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Popular Consensus: Climate Change Set to Continue

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Abstract

Most domain experts agree that human CO_2 emissions cause anthropogenic global warming (AGW), reflected in increased global temperatures during every decade since 1970. Notwithstanding, some public figures have claimed that warming stopped in 1998. In a large experiment ($N = 200$), participants extrapolated global climate data, presented graphically either as share prices or temperatures. Irrespective of attitudes towards AGW or presentation format, people judged the trend to be increasing, suggesting that presentation of climate data can counter claims that warming has "stopped."

Popular Consensus: Climate Change Set to Continue

There is near unanimity among climate scientists that the global climate is changing and that human greenhouse gas emissions (primarily CO_2) are a principal cause (i.e., $> 95\%$ agreement; Anderegg, Prall, Harold, & Schneider, 2010; Doran & Zimmerman, 2009). There are credible suggestions that the U.N.'s latest climate assessment (IPCC, 2007) was conservative rather than alarmist (Allison et al., 2009); however, those scientific indicators of increasing actual risk are accompanied by an apparent decline in the public's perception of those risks, at least in some countries (e.g., Hanson, 2009). This decline may have multiple causes; for example, people have a limited "worry quotient" (Linville & Fischer, 1991), and climate change may be less pressing now compared to economic worries. Another reason 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 Inhofe) and organizations (e.g., Heartland Institute) opposing the scientific consensus; namely, that "global warming stopped in 1998" (Carter, 2006). This claim rests primarily on a particularly strong El Niño that year,[1] which pushed temperatures far above the trend line, thus creating the appearance of cooling during several subsequent years (see panel B of Figure 1). In actual fact, heating has continued during the last decade (Murphy et al., 2009), and according to NASA, 2010 may be the hottest year ever recorded (Hansen, Ruedy, Sato, & Lo, in press). Accordingly, a quasi-study conducted by the Associated Press with statisticians who were blind to the data source (Borenstein, 2009), revealed that experts saw no evidence for a decline in the temperature trend. Instead, they decried the "cherry-picking" of observations on which any such claim is necessarily based.[2]

The question remains, however, whether non-statisticians would similarly emphasize the long-term trend or whether they might be susceptible to brief dips. People are known to be able to extract information from noisy data presented in graphical form, as revealed by judgments of correlations (Lewandowsky & Spence, 1989) or by eliciting extrapolations in forecasting studies (e.g., Du & Budescu, 2007; Harvey & Bolger, 1996; Harvey, Ewart, & West, 1997; Lawrence, Goodwin, O'Connor, & Önkal, 2006). People's extrapolations of time series turn out 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 over-emphasizing recent observations (Bolger & Harvey, 1993). With high autocorrelations, by contrast, 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, 2008), it is unknown whether people would primarily focus on the last few data points or the overall trend when examining climate data. It is also unknown how prior attitudes might modulate perception of the data.

This study thus pursued two questions: (1) How do people process climate data presented in graphical form? (2) Is processing mediated by acceptance of the proposition that CO_2 emissions cause anthropogenic global warming (AGW).

Method

Participants

200 pedestrians (mean age 37.8; $s = 19$; range 13 – 87) were approached in a downtown pedestrian mall in Perth, Western Australia, and completed the task without remuneration. Maximum temperatures during testing (February 2010) ranged from 24.6°C to 34.3°C ($M = 31.5$), approximating the monthly average (34.1°C).

Procedure and materials

Participants were shown global climate data, either identified as such or as fictitious share prices ($N = 100$ each, randomly chosen; see panels A and C of Figure 1). Participants predicted 3 future data points before completing a questionnaire examining attitudes towards science. I report here one item that examined acceptance of AGW (5-point scale; "Strongly Disagree" to "Strongly Agree").

Results

Figure 1 (panels A and C) shows that people linearly extrapolated the trend 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 people 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 person's 3 extrapolation responses revealed a mean difference between temperatures ($M = 5.51$) and share prices ($M = 3.66$), although that difference failed to reach significance, $F(1, 194) = 2.62$, $MSe = 64.14$, $p \simeq .11$.

Slopes correlated with acceptance of AGW when the data were presented as temperatures, $r(96) = .21$, $p < .05$, but not when 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 disagreed with AGW ($N = 26$), $t(24) = 2.56$, $p < .01$, and they remained positive ($M = 3.77$) for the 6 participants who explicitly rejected AGW, $t(5) = 2.07$, $p < .05$ (one-tailed).

Discussion

This study, and a companion experiment ($N = 200$) which 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. This finding is consonant with previous results involving autocorrelated data (Bolger & Harvey, 1993) and suggests that presentation of climate data can counteract contrarian claims about global warming having stopped.

