respondents rated the accuracy of media coverage using an 11-point scale (0-not at all accurate, 10-very accurate).

an average score of 6.61.⁶ This indicates that the general assessment of media accuracy is unlikely influenced by their personal experience.

It is clear that scientists do not believe the media understands GCC, and they believe the media is more likely than not to get things wrong when they do report on GCC. Recognizing this problem, do climate scientists take it upon themselves to try to correct these mistakes when they appear? Again, as the primary vehicle for understanding GCC, it is important that media coverage is as accurate as possible to best educate the masses. Therefore, we also asked climate scientists if they attempted to correct any inaccuracies that may have been reported. We found that only 32.6% of those who thought there were inaccuracies attempted to do so. In other words, a supermajority of all media mistakes is never brought to the attention of the journalists who made the mistake. Of the attempts to correct a mistake, the media corrected only 29.4%. This lack of response likely contributes to the lack of communication between the two groups, as climate scientists may believe it is not worth the effort since they will be ignored.

The takeaway from all of this is fairly evident. Everyone needs to share in the responsibility for poor understanding of the science of GCC by the media, public, and government officials. Those with the access to climate scientists are not making an effort to seek their expertise. Climate scientists are not proactive and appear to do little to increase public and policymaker knowledge and understanding of GCC, which directly influences their risk perceptions. Additionally, climate scientists do not appear to be concerned about correcting inaccuracies reported about their research, and media outlets do not feel compelled to correct these mistakes when notified.

⁶ This behavior is not unique to climate scientists. Political scientists have found similar patterns to public perceptions in other phenomenon such as the public likes their Congressman but does not like Congress (e.g. Fenno, 1975; Jacobson, 1992). Fenno (1975) argues that we use different standards when evaluating at the individual level, as opposed to the aggregate. It is likely that the same is occurring for climate scientists' evaluations of media coverage.

Assessments of government

The final explanation examined for the difference between climate scientists and the public and government officials on GCC risk perceptions and policy development comes down to trust. Humans tend to have a better working relationship with those they trust (Ullmann-Margalit, 2004). If you do not trust someone's expertise in a specific area, you are more likely to not want to have anything to do with that person. As illustrated in Figure 4, we find support for H7, as climate scientists generally do not believe that they have a strong working relationship with government officials. Indeed, using an eleven-point scale from 0 to 10, we find that the average evaluation of this relationship is only 3.7.⁷

[Insert Figure 4 about here]

Additionally, recall that Rosenberg et al. (2010) found that only 51% of climate scientists believed that climate scientists have played an important role in influencing the policy debate on GCC. With such a large percentage believing that they have no influence, we sought to determine the extent to which scientists believe that government officials use relevant, scientific knowledge in their decision-making. As illustrated in Figure 4, the results indicate that scientists believe that officials are not using state-of-the-art knowledge. With an average score of 3.3, based on an eleven-point scale from 0 to 10, we find support for H8 – climate scientists do not believe that policy makers use scientific information when legislating on GCC. Part of this may be a byproduct of scientists' not engaging government. Not surprisingly, these three revelations help to explain why the two groups disagree on the need to and how to address GCC.

Recall, competence is an important component of trust, and those who are more knowledgeable about their trade and more capable are more likely to be considered competent.

⁷ Respondents rated the quality of their working relationship with policy makers and the ability of policy makers to use up-to-date GCC data in the policy formulation process using 11-point scales - (0-No relationship, 10-very strong relationship) and (0-never, 10-always), respectively.

