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Climate Change

An empirical assessment of public understanding of climate change in Benin City, Nigeria

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Despite the increasing availability of scientific information about climate change and global warming, there exists a state of confused or lack of understanding of global warming among the public. Nevertheless, there has been little empirical research done to assess public understanding, trust and engagement; hence, this study aims to provide data about public levels of understanding, trust, concern and response to climate change. Data were obtained from 120 respondents chosen through a self-selected sampling technique, and administration of closed-ended questionnaire based on the Fifth Assessment Report of the Inter-governmental Panel for Climate Change (IPCC). Data obtained were analyzed using charts and scatterplots. The result shows that there is considerable understanding of and concern for climate change and a limited level of trust in its occurrence; hence, the unwillingness to act. This study recommends that climate scientists should pay greater attention to their approach in communicating climate change messages to the public

INTRODUCTION

The global climate is changing. Over the last century global surface temperatures have risen, on the average, by about 0.5 ºC (IPCC, 2013). This observed warming is scientifically deemed most likely to be the result of human activities through emissions of greenhouse gases. These gases mainly include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (NO_2), sulphur hexafluoride (SF_6), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs) (IPCC, 2013). The observed changes in the global climate have been responsible for, and will continue to be responsible for extreme weather disasters, food security issues, health instabilities amongst other problems, if not mitigated promptly (UNFCCC, 2007).

Because climate change poses serious developmental threats to mankind, it has become of growing concern to various stakeholders world-wide (UNDP, 2007; Budescu *et al.*, 2009). It is believed that better understanding of the value of the climate system and its vulnerability to human activities is critical (Anable *et al.*, 2006; Pearson, 2010). It is also believed that such understanding would stimulate the advent of more sustainable policies and also enhance public climate change engagement (*i.e.* response to climate change). This can be triggered by careful, constructive and public-focused approaches to communicating climate change (Hulme, 2009; Somerville and Hassol, 2011).

Following the demand for better public understanding, there is an increasing need for scientists to improve the ways in which they communicate dynamic atmospheric processes to the public (Somerville and Hassol, 2011). This can be seen in a number of studies relating to communicating various aspects of climate science. These have included weather forecasts (Morss *et al.*, 2010) and global climate change (Budescu *et al.*, 2012; Donald, 2013; Hope, 2013). Indeed, over the last few decades, climate change has been communicated increasingly in a variety of ways. These include scientific publications, mass media channels *via* news sites such as the Guardian, online blogs such as Real Climate and Carbon Brief, and a host of others. These have been aimed at increasing public awareness, understanding and engagement with climate change (Burt, 2010; Manzo, 2010 Anita H Philip et al. 2018; Ojeh and Ozabor, 2018).

However, qualitative inquiries of climate knowledge show that self-proclaimed awareness does not necessarily mean adequate understanding of specific climatic issues (Lorenzoni *et al.*, 2007). In fact, there appears to be some confusion of the key issues among the public (Poortinga *et al.*, 2006; Goodwin and Dahlstrom, 2013). For example, Lorenzoni *et al.* (2007) reported frequent (but unquantified) cases of respondents who equated climate change with the ozone hole. Similarly, Shuckburgh *et al.* (2012) noted that people often conflate climate change with other environmental issues, with less people being able to boast of at least a "fair" knowledge of climate change. Interestingly, while these studies noted the possibility of some climate change confusion among the public, more recent studies, notably Somerville and Hassol (2011) have explicitly made cases for "large-scale" confusion.

