Popular Consensus : Climate Change Is Set to Continue

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Popular Consensus: Climate Change Is Set to Continue

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Abstract

Most climate experts agree that human carbon dioxide emissions cause anthropogenic global warming (AGW), reflected in increased global temperatures during every decade since 1970. Nonetheless, some public figures have claimed that AGW stopped in 1998. In a large experiment (N = 200), participants extrapolated global climate data, presented graphically either as share prices or as temperatures. Irrespective of their attitudes toward AGW, and irrespective of presentation format, people judged the trend to be increasing. These results suggest that presentation of climate data can counter claims that AGW has stopped.

Keywords

climate change, graphical perception, judgmental forecasting

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There is near unanimity (i.e., > 95% agreement) among climate scientists that the global climate is changing and that human greenhouse-gas emissions (primarily carbon dioxide, or CO_2) are a principal cause (Anderegg, Prall, Harold, & Schneider, 2010; Doran & Zimmerman, 2009). In addition, there are credible suggestions that the United Nations' latest climate assessment (Intergovernmental Panel on Climate Change, 2007) was conservative rather than alarmist (Allison et al., 2009). However, scientific indicators of increasing actual risk are accompanied by an apparent decline in the public's perception of that risk, at least in some countries (e.g., Hanson, 2009). This decline may have multiple causes: For example, people have a limited worry "resource" (Linville & Fischer, 1991), and climate change may seem less pressing today than current economic worries do. Another reason for the decline is that public doubts about climate science have demonstrably been fostered by vested interests and political groups (Jacques, Dunlap, & Freeman, 2008; McCright & Dunlap, 2003, 2010; Mooney, 2007; Oreskes & Conway, 2010; Stocking & Holstein, 2009).

This article focuses on one claim frequently made by individuals (e.g., U.S. Senator James Inhofe) and organizations (e.g., the Heartland Institute) opposing the scientific consensus, namely, that "global warming stopped in 1998" (Carter, 2006). A particularly strong El Niño that year[1] pushed temperatures far above the trend line, thus creating the appearance of cooling during several subsequent years (see the inset in Fig. 1a). In fact, heating has continued during the past decade (Murphy et al., 2009), and according to the National Aeronautics and Space Administration (NASA), 2010 may have been the hottest year ever recorded (Hansen, Ruedy, Sato, & Lo, in press). In a quasi-study conducted by the Associated Press (Borenstein, 2009), statisticians who were blind to the data source saw no evidence for a decline in the temperature trend in the years since 1998. Instead, they decried the cherry-picking of observations on which any such claim is necessarily based.[2]

The question remains, however, whether nonstatisticians would similarly emphasize the long-term trend, or whether these people might be confused or misled by brief dips in the time series. Studies of judgments of correlations (Lewandowsky & Spence, 1989) and extrapolations in forecasting studies (e.g., Du & Budescu, 2007; Harvey & Bolger, 1996; Harvey, Ewart, & West, 1997; Lawrence, Goodwin, O'Connor, & Önkal, 2006) have shown that people are able to extract information from noisy data presented in graphical form. However, people's extrapolations of time series appear to be sensitive to serial dependencies in the data. When autocorrelations are low, people anchor their extrapolations on the last data point and add an adjustment proportional to the last pairwise change—thus overemphasizing recent observations (Bolger & Harvey, 1993). When autocorrelations are high, however, people rely more on the overall trend in the data (Bolger & Harvey, 1993). Given that temperatures are moderately autocorrelated (e.g., Foster, Annan, Schmidt, & Mann,

