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opportunities, and academic promotion for producing solid research on behavior change will likely be widely available.

Practitioners

Organizational behavior management professionals have helped businesses design and implement environmentally friendly programs and their efforts provide the foundation for far-reaching applications (e.g., Knott, Kernan, Luke, & Alavosius, 2012; Lattal, this issue). Most behavior analysis practitioners today work in autism, developmental disabilities, and education—fields where their knowledge and skills are greatly needed. What if some of the many human service agencies run by behavior analysts made reducing their programs' carbon footprints a priority? ABA autism treatment programs could experiment with interventions to encourage staff to increase recycling, conserve energy, and reduce fuel consumed by company vehicles. ABAI's home office staff in Kalamazoo might do the same. Such efforts could serve as model demonstration projects and research sites.

ABAI's affiliated chapters could add a sustainability track to their annual conferences and encourage green R&D projects by their members. Each of ABAI's 20,000+ members and affiliate members might examine his or her behavior per Darrel Bostow's (2011) challenge for behavior analysts to be better models of the lifestyles we promote.

The Ultimate Outcome?

I am not suggesting that behavior analysts can save the world on their own. Collaboration with other scientists and professionals has never been more important (Stratton, this issue). And, as Hiroshi Komiyama and Kazuhiko Takeuchi (2006) illustrate, the door is wide open.

> Precisely because sustainability science includes global, social, and human systems in its purview, and because the problems it addresses involve disparate elements—from science and technology, to politics and economics, to human lifestyles and behavior—this new discipline must necessarily embrace the social and natural sciences. (p. 5)

How did Werner answer the provocative question he posed? With inputs based on humanity's present behavior his predictive model didn't paint a pretty picture. But in the Q&A following his talk, Werner acknowledged that "maybe the Earth is not quite f**ked yet after all. But the ultimate outcome may depend on how much, and how many, scientists choose to wade into the fray" (Mingle, 2012).

Behavior analysts must do more than wade in. The world wants and needs our best efforts now.

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We've Got Our Work Cut Out for Us

The Greatest Challenge of Global Climate Change: An Inconvenient Truth Meets the Inconvenienced Mind

BY LONNIE G. THOMPSON

In a paper published a couple of years ago in *The Behavior Analyst,* I laid out the evidence for climate change and the options available to us: mitigation, adaptation, or suffering (Thompson, 2010). In this essay I provide a brief update on the state of the global climate system and the need for widespread human response to it.

Some Inconvenient Truths

Our Earth's climate system continues to warm at an alarming rate due largely to human activities.

The Earth's Ice Cover

One of the most disconcerting signs of climate change is the loss of ice around the world. Glaciers, the "canaries in the coal mine," are the planet's early warning systems of global climate change (see Figure 1).

They both respond to and record key climatological variables such as temperature, precipitation, cloudiness, humidity, and radiation. Thirty years of data from more than 7,000 glaciers in the Himalayas and across the Tibetan Plateau show that about 9% of the ice present in the 1970s had disappeared by the early 2000s (Yao et al., 2012). Even more disturbing is that the rate of melting is accelerating. Between 2003 and 2008 glaciers in this region were losing 12.8±3.5 gigatonnes per year (Kääb et al., 2012), much more than previously reported (Jacob et al., 2012). The

Figure 1. The shrinking glaciers on Kilimanjaro as documented in Thompson, 2010 continue. The top photo shows the Furtwangler glacier (foreground) as it appeared in January, 1999 and a photo taken from the same location in September of 2012 by Michael O'Toole, Boulder, Colorado.

increase in melt rate is in line with the ground based observations of Yao and colleagues. There are over 46,000 glaciers in this region, most of which are shrinking. Many of these glaciers are at the headwaters of prominent Asian rivers (including the Indus, Ganges, and the Bramaputra) so the glacier shrinkage will mean reduced water flow, particularly in the dry season.

Between July 8–12, 2012, 97% of Greenland's ice surface experienced melting, which had not happened since at least 1889 (http://www.nasa.gov/topics/earth/features/greenland-melt.html). Sea ice cover in mid-September, according to the National Snow and Ice Data Center in Boulder, Colorado was 290,000 square miles less than the previous record set in 2007, a 20% decline.

Carbon Dioxide

As of July 2012, the CO_2 level measured at the top of Mauna Loa was just over 394 ppm, compared to 391 ppm at the time I wrote for *The Behavior Analyst*. In the spring of 2012, CO_2 levels crossed a milestone of 400 ppm for the first time in Barrow, Alaska, and in Canada, Iceland, Finland, Norway, and over the North Pacific (www.esrl.noaa.gov/gmd/ccgg/trends/ and http://researchmatters.noaa.gov/news/Pages/arcticCO2.aspx).