In an effort to understand better this complex relationship between government and climate scientists, we asked the participants to evaluate the level of competence for three federal agencies (NOAA; Environmental Protection Agency, or EPA; and the Department of Energy, or DOE) and three levels of government (Congress, state, and local).⁸ Table 2 presents the results of these questions. What immediately becomes clear is that climate scientists believe that the three federal agencies are much more competent than Congress, state officials, or local officials, providing support for H9, that climate scientists will trust federal agencies more than legislative bodies on GCC policy development and choices. Indeed, 61% believed that NOAA's level of competence was an eight or higher. The average perception of competence for NOAA was 7.5, while the EPA was 5.6, and the DOE was 5.1. Anything higher than 5 indicates that these institutions were viewed as more competent than not, indicating that the EPA and DOE were considered barely more competent than not. The differences between the EPA/DOE and NOAA indicate that we found support for H10, which states that the more closely an agency's emphasis is toward GCC, the more likely climate scientists will trust that organization on GCC policy development. On the other hand, all three levels of government were viewed as not being particularly competent. Perceptions of Congress averaged a score of 3.2, local officials 3.4, and state officials topped this list with a 3.6. Since states have been more proactive with regards to climate policy (Rabe, 2013), it is not surprising that they would be the highest, even if their competence evaluation is, overall, quite low.

[Insert Table 2 about here]

These results indicate that climate scientists are less likely to trust Congress and state or local governments and barely trust the EPA and DOE. Conversely, they appear to place a great

⁸ Respondents rated the competence of three agencies and the different levels of government using an 11-point scale - (0- not at all competent, 10- completely competent).

deal of trust in NOAA. Together, these provide partial support for H9 and H10. Importantly, trust is a foundational component that influences human interaction. If we do not trust someone, we are far less likely to want to interact with that person, and vice versa (e.g. Ullmann-Margalit, 2004). These results may help explain why we find so little contact between climate scientists and virtually every organization examined (see Bauer, Allum & Miller, 2007). For instance, climate scientists may rarely contact government officials simply because they do not trust them.

Discussion

We began this project seeking to understand better why the public and government officials do not view the risk of GCC or hold policy preferences that are similar to those of climate scientists. We had identified three logical explanations for this separation and solicited the opinions of climate scientists to evaluate their perspective on these issues. The results indicate that we have a self-reinforcing circle that further perpetuates the differences between the public/government officials and climate scientists. In short, all parties are guilty.

First, climate scientists clearly do not believe that non-experts understand GCC. This likely feeds into their evaluations of the competence of governmental agencies and the different levels of government, as competence is related to understanding the issue (Cvetkovich & Nakayachi, 2007). Because scientists do not believe that government officials understand GCC, thus likely believing they are incompetent, scientists have little contact with them, which is consistent with the research paradigm that suggests scientists will disengage when dealing with outsiders that are ignorant of the issue (see Bauer et al., 2007). Inevitably, this perpetuates the ignorance and further strains relations.

Second, the results may indicate that scientists believe the media must also accept responsibility for the GCC acceptance gap. Climate scientists are in the best position to evaluate

the accuracy of the media, and their evaluations are not particularly favorable. The media appears to be more inaccurate than accurate in their portrayal of GCC, and they are unwilling to correct errors when they are pointed out. As the best method to educate the public on issues like GCC, the “Fourth Estate” needs to accept their responsibility for quality journalism. The media may also benefit from soliciting information from a more diverse group of scientists.

Finally, scientists appear to believe government officials need to accept that they do not understand GCC at the level needed to make appropriate policy (see V. Ostrom, 2007) and that they may actually need the assistance of climate scientists. Politicians need to stop playing political games with GCC (see e.g. Rich & Merrick, 2007; Union of Concerned Scientists, 2007), as the potential risk of GCC could be catastrophic. In general, the politicization of GCC has turned it into an issue that is divided upon left/right considerations (e.g. McCright & Dunlap, 2011) and has resulted in a logic schism that has caused the two sides to talk past each other (Hoffman, 2011). Officials need to do their job and make informed decisions about how to best deal with GCC. If, after becoming educated on the topic, they still do not perceive risk and decide that there is no reason to act, there is not much that can be done. At least, though, they would have made an informed decision, which is something that is unlikely to occur in the current political environment.

In a similar fashion, climate scientists need to make greater efforts to restore communications with government officials. Because scientists have become more overtly political (Martin & Richards, 1995) and are likely to be engaged with environmental advocacy groups (Bromley-Trujillo et al., 2014), it is easy for them to have been used as pawns by government officials (see Boswell, 2009). Simply sitting back and producing more research on GCC will not fix this relationship, as most of this research is simply ignored, even when

commissioned by the government (Boswell et al., 2011). This relationship is a two-way street, and both parties need to put aside their differences to focus on what is important – the impact of GCC.