It is quite ironic, therefore, that despite increasing availability of scientific information, a state of confused understanding, or

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Table 1 Frequency of demographic classes among respondents

Gender	Male	Female	Total
Controlled (n=35)	25	10	35
IPCC (n=32)	15	17	32
Simplified (n=32)	18	14	32
All respondents (N=99)	58	41	99

Age (in years)	Below 20	20-30	31-40	41-50	51-60	Above 60
Controlled (n=35)	7	25	1	-	2	-
IPCC (n=32)	3	18	1	1	3	6
Simplified (n=32)	2	19	4	3	2	2
All respondents(N=99)	12	62	6	4	7	8

Education	Secondary or below	University	Postgraduate
Controlled (n=35)	1	28	6
IPCC (n=32)	7	10	15
Simplified (n=32)	-	16	16
All respondents(N=99)	8	54	37

Table 2 understanding, trust, concern and willingness to act

Average understanding and trust among respondents		
	Understanding	Trust
Controlled (n=35)	5.7	4.7
IPCC (n=32)	5.4	4.4
Simplified (n=32)	5.5	4.7
All respondents (N=99)	5.5	4.6

Average concern and willingness to act among respondents		
	Concern	Willingness to act
Controlled (n=35)	4.6	3.5
IPCC (n=32)	6.3	5.4
Simplified (n=32)	5.8	5.0
All respondents (N=99)	5.6	4.6

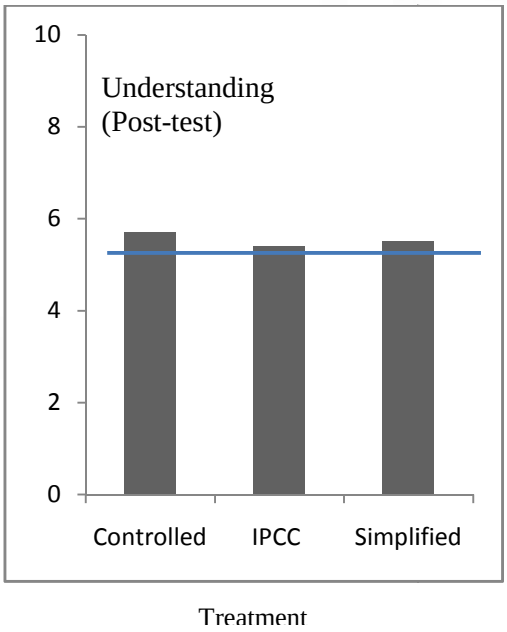

Figure 2 Average level of understanding among respondents in each treatment group.

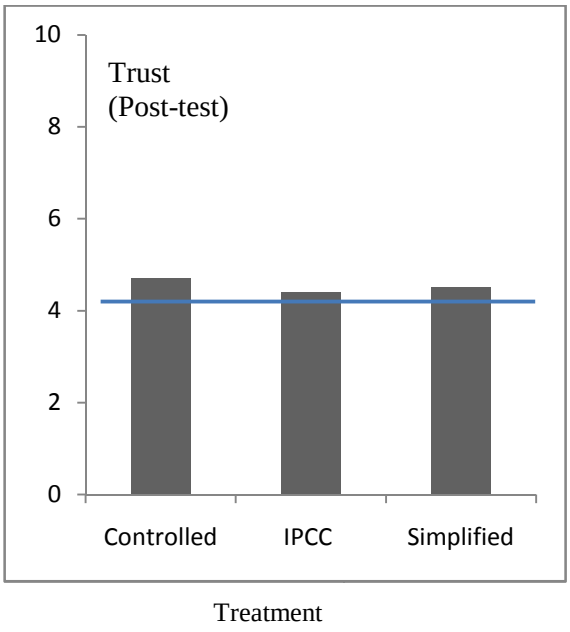

Figure 3 Average level of trust among respondents in each treatment group.