Temperature and Drought

NASA's Goddard Institute for Space Studies in New York, which monitors global surface temperatures on an ongoing basis, released an updated analysis that showed that the average global temperature in 2011 was 0.92oF (0.51oC) warmer than the mid-20th century baseline. Nine of the ten warmest years were in the 21st Century, the one exception being 1998, which was influenced by the strongest El Niño of the past century (http://www.nasa.gov/topics/earth/features/2011-temps.html). Record temperatures continued into 2012, with July being the hottest month in the lower 48 states since the government began keeping records in 1895. As of August 14, 2012, over 60% of the contiguous U.S. states experienced drought, marking the largest percentage of the nation experiencing such conditions in the 12-year record of the U.S. Drought Monitor. The droughts were made worse by unprecedented temperatures; in March alone about 15,000 records were broken.

Sea Level Rise

The ocean levels rose at an average rate of around 1.7 mm per year from 1950–2009 and at a rate of about 3.3 mm per year from 1993–2009 (Nicholls & Cazenave, 2010), an increase over earlier estimates (Church et al., 2001; Church et al. 2011). Sea level is currently rising as a result of both ocean thermal expansion and ice sheet and glacier melt, each contributing about 50% and both caused by recent increases in global mean temperature. For the period 1961–2003, the observed sea level rise due to thermal expansion was 0.42±0.12 mm/yr, while 0.69 mm/yr could be attributed to total glacier melt (0.50±0.18 for small glaciers, 0.19±0.43 for large ice sheets). Between 2003–2008, sea level rose at a rate of 2.5±0.4 mm/year with 2.1 mm/yr from melting glaciers and only 0.34 mm/yr from steric sea level change (Cazenave et al., 2008).

Extreme Events

The frequency of catastrophic events such as intense storms, floods, land slides, temperature extremes, drought, and wildfires has risen several-fold between 1980–2010 (http://www.munichre.com/en/media_relations/company_news/2010/2010-08-05_company_news.aspx). In 2010, in the US alone there were 247 such events (http://ebookbrowse.com/munich-re-2010-natcat-review-pdf-d57776805). Since then, extreme weather has become more frequent and intense. Some of the more noticed events include the February 2011 blizzard that crippled Chicago, and deadly tornadoes in Missouri on May 22, 2011 and in Alabama on April 27, 2011, the day on which a record 199 tornadoes were sighted. The National Weather Service placed the number of U.S. weather fatalities in 2011 at 1,070, almost double the 10 year average of 563. The drought and high temperatures contributed to record fires in Colorado in June, and the intense fire season continued in the western US into July and August.

The weather extremes are global in scope, ranging from fires in Russia in July 2011 to flooding in Sindh Provice of

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Pakistan in September 2011. The overall losses for 2011 amounted to $148 billion, with insured losses of $55 billion (http://www.reuters.com/article/2012/05/31/us-climate-risk-disclosure-idUSBRE84U11220120531). Last winter the extremes included snowstorms in Rome, ice on Venice canals, and severe cold along the Adriatic Sea. In July, the Black Sea region suffered unusually severe flooding.

Population

This year the global population surpassed 7 billion and is expected to increase to 9 billion by 2050. There has been more than a 20-fold increase in total energy use since the Industrial Revolution, caused slightly more by population increase than by expansion of per capita consumption (Ehrlich, Kareiva, & Gretchen, 2012, modified from Holdren, 1991). Over the last two centuries both population growth and economic growth (and therefore consumption) have been exponential in nature. For example, in order to support the world's seven billion people we need 17 billion fowl, 1.9 billion sheep and goats, 1.4 billion cattle, 1 billion pigs, 400 million dogs, and 500 million cats.

Must We Be Inconvenienced to Deal With the Truth?

To virtually all scientists, these statistics on global climate system, population growth, and exploitation of the Earth's resources are alarming. But as you know, people tend to resist accepting facts that conflict with their lifestyles and livelihoods. Thus, it is more convenient for us to believe that the current rise in temperatures is a "natural cycle," and thus we cling to anything that might support that belief, even if science contradicts it. However, climate change is not driven by belief, but by the laws of physics and chemistry. If we choose not to deal with the consequences of our actions, then Nature will eventually force us to face those consequences in very unmerciful ways.

B.F. Skinner, one of the founding fathers of behavior analysis, was an optimist for much of his career, but over time became less confident about the power of behavior analysis to solve the major problems facing humanity (Chance, 2007). The reason was that certain evolved characteristics now work against us. Perhaps the most important of these is that immediate consequences outweigh delayed consequences. This understandably leads to pessimism, even among behavior analysts, the experts on behavior change. However, recent events are telling us that climate change is no longer a future threat; it is in the "here and now," a time frame to which human's are likely to respond.

Reasons for Optimism

People are increasingly affected by events that are traceable to global warming. Severe winds, tornados, floods, droughts, and fires are becoming commonplace. Many people are seeing their homes crumble in a matter of seconds. Even those who are not directly impacted by disasters feel the effects through increased insurance premiums and energy prices. It is becoming increasingly difficult for people to deny that the planet is undergoing important changes. In spite of millions of dollars spent to discredit climate science and scientists, 6 out of 10 Americans see climate change as a real problem (Pew Research Poll, 12/01/2011).