Although the data presented in this manuscript is to some extent dated, the information provided offers an important and understudied window into the views and behaviors of climate scientists. We are unaware of any literature that addresses these issues within the United States, and following the Climategate scandal, these attitudes should be particularly relevant.⁹

Importantly, we find that climate scientists do not have a particularly large amount of interaction with policymakers or the media, and they do not have much confidence in these groups despite the country moving closer to what many describe as a potential tipping point (e.g. Guber & Bosso, 2013) beginning the year after the survey was conducted. Given the collapse of efforts to establish a comprehensive, national climate policy and the media coverage of Climategate, it is probable that the results reported here represent the high water level for these attitudes and behaviors. If true, then it is likely that current levels of engagement and attitudes toward policy makers and media are worse than the poor levels reported here, which would help to explain why public opinion has not rebounded much (e.g. Stoutenborough, Liu & Vedlitz, 2014) even after those who were involved in Climategate were cleared of wrongdoing (Nature, 2010). Until communication is restored and scientific knowledge flows, it is unlikely that public and policy makers' risk perceptions will adequately align with scientists, which will limit policy action.

⁹ In 2008, a global survey of climate scientists asked a few question with regards to issues like contact with media and policymakers (Bray & Storch, 2010). This survey resulted in 375 completed surveys, of which only 147 were from the United States.

References

- Akerlof, Karen, Katherine E. Rowan, Dennis Fitzgerald, and Andrew Y. Cedeno. 2012. "Communication of Climate Projections in US Media amid Politicization of Model Science." *Nature Climate Change* **2**(9): 648–654.
- Antilla, Liisa. 2005. "Climate of Skepticism: US Newspaper Coverage of the Science of Climate Change." *Global Environmental Change* **15**(4): 338–352.
- Antilla, Liisa. 2010. "Self-Censorship and Science: A Geographical Review of Media Coverage of Climate Tipping Points." *Public Understanding of Science* **19**(2): 240–256.
- Bauer, Martin W., Nick Allum, and Steve Miller. 2007. "What Can We Learn from 25 Years of PUS Survey Research? Liberating and Expanding the Agenda." *Public Understanding of Science* **16**(1): 79–95.
- Boswell, Christina. 2009. *The Political Uses of Expert Knowledge: Immigration Policy and Social Research*. Cambridge: Cambridge University Press.
- Boswell, Christina, Andrew Geddes, and Peter Scholten. 2011. "The Role of Narratives in Migration Policy-Making: A Research Framework." *British Journal of Politics and International Relations* 13 1–11.
- Boykoff, Maxwell T., and Jules M. Boykoff. 2004. "Balance as Bias: Global Warming and the US Prestige Press." *Global Environmental Change* **14**(2): 125–136.
- Boykoff, Maxwell T., and Jules M. Boykoff. 2007. "Climate Change and Journalistic Norms: A Case-Study of US Mass-Media Coverage." *Geoforum* **38**(6): 1190–1204.
- Bray, Dennis, and Hans von Storch. 2010. *ChiSci2008: A Survey of the Perspectives of Climate Scientists Concerning Climate Science and Climate Change*. Geesthacht: GKSS.