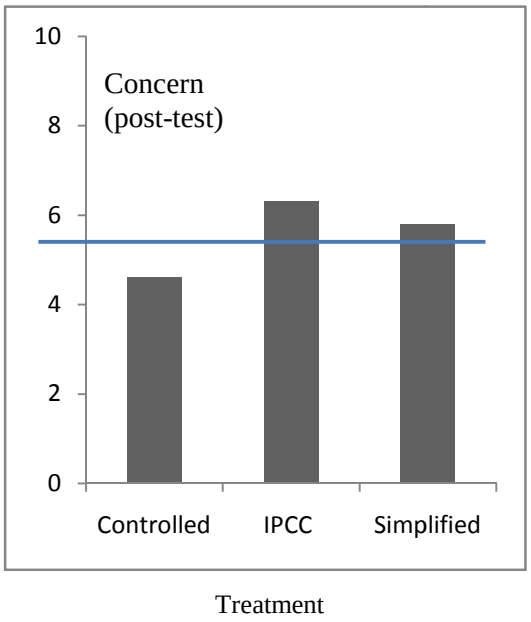

Figure 4 Average level of concern among respondents in each treatment group

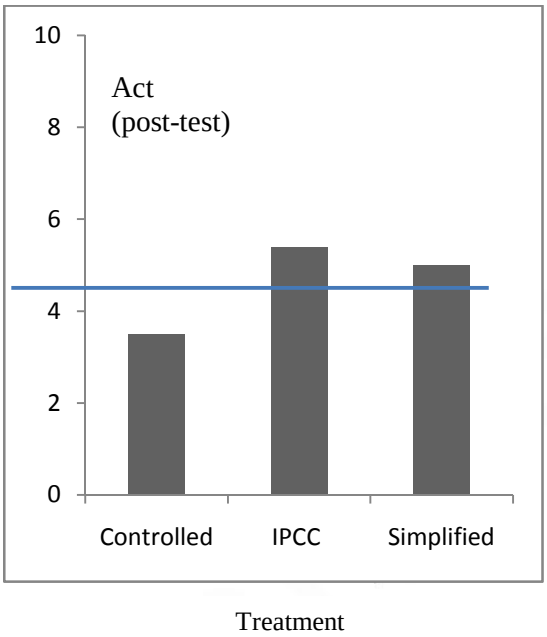

Figure 5 Average willingness to act among respondents in each treatment group

the lack of it, is fuelling inaction concerning global warming among the public (Goldenberg, 2009; Henderson-Sellers, 2009). A number of studies have described this situation as the possible result of increasing availability of incomprehensible and/or not-so-trusted information; thus, resulting into corresponding in action among members of the public. Nevertheless, there has been little research done to assess these assertions empirically. As a result, this necessitates further investigative studies which will attempt to evaluate public levels of understanding, trust, concern and response to climate change. In addition to providing data about public levels of understanding, trust, concern and response to climate change which will be of help to policy makers and climate change communicators, this study seeks to stair up the understanding of climate change by bringing information about it closer to the people hence stirring actions. This study attempts to do so by using as a case study, the IPCC's AR5 WG1 (*i.e.* the Working Group 1 contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change) (IPCC, 2013) which was published in September 2013.

RESULTS AND DISCUSSION

Demographic characteristics of respondents

For each treatment group, the questionnaires were framed to collect responses on demographic characteristics of respondents including attributes such as gender, age and level of education attainment. The demographic profiles of respondents are presented in the Table 1.

Understanding, trust, concern and willingness to act

The Table 2 presents findings from the post-test. These findings relate to the responses provided after respondents had read the texts (depending on their allocated treatment group). These responses provided a basis for comparing respondents' understanding of the texts, trust in the texts, concern for climate change and willingness to act, based on the kind of text which they read (*i.e.* treatment). They also provided an opportunity for comparing respondents' understanding, trust, concern and willingness to act after reading the texts *(i.e.* post-test), with the equivalent responses before they had read the texts (*i.e.* pre-test).