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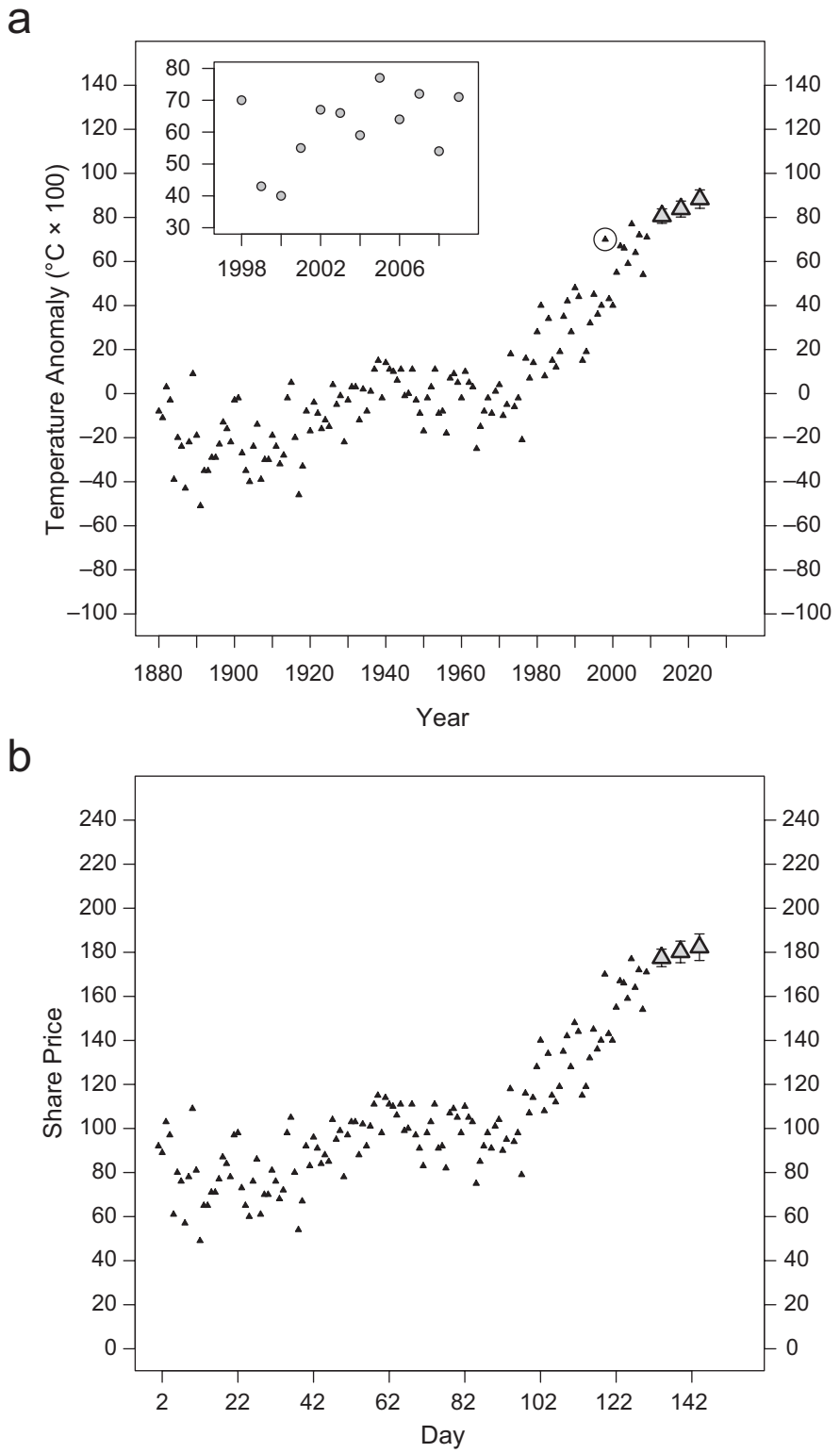

Fig. 1. Stimuli and results for both conditions. The graph in (a) shows actual global mean land-surface air-temperature anomalies (i.e., departures from the long-term average) from 1880 to 2009 (small triangles) and participants' extrapolations of the trend (large triangles). The El Niño event of 1998 is circled here for illustrative purposes, but was not identified in any way in the materials used in the experiment. The inset (which was not presented to participants) shows the data from 1998 to 2009 only; owing to the El Niño event of 1998, the data have the misleading appearance of a flat trend. The graph in (b) contains the same temperature data and participants' extrapolations of the data, but instead is labeled as showing the trend of share prices across 130 days for a fictitious corporation. When the graphs in (a) and (b) were presented to participants as stimuli, labels at the top identified the data as share prices or temperatures, and the three extrapolation points were denoted by question marks that were printed within the frame of the graph and separated by thin vertical lines to create three columns in which participants marked their predictions. In both panels, error bars for the behavioral data represent 95% confidence intervals. The temperature data are from the National Aeronautics and Space Administration (2009).