- Bromley-Trujillo, Rebecca, James W. Stoutenborough, Kellee J. Kirkpatrick, and Arnold Vedlitz. 2014. "Climate Scientists and Environmental Interest Groups: The Intersection of Expertise and Advocacy." *Politics, Groups, and Identities* 2(1):120-134.
- Cook, John, Dana Nuccitelli, Sarah A. Green, Mark Richardson, Bärbel Winkler, Rob Painting, Robert Way, Peter Jacobs, and Andrew Skuce. 2013. "Quantifying the Consensus on Anthropogenic Global Warming in the Scientific Literature." *Environmental Research Letters* 8(2): 1–7.
- Cvetkovich, George, Kazuya Nakayachi. 2007. "Trust in a High-Concern Risk Controversy: A Comparison of Three Concepts." *Journal of Risk Research* 10(2): 223–237.
- Delli Carpini, Michael X., and Scott Keeter. 1996. *What Americans Know about Politics and Why It Matters*. New Haven, CT: Yale University Press.
- Doran, Peter T., and Maggie Kendall Zimmerman. 2009. "Examining the Scientific Consensus on Climate Change." *Eos, Transactions American Geophysical Union* 90(3): 22–23.
- Farnsworth, Stephen J., and S. Robert Lichter. 2012. "The Structure of Scientific Opinion on Climate Change." *International Journal of Public Opinion Research* 24(1): 93–103.
- Fenno, Richard F. 1975. "If Ralph Nader Says, Congress Is 'The Broken Branch,' How Come We Love Our Congressman So Much?" In *Congress in Change: Evolution and Reform*, ed. Norman J. Ornstein. New York: Praeger, 275–287.
- Guber, Deborah Lynn, and Christopher J. Bosso 2013. "'High Hopes and Bitter Disappointment': Public Discourse and the Limits of the Environmental Movement in Climate Change Politics." In *Environmental Policy: New Directions for the 21st Century*, 8th ed., eds. Norman J. Vig and Michael E. Kraft. Washington D.C.: CQ Press, 54–82.

- Gunter, Barrie, Julian Kinderlerer, and Deryck Beyleveld. 1999. "The Media and Public Understanding of Biotechnology: A Survey of Scientists and Journalists." *Science Communication* **20**(4): 373–394.
- Hilgartner, Stephen. 1990. "The Dominant View of Popularization: Conceptual Problems, Political Uses." *Social Studies of Science* **20**(3): 519–539.
- Hmelo-Silver, Cindy E. 2004. "Problem-Based Learning: What and How Do Students Learn?" *Educational Psychology Review* **16**(3): 235–266.
- Hoffman, Andrew J. 2011. "Talking Past Each Other? Cultural Framing of Skeptical and Convinced Logics in the Climate Change Debate." *Organization & Environment* **24**(1): 3–33.
- Holliman, Richard, Liz Whitelegg, Eileen Scanlon, Sam Smidt, and Jeff Thomas (Eds.). 2009. *Investigating Science Communication in the Information Age: Implications for Public Engagement and Popular Media*. New York: Oxford University Press.
- Hulme, Mike. 2009. *Why We Disagree About Climate Change: Understanding Controversy, Inaction, and Opportunity*. New York: Cambridge University Press.
- Irwin, Alan, Alison Dale, and Denis Smith. 1996. "Science and Hell's Kitchen: The Local Understanding of Hazard Issues." In *Misunderstanding Science? The Public Reconstruction of Science and Technology*, eds. Alan Irwin, and Brian Wynne. New York: Cambridge University Press, 47.
- Jacobson, Gary C. 1992. *The Politics of Congressional Elections*. New York: Harper Collins.
- Martin, Brian, and Evellen Richards. 1995. "Scientific Knowledge, Controversy, and Public Decision-Making." In *Handbook of Science and Technology Studies*, eds. Sheila

- Jasanoff, Gerald E. Markle, James C. Petersen, and Trevor Pinch. Newbury Park, CA: Sage, 506–526.
- Matisoff, Daniel C. 2008. “The Adoption of State Climate Change Policies and Renewable Portfolio Standards: Regional Diffusion or Internal Determinants?” *Review of Policy Research* **25**(6): 527–546.
- McCright, Aaron M., and Riley E. Dunlap. 2003. “Defeating Kyoto: The Conservation Movement’s Impact on U.S. Climate Change Policy.” *Social Problems* **50**(3): 348–373.
- McCright, Aaron M., and Riley E. Dunlap. 2011. “The Politicization of Climate Change and Polarization in the American Public’s Views of Global Warming, 2001–2010.” *The Sociological Quarterly* **52**(2): 155–194.
- Nature. 2010. “Editorial: A Question of Trust.” *Nature* **466**(7302): 7.
- Ostrom, Elinor. 2007. “Institutional Rational Choice: An Assessment of the Institutional Analysis and Development Framework.” In *Theories of the Policy Process*, 2nd ed., ed. Paul A. Sabatier, Boulder, CO: Westview Press, 21–64.
- Ostrom, Vincent. 2007. *The Intellectual Crisis in American Public Administration*, 3rd ed. Tuscaloosa, AL: University of Alabama Press.
- Rabe, B. G. (2013). “Racing to the Top, the Bottom, or the Middle of the Pack? The Evolving State Government Role in Environmental Protection.” In *Environmental Policy: New Directions for the 21st Century*, 8th ed., eds. Norman J. Vig & Michael E. Kraft. Washington D.C.: CQ Press, 30–53.
- Rich, Robert F., and Kelly R. Merrick. 2007. “Use and Misuse of Science: Global Climate Change and the Bush Administration.” *Virginia Journal of Social Policy and Law* **14**: 223–252.