Understanding and trust

Table 2 shows the average levels of understanding, trust, concern and willingness to act among respondents in each treatment group. Out of a maximum possible 10, the average level of understanding among all 99 respondents was found to be 5.5. The controlled text, IPCC text and simplified text groups showed average understanding of 5.7, 5.4 and 5.5 respectively. Average trust among all respondents was found to be 4.6. Respondents in the controlled, IPCC text and simplified text groups showed average trust of 4.7, 4.4 and 4.7 respectively. As shown in Figures 2 and 3, there is an indication that the levels of understanding were generally slightly higher than the levels of trust. Although it can also be seen that the levels of understanding and trust in the groups lay close to the overall averages (shown by the solid blue line), it appears that the levels of understanding and trust among the groups are different.

Concern for climate change and willingness to act

Table 5 also shows the levels of concern for climate change among the respondents. Average level of concern for climate change was found to be 5.6. Respondents in the controlled text, IPCC text, and simplified text groups showed concern of 4.6, 6.3 and 5.8 respectively. Overall willingness to act among all respondents was 4.6 (lower than the overall concern). For the controlled, IPCC and simplified text respondents, willingness to act stood at 3.5, 5.4 and 5.0 respectively. Figures 4 and 5 below show that both concern and willingness to act were much lower for the controlled text respondents compared to the overall averages, the IPCC text and the simplified text respondents.