Thus, there is good reason to believe that people are ready to embrace change. There are many helpful things people can do in the way of lifestyle changes: buying organic foods and avoiding heavily packaged products, eating less meat, reducing the number of miles they drive, keeping their cars tuned up and the tires properly inflated, choosing fuel efficient vehicles, recycling more, and flying less. Many people are already doing these things.

As Friedman and Mandelbaum (2011) pointed out, in order to enact effective changes, we have to develop a new economy based on sustainability rather than consumerism. This requires a public awakening, establishment of political will, resetting of priorities, and an alliance of governments, businesses, and citizens. Businesses and governments are taking steps to conserve energy. Research and development is being undertaken involving fuel cells, zero emission coal-burning power plants (integrated gasification combined cycle), and renewable energy development. We are moving towards more intra-city mass transit systems, improved housing design, and more compact cities. Certainly, nanotechnology and LED technology will play important roles in the solutions. Already in the US there are more than 100,000 people working in solar-related production (http://www.seia.org/solar-jobs) compared to 80,000 people working in coal mines (www.sourcewatch.org/index.php?title=Coal_and...United_States).

The Clock Is Ticking

We can build a sustainable future with environmentally friendly fuels, clean air and water, and with economic development and good jobs. The question is whether we will move in this direction at a fast enough pace to avoid disaster. It is not enough that people are amenable to change; they need help in making and sustaining the changes. That's where behavior analysis comes in. We need experts in behavior change who can get people to put on a sweater rather than turn up the heat; who can show businesses how to profit from going green; who can help politicians create legislation that will reduce gas consumption without losing elections; and who can help environmentalists, industrialists and governments work together to move toward a sustainable economy.

We don't know how much time we have to get the job done. Nature is the time keeper, and none of us can see the clock. But we do know the clock is ticking.

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Think Big to Save the World

Actively Caring for the Environment: How Applied Behavior Analysis Can Do More for Sustainability

BY E. SCOTT GELLER

The future state of our living environment is uncertain because of acid rain, global warming, damage to the ozone layer, worldwide misuse of land and water, and overpopulation. Technological advances can reduce these threats, but not remove them. The crucial role for applied behavior analysis (ABA) in addressing our environmental crisis is obvious. The sustainability of our planet is inextricably dependent upon human behavior.

Numerous studies have demonstrated the three-term contingency of ABA (i.e., activator-behavior-consequence) to be an effective tool for promoting environmentally friendly behavior (EFB; e.g., Cone & Hayes, 1980; Dwyer, Leeming, Cobern, Porter, & Jackson, 1993; Geller, Winett, & Everett, 1982; Lehman & Geller, 2004). However, very few large-scale applications of these behavior-change strategies for ecological sustainability have been implemented (Allcott & Mullainathan, 2010). Thus, while ABA is clearly the most cost-effective strategy for increasing EFB and decreasing environment-destructive behavior, this method has only recently started to produce some large-scale environmental benefits (cf. Ayres, Raseman, & Shih, 2009). Why is this the case and how might we address these barriers so ABA has a greater impact on sustainability?

Who Is the Audience?

Most ABA research demonstrating beneficial sustainability effects is published in professional journals and books read almost exclusively by other psychologists. As such, the authors give convincing demonstrations of the efficacy of their behavior-change techniques to people who have little or no influence on large-scale applications and dissemination. In other words, the critical social-marketing aspects of behavior-change technology for sustainability have not been adequately addressed (Geller, 1989). Bailey (1991) commented on this dissemination problem:

> We have a great science (the experimental analysis of behavior) and a pretty good technology (applied behavior analysis) but no product development or marketing... we do not value marketing [and have] neglected to develop socially acceptable terminology for presenting our concepts to consumers... we have, in our zest for science and technology, taken the human concerns out of behavior analysis (p. 39).

What Behaviors Have We Targeted?

Stern and Gardner (1987) distinguish between curtailment EFBs (e.g., increasing conservation behavior) and efficiency EFBs (e.g., purchasing energy-saving equipment). They contend that purchasing fuel-efficient vehicles and Energy Star water heaters saves more environmental resources than does carpooling or reducing showering time.

Efficiency EFBs require a one-time purchase of an environment-friendly product (e.g., from hybrid cars and major appliances to home heating and cooling systems), whereas curtailment EFBs require a person to repeat inconvenient or sacrificial actions (e.g., from carpooling and collecting recyclables to reducing water use and turning back thermostats). Early applications of behavioral interventions for ecological sustainability did not target one-shot efficiency EFBs, and this trend has continued to the present (Lehman & Geller, 2004).

Who Should Change?

Efficiency EFBs require accessible and affordable options, and such availability is greatly determined by organizations and government policy. Stern and Gardner (1987) emphasized "corporations make a greater direct contribution to environmental problems than individuals, and it is worth examining whether more can be done to

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