- Rosenberg, Stacy, Arnold Vedlitz, Deborah F. Cowman, and Sammy Zahran. 2010. "Climate Change: A Profile of U.S. Climate Scientists' Perspectives." *Climatic Change* **101**(3-4): 311–329.
- Sabatier, Paul A., and Christopher M. Weible. 2007. "The Advocacy Coalition Framework: Innovations and Clarifications." In *Theories of the Policy Process*, 2nd ed., ed. Paul A. Sabatier. Boulder, CO: Westview Press, 189–220.
- Seargent, John, and Jane Steele. 1998. *Consulting the Public: Guidelines and Good Practice*. London: Policy Studies Institute.
- Stoutenborough, James W., Xinsheng Liu, and Arnold Vedlitz. 2014. "Public Attitudes toward Climate Change: Risk, Hazards, and Public Policy." *Risk, Hazards & Crisis in Public Policy* 5(1): 22-37.
- Stoutenborough, James W., and Arnold Vedlitz, A. 2012. "Public Opinion and Climate-Related Policy Solutions: A Comparison of the Policy Preferences of the Public, Stakeholders, and Climate Scientists." Paper presented at the annual meeting of the Midwest Political Science Association, Chicago.
- Stoutenborough, James W., and Arnold Vedlitz. 2014. "The Effect of Perceived and Assessed Knowledge of Climate Change on Public Policy Concerns: An Empirical Comparison." *Environmental Science & Policy* **37**: 23–33.
- Trench, Brian. 2009. "Science Reporting in the Electronic Embrace of the Internet." In *Investigating Science Communication in the Information Age: Implications for Public Engagement and Popular Media*, eds. Richard Holliman, Liz Whitelegg, Eileen Scanlon, Sam Smidt, and Jeff Thomas. New York: Oxford University Press, 166–180.

- Ullmann-Margalit, Edna. 2004. "Trust, Distrust, and in Between." In *Distrust*, ed. Russell Hardin. New York: Russell Sage Foundation, 60–82.
- Union of Concerned Scientists. 2007. "Atmosphere of Pressure (2007): Political Interference in Federal Climate Science." Available:
http://www.ucsusa.org/scientific_integrity/abuses_of_science/atmosphere-of-pressure.html. Accessed March 14, 2014.
- Wilson, Kris M. 2000. "Drought, Debate, and Uncertainty: Measuring Reporters' Knowledge and Ignorance about Climate Change." *Public Understanding of Science* 9(1): 1–13.

Table 1: Climate scientists' opinions on the general state of knowledge pertaining to global climate change

System Participant	Understanding of Global Climate Change			
	Very Well	Moderately Well	Not Well	Not at All
Climate Scientists	56.1%	40.2%	3.3%	0.4%
Media	0.8%	28.1%	63.0%	8.0%
Policy Makers	0.0%	16.4%	65.2%	18.2%
Public	0.0%	10.4%	68.5%	21.1%