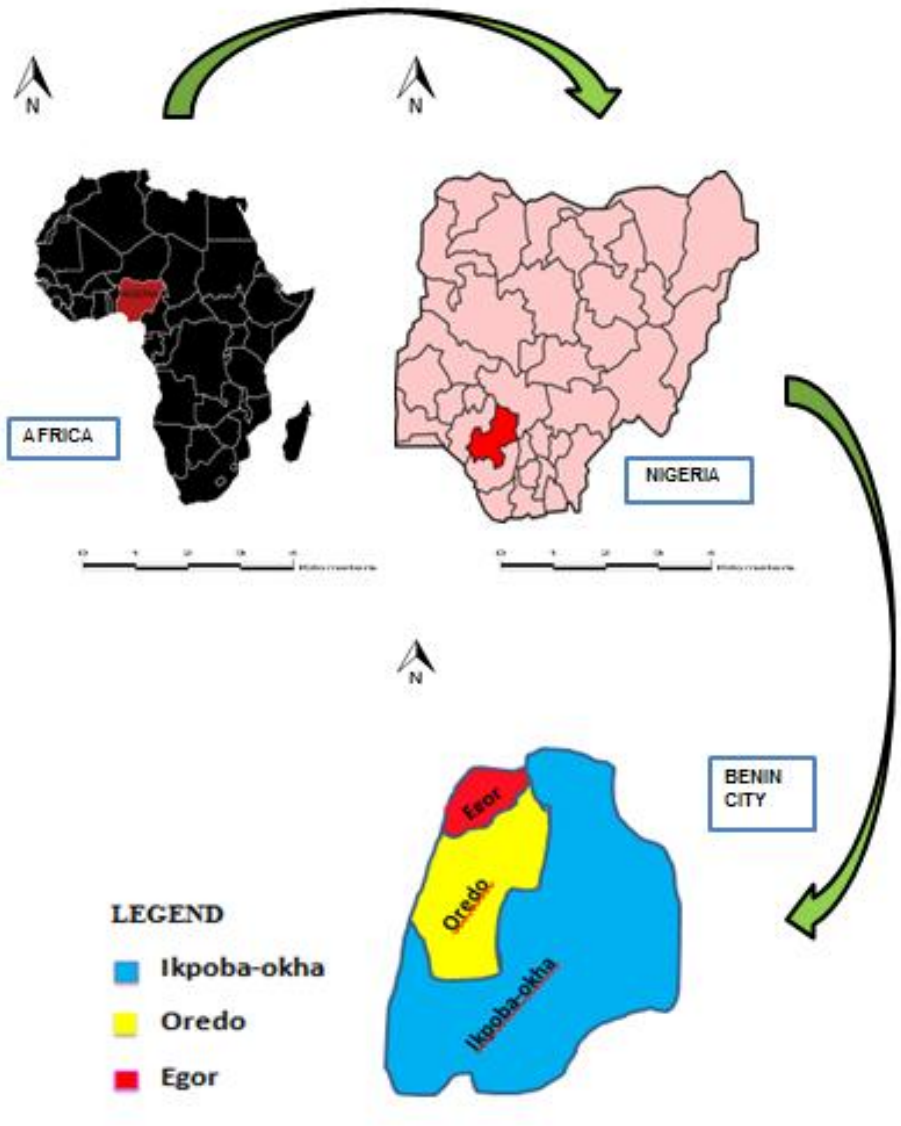

Figure 1 Map showing the Study Area

CONCLUSION

This paper assesses public understanding, trust and engagement with climate change in Benin City by considering the demographic characteristics of respondents; familiarity with climate change and sources of information; predisposition to reading; belief, understanding and attitude toward climate change; understanding, trust, concern and willingness to act. The finding of the study that the average climate change understanding, trust, concern and willingness to act were 5.5, 4.6, 5.6 and 4.6 respectively indicates that though there is considerable understanding of and concern about climate change. However, there is a little drawback in trusting what is presented as evidence of climate change occurrence; hence, the unwillingness to act. Following from the findings of the study, it can be concluded that understanding and trust are elements of public climate change engagement which should not be taken for granted by climate change communicators. In addition to suggestions and proposals in existing studies on climate change communication, this study has added to the evidence that there is need for climate scientists to pay greater attention to their style and approach when communicating climate change to the public. This will potentially be of help in obtaining greater public engagement through improved understanding and enhanced trust in climate change messages. Also, it is essential that studies such as this should be conducted from time to time and in different regions, in order to re-evaluate the recommendations made. This will help climate scientists and communicators to continually stay abreast of factors which promote and prevent public audiences from engaging with their messages. Thus, climate scientists will be able to harness the positive factors, while avoiding the factors which limit public engagement with climate change.

METHOD AND MATERIALS

Study Area

Benin City is the capital of Edo State and is located between longitude 5°34'E to 5°44'E and latitude 06°14'E to 6°21'E.The City comprises three three political divisions or local government