2008), it is unknown whether people would focus primarily on the last few data points or the overall trend when extrapolating from climate data. It is also unknown how prior attitudes might modulate perception of the data.

The study reported in this article investigated two questions: First, how do people perceive the trend in climate data when it is presented in graphical form? Second, is such processing mediated by acceptance of the proposition that CO_2 emissions cause anthropogenic global warming (AGW)?

Method

Participants

Two hundred pedestrians (mean age = 37.8 years, *SD* = 19, range = 13–87) were approached in a downtown pedestrian mall in Perth, Australia. All 200 agreed to complete the task without remuneration. Maximum temperatures during testing (February 2010) ranged from 24.6 °C to 34.3 °C (M = 31.5 °C), approximating the monthly average temperature (31.8 °C).

Procedure and materials

Participants were assigned randomly to either the global-data condition (n = 100) or the share-price condition (n = 100). Participants in the global-data condition were shown global climate data identified as such; those in the share-price condition were shown the same data described as fictitious share prices. Specifically, people in the two conditions were given the graphs in Figures 1a and 1b, respectively. Participants then predicted three future data points before completing a questionnaire examining their attitudes toward science. I report here results for the one item that assessed participants' acceptance that AGW is taking place (on a 5-point scale ranging from 1, *strongly disagree*, to 5, *strongly agree*).

Results

The behavioral data in Figure 1 show that participants extrapolated the trend linearly regardless of how the data were presented. Extrapolations were conservative, replicating the well-established *trend-damping* phenomenon (e.g., Harvey & Bolger, 1996). The figure also suggests that participants were more conservative when the data were disguised as share prices; comparison of the slopes of regression lines fit to the last actual temperature and each participant's three extrapolation responses revealed a difference between the global-data condition (M = 5.51) and the share-price condition (M = 3.66), although that difference failed to reach significance, $F(1, 194) = 2.62$, MSE = 64.14, $p \approx .11$.

Slopes correlated with acceptance of AGW when the data were presented as temperatures, $r(96) = .21$, $p < .05$, but not when they were presented as share prices, $r(96) = .09$, $p > .1$. Nonetheless, slopes were positive (M = 3.75) for temperatures even for those individuals who were neutral or who did not believe that AGW is taking place (n = 26), $t(24) = 2.56$, $p < .01$, and they were positive (M = 3.77) for the 6 participants who explicitly rejected AGW as a real phenomenon, $t(5) = 2.07$, $p < .05$ (one-tailed).

Discussion

This study, and a companion experiment (N = 200) that presented the data also as a downward trend, confirmed that untrained observers—like expert statisticians—focus on the long-term trend and ignore short-term dips in extrapolating data. This finding is consonant with previous results involving autocorrelated data (Bolger & Harvey, 1993) and suggests that presentation of climate data can counteract contrarian claims that global warming has stopped.

It is important to note that although extrapolations overall differed little between the two presentation formats, participants' perceptions were related to their belief in AGW only when the data were identified as temperatures; however, even the few individuals in that condition who explicitly rejected AGW extrapolated a (just) significantly positive trend. Although little is known about the effects of beliefs on forecasting, these results are consistent with the view that in general people make an initial assessment based on their beliefs, and that this assessment is then followed by an adjustment, if necessary, based on inspection of the data (Lawrence et al., 2006).

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Declaration of Conflicting Interests

The author declared that he had no conflicts of interest with respect to his authorship or the publication of this article.

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Notes

1. El Niño refers to increased surface temperatures of the eastern Pacific Ocean that are part of a tropical oscillation (the Southern Oscillation).
2. A particularly engaging animation of the consequences of cherry-picking comparison periods can be found at http://hot-topic.co.nz/keep-out-of-the-kitchen/.

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