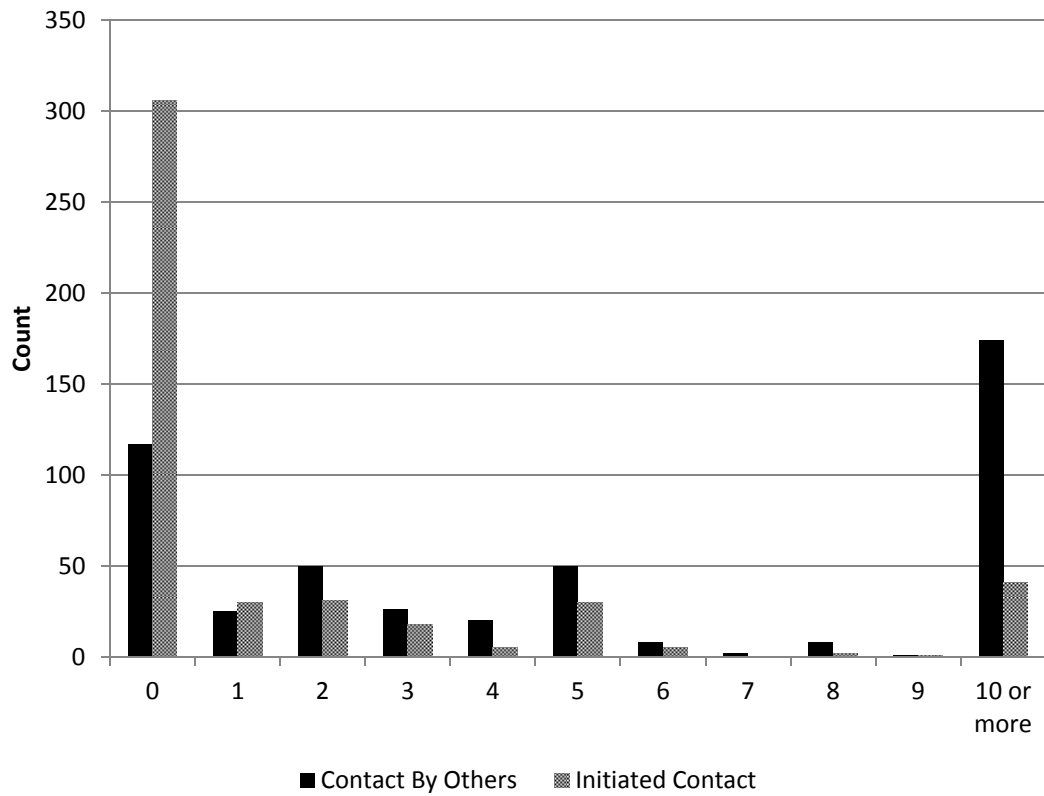


Figure 1: Rate of climate scientists' contact with other groups

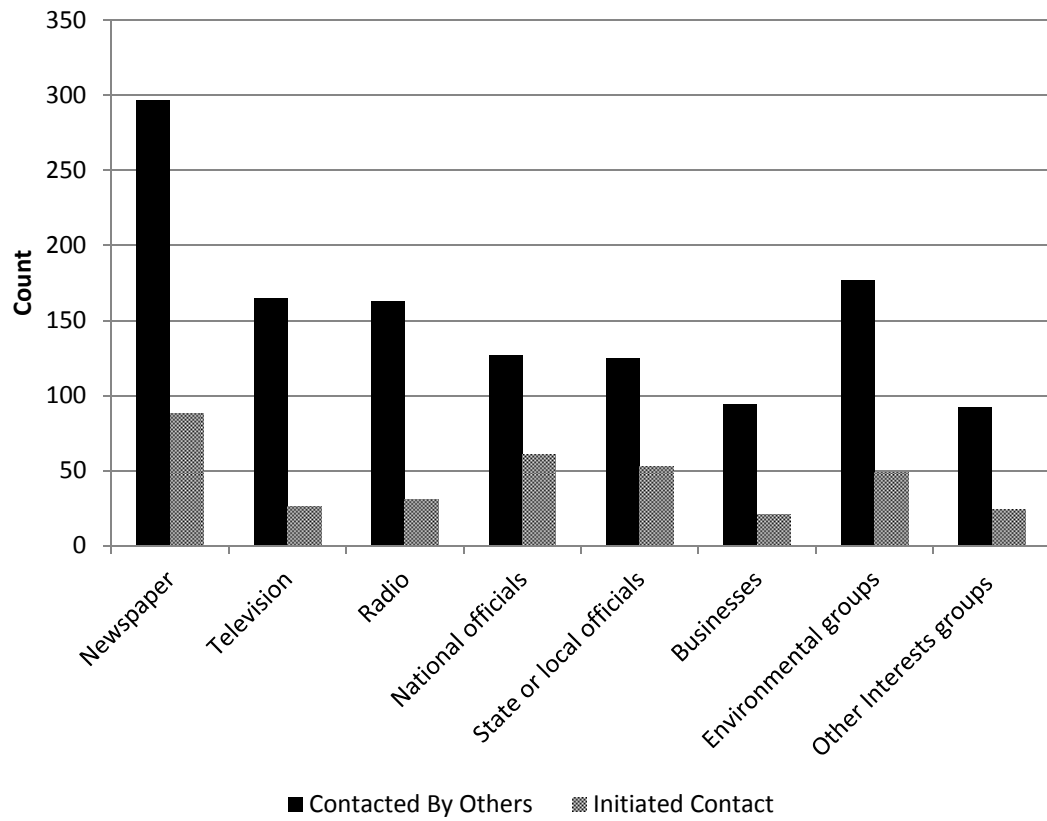


Figure 2: Distribution of climate