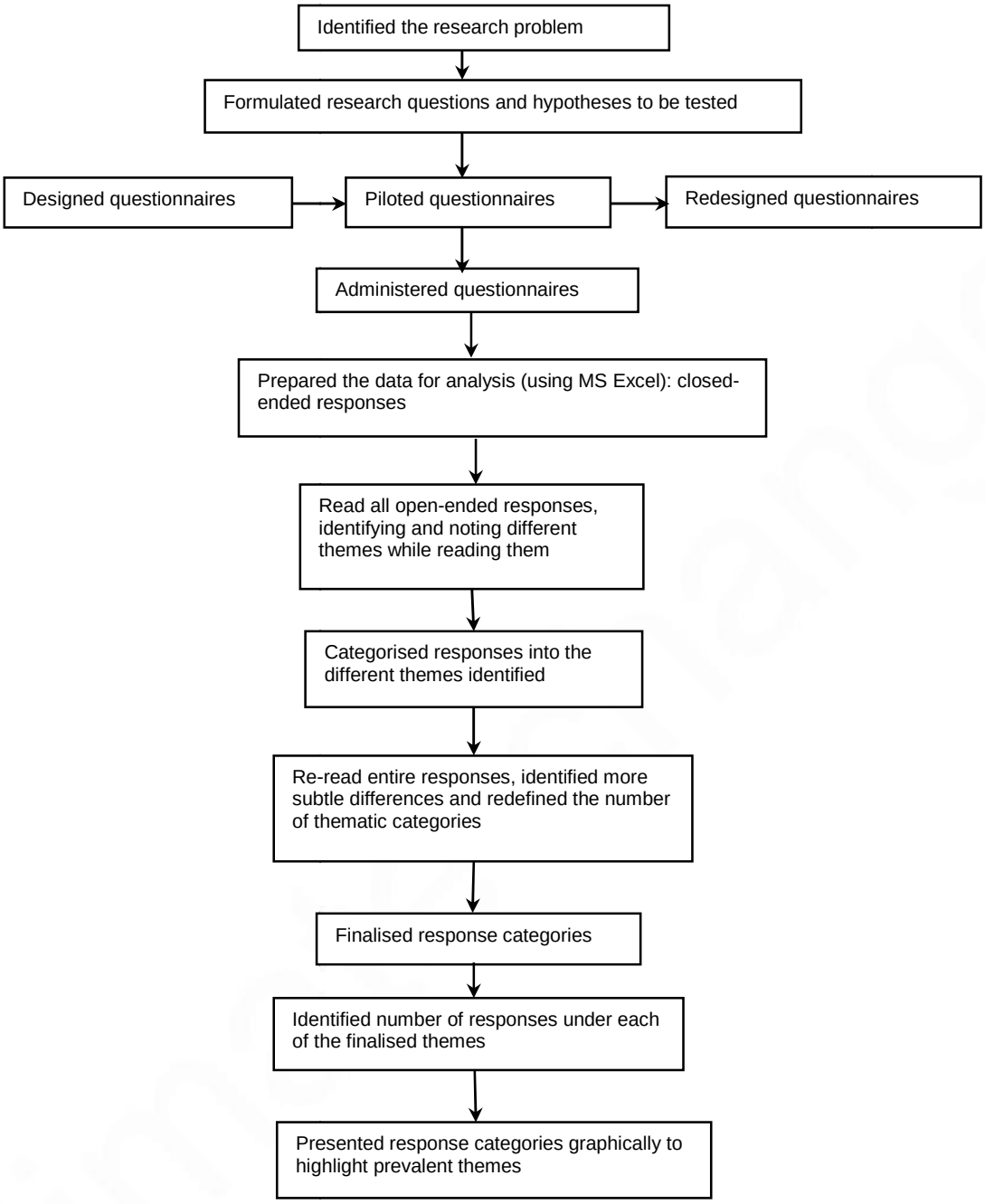

Figure 2 Methodological framework of this study

areas; namely, Egor, Oredo and Ikpoba-okha. Its average elevation above sea level stands at 77.8 meter and is underlain by the Benin formation also referred to as the sedimentary formation of the Miocene-Pleistocene age (Odemerho, 1988). The city is located in the humid tropical rainforest belt of Nigeria. According to the National Population Commission (1991), the city has a total population of 762,717 persons and a projected population of 2.0 million by 2020 using the growth rate of 2.7 per cent. Figure 1 below shows the location of Benin City. Benin City comprise of three local government areas, including Egor, Oredo and Ikpoba-okha.The rainy season in Benin City begins in March/April and ends in October/November. Rainfalls are of high intensity and usually double maxima with a dry little spell in August usually referred to as 'August Break'. Rainfall, temperature, wind and relative humidity are the most significant climatic elements in Benin City. Some cases of temperature extremes between 30^0C and 35^0C have been recorded in the City metropolis in November and December.

Research design

This study adopts the descriptive research design. This type of design, according to Ogundipe, Lucas and Sanni (2006), is used to find the meaning and obtain understanding of the present conditions, beliefs attitudes, a careful study and methodical observation of a particular event in the real world. The choice of the design is informed by the purpose of this study, which is to seek the level of understanding of climate change phenomenon.