Notably, although extrapolations overall differed little between presentation formats, people's perceptions were related to their attitudes only when the data were identified as temperatures; however, even for those few individuals in that condition who explicitly rejected AGW, extrapolations were still (just) significantly positive. Although little is known about the effects of beliefs on forecasting, these results mesh well with the view that an initial belief assessment is followed by a qualification based on inspection of the data (Lawrence et al., 2006).

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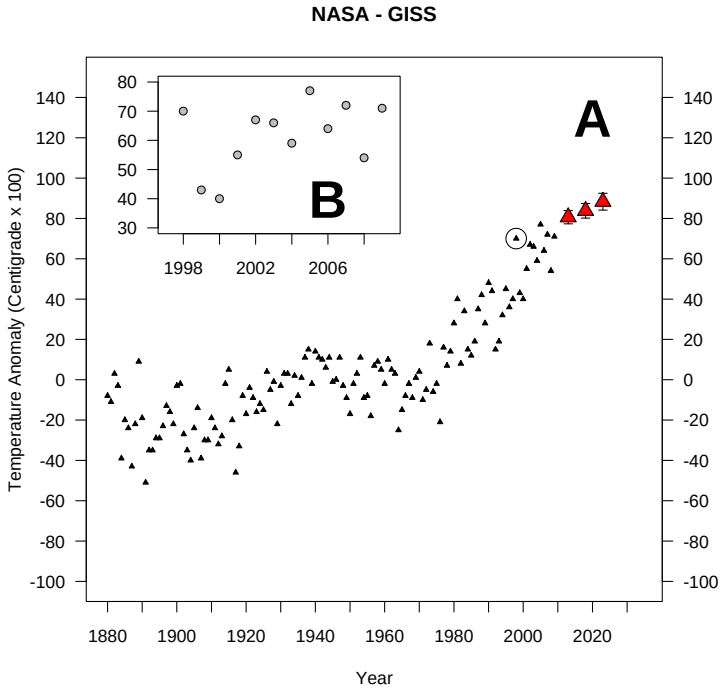
Footnotes

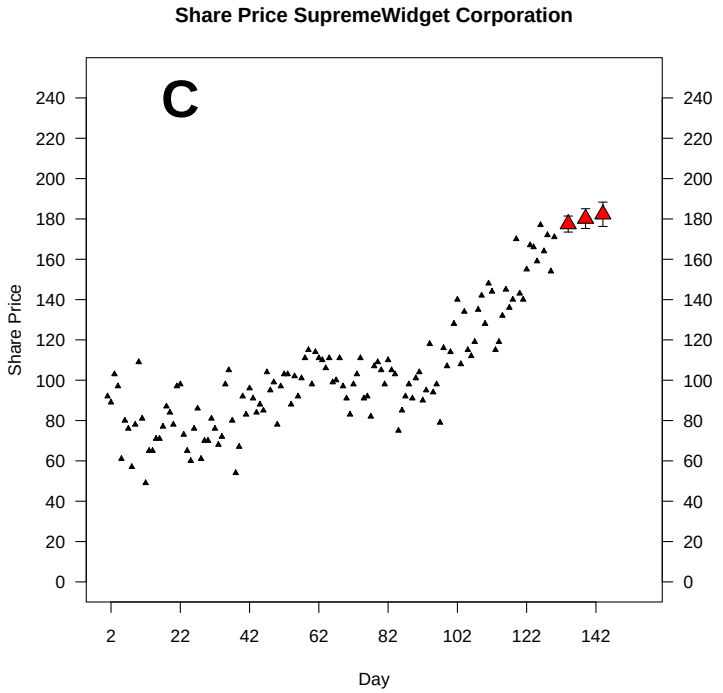
[1] El Niño forms part of a tropical oscillation (the "Southern Oscillation") and refers to increased surface temperature of the eastern Pacific.

[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/.

Figure Captions

Figure 1. Panel A shows actual global mean land-surface air temperature anomalies from 1880 to 2009 (small triangles) and people's extrapolations of the trend (large triangles). The El Niño event of 1998 is circled. Panel B (inset) shows the same data from 1998 to 2009 only, which owing to the El Niño event of 1998 gives the misleading appearance of a flat trend. Panel C contains the same temperature data but labeled as the trend (and observed extrapolations) of share prices across 130 days for a fictitious corporation. In both panels, error bars represent 95% confidence intervals for the behavioral data. Temperature data are from NASA's Goddard Institute for Space Studies (http://data.giss.nasa.gov/gistemp/; downloaded on 4 February 2010.) When graphs were presented to participants as stimuli (using panels A and C), the El Niño event was not identified and the 3 extrapolation points were denoted by "?"s printed at the top of the graph, separated by thin vertical lines to create 3 columns in which people marked their predictions.


NASA - GISS
A
B
Temperature Anomaly (Centigrade x 100)
Year
1880
1900
1920
1940
1960
1980
2000
2020
1998
2002
2006


Share Price SupremeWidget Corporation
C
Share Price
Day
2
22
42
62
82
102
122
142