scientists' contact with specific groups

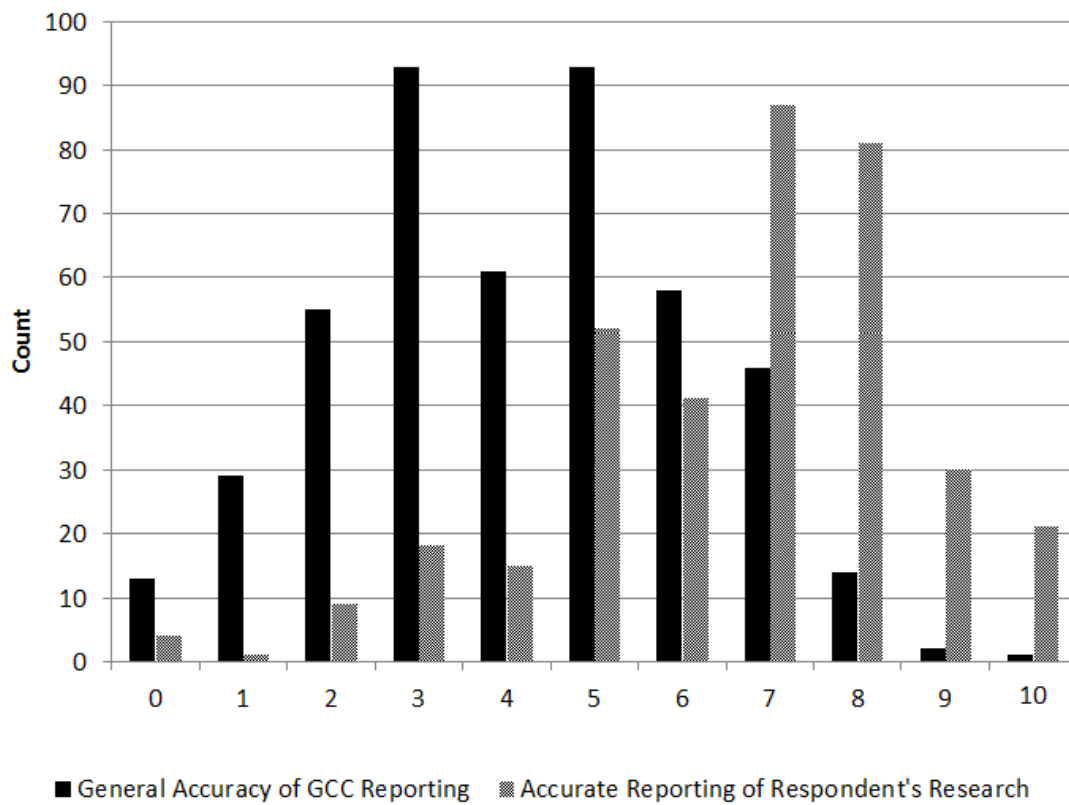


Figure 3: Climate scientists' assessment of the accuracy of media coverage of global climate change