Population and Sample

This study population was loosely defined as including any member of the Benin City public with the ability to read the contents of the IPCC's Fifth Assessment Report of the Working Group 1 (IPCC, 2013), hereafter called IPCC's AR5 WG1. The sampling area was focused around the three Local Government Areas in Benin City. The drafted questionnaires were pilot-tested on five respondents who fitted the characteristics of the study population in order to identify the limitations of the instrument as well as the adequacy of its scope and content. A self-selected sampling technique was used. This method was preferred because attitudinal studies such as this typically require people who are willing to respond to the survey. This technique has been used in public climate change engagement studies such as O'Neill and Hulme (2009). The self-selection method used in this study was a mixed-approach type. It involved soliciting for interested respondents *via* two main mediums at various times and locations in Benin City between January and June 2017. These included:

- 8thJanuary 2017: used publicity materials such as leaflets, posters and social media (Facebook) to invite people (including non-academic staff, lecturers and students) to a one-off data collection event tagged: "Climate change communication" (45 complete responses were retrieved).
- May to June 2017: persuaded people to fill out questionnaires at different locations within Benin City as the researcher went about his daily activities (54 complete responses were retrieved).

In all, 120 individuals showed interest in participating in the study. However, 99 complete responses were retrieved from all the three sources mentioned above (*i.e.* 82.5% complete response rate). Completeness was adjudged based on full responses to all the closed-ended quantitative questions and only the findings from such complete responses were included in the analyses and results presented in this study. The respondents included people from both gender types, various age groups and educational backgrounds. Closed-ended questionnaires used in this study and the questions included were framed to capture details which are capable of providing answers to study objective. They also included texts selected from the IPCC's AR5 WG1 Summary for Policy Makers (IPCC, 2013). The questionnaire was structured in a pre-test/post-test fashion. The pre-test was aimed at obtaining responses about respondents' attitudes and climate change engagement before the study, while the post-test (*i.e.* the main test) was used to investigate respondents' climate change engagement after they had read the texts selected from IPCC's AR5 WG1. Such pre-test/post-test technique has been used in climate change communication studies such as Lowe (2006) and O'Neill and Hulme (2009). A total of 120 questionnaires were handed out. These were divided equally into three groups, namely the controlled text, the IPCC text and the simplified text, with 40 questionnaires in each group. For the controlled text respondents, 35 completed questionnaires were retrieved, while 32 completed questionnaires each were retrieved from the IPCC text respondents and the simplified text respondents respectively. This made up a total of 99 respondents in all the three groups. In addition, the questionnaires were closed-ended and contain eleven points, 0 to 10 scale. The overall methodology used for the entire study is illustrated in the process workflow shown in Figure 1.

Data Analysis

Using an interval-based technique, the 99 respondents were separated into three treatment groups namely, the controlled text group, the IPCC text group and the simplified text group. The separation was such that every third respondent was allocated to a particular treatment text group in this manner: 1st respondent (controlled text), 2nd respondent (IPCC text), 3rd respondent (simplified text), 4th respondent (controlled text) and so on. The motive for these treatments (*i.e.* separation of respondents) was to enhance the possibility of comparing the effects of a less ambiguous text (the simplified text group) and a controlled text (in which expressions of confidence and uncertainty were not highlighted), against the actual IPCC text. In the IPCC treatment text, the same texts in the 19 HSs are presented.

However, expressions of uncertainty and confidence found in the HSs were highlighted in bold fonts to draw respondents' attention to these words used in IPCC's AR5 WG1. The simplified text was designed as a modification of the IPCC text. It also included all the 19 HSs as well as the expressions of uncertainty and confidence highlighted in bold text. The only difference was that those IPCC words which have been speculated as possibly ambiguous and confusing to the public (in Hassol, 2008; Henderson-Sellers, 2009; Somerville and Hassol, 2011; Hassol, 2013) were replaced with simpler, less ambiguous alternative words. Hence the name "simplified text". The controlled text on the other hand was designed in a way similar to the IPCC text. It also preserved the exact words from the HSs in IPCC's AR5 WG1. Like the IPCC text, the controlled text was designed to investigate the effect of the likelihood and confidence expressions on respondents' trust in the texts. The quantitative responses to closed-ended questions were coded numerically and analysed using statistical techniques of charts and scatterplots

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Conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this manuscript.

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