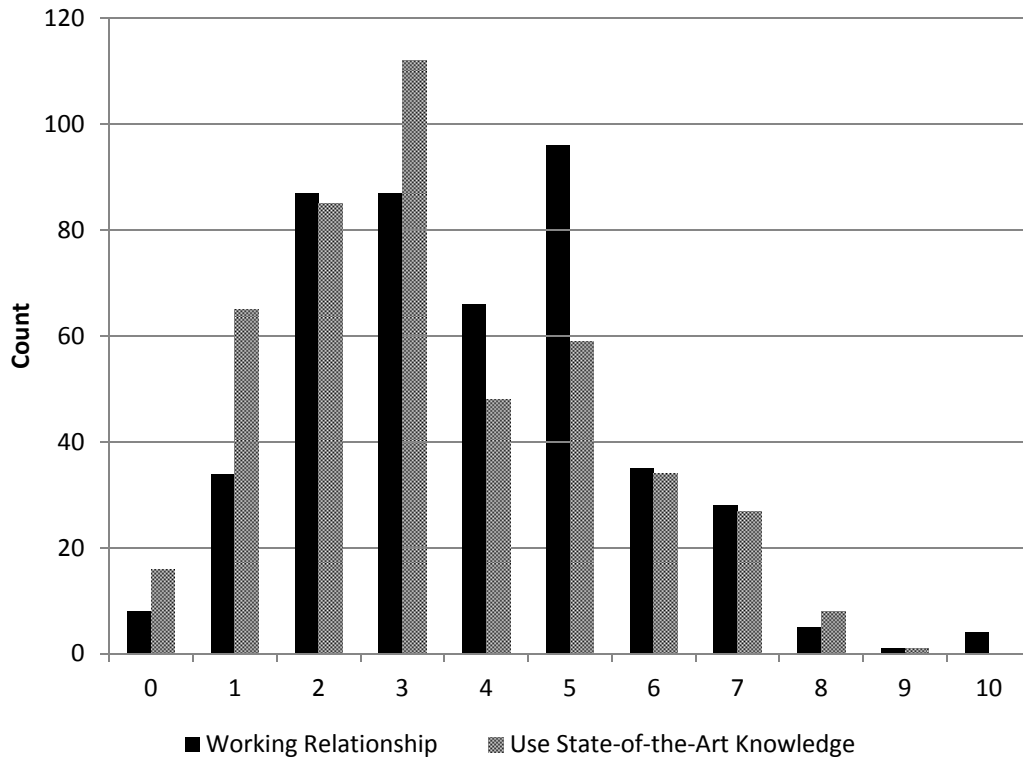


Figure 4: Climate scientists' perceptions of their relationship with government officials and their belief that officials use state-of-the-art knowledge

Table 2: Climate scientists' evaluations of the competence of different institutions in making decisions about global climate change

Institution	0	1	2	3	4	5	6	7	8	9	10
Environmental Protection Agency	3.2%	2.3%	5.8%	9.7%	8.3%	16.2%	13.7%			3.9%	3.2%
National Oceanic and Atmospheric Administration	0.0%	0.2%	0.9%	2.5%		6.2%	7.5%	15.3%	18.3%	17.3%	10.7%
Department of Energy	3.3%	6.8%	7.5%	9.4%	4.6%	16.9%	11.5%	14.8%	12.2%	5.2%	2.8%
Congress	8.0%	15.7%	17.3%	18.2%	12.8%	15.3%	6.2%	2.7%	0.7%	1.4%	1.8%
Local Officials	7.1%	13.1%	17.1%	18.9%	12.4%	12.7%	9.7%	5.1%	3.5%	0.0%	0.5%
State Officials	6.5%	9.3%	16.9%	19.4%	13.2%	14.8%	9.7%	5.1%	3.7%	0.7%	0.7%

(0-Not all competent and 10-Completely competent)