Human Behavior and Environmental Sustainability: Problems, Driving Forces, and Research Topics

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Social and behavioral research is crucial for securing environmental sustainability and improving human living environments. To put the following articles into broader perspective, we first give an overview of worldwide developments in environmental quality and trends in resource use. Second, five general driving forces of global environmental change are distinguished: population, affluence, technology, institutions, and culture; these are considered in view of critical transitions in the evolution of human society. Third, inspired by a four-stage model approach to common resource dilemmas, our introduction describes this issue's specific topics for research and policy support concerning environmental sustainability at different scale levels. Finally, the necessity of multidisciplinary collaboration and desirable developments in environmental psychology are discussed.

Environmental sustainability is a key issue for human societies throughout the 21st century's world. All countries need to secure sufficient quality—in the short and the long term—of natural resources, ecosystems, and the diversity of plant and animal species, including the human living environment. Since 1987, the term "sustainable development" has been used to denote economic, social, and environmental dimensions of our future survival (WCED, 1987; see Robinson, 2004, for a conceptual review). In this issue, we focus on environmental sustainability and its relation to human quality of life. Our focus is on positive and negative qualities of human living environments including nature for people, on what they "do" to people, what people "do" to them, and how this could be changed for the common good.

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In the social and behavioral sciences, environmental degradation, human well-being, and environmental behavior have been research topics for several decades (e.g., Bechtel & Churchman, 2002; Geller, Winett, & Everett, 1982; Kaminski, 1976; Redclift & Woodgate, 1997; Stokols & Altman, 1987; Wohlwill, 1970), giving rise to journals like *Ecological Economics*, *Environment and Behavior*, *Human Ecology Review*, and *Journal of Environmental Psychology*. Recently, environmental psychology has been broadened to incorporate sustainability problems (e.g., Bonnes & Bonaiuto, 2002; Gardner & Stern, 2002; Kaufmann-Hayoz, 2006; Schmuck & Schulz, 2002; Steg & Vlek, in press; Vlek, 2000; Winter & Koger, 2004).

After a provisional start devoted to "Human response to the physical environment" (vol. 12, no. 4, 1966), the *Journal of Social Issues* devoted five earlier issues to environmental problems, respectively, to "Energy conservation" (vol. 37, no. 2, 1981), "Managing the environment" (vol. 45, no. 1, 1989), "Green justice: Conceptions of fairness and the natural world" (vol. 50, no. 3, 1994), "Psychology and the promotion of a sustainable future" (vol. 51, no. 4, 1995), and "Promoting environmentalism" (vol. 56, no. 3, 2000). In the latter issue, Oskamp (2000) pleaded for social science to address sustainable development, referring to the "threat of population growth," the "trap of overconsumption," and the "tragedy of under-conservation." In the *Annual Review of Psychology,* Stern (1992) defined a clear position for psychology in research on global change, mitigation, and adaptation. The *American Psychologist* (May 2000) issued a special section on "Psychology and sustainable development." And in a separate section of *Umweltpsychologie* (vol. 10, no. 1, 2006), several authors put forward sustainable development as a new challenge for psychology, thereby indicating distinct lines of relevant research.

The present issue offers a set of more recent research, conducted largely by European psychologists. The various articles address key theoretical, methodological, and policy-making questions about the behavioral dimensions of environmental sustainability. Before describing these articles in particular, we sketch their context by discussing some of the most pressing environmental problems of our time, as well as their general driving forces. This introduction thus goes from environmental to behavioral and from general to specific.

Environmental Sustainability as a Problem for Human Society

Concerning environmental sustainability, social and behavioral researchers need to understand the state of affairs regarding various physical problems and expected developments in environmental resource use. Although many readers may be acquainted with the litany of environmental damage and risks, a look at the current picture may be useful. Not all of the news is bad. This section presents an overview.

The Environmental State of Affairs

After 30 years of environmental policy making many cases of hazardous pollution have been resolved. Lead has been banned from car fuels, DDT from pesticides, and asbestos from building materials. Toxic wastes are treated with greater care, industrial safety has significantly increased, electric power plants have become cleaner, and energy and materials are used more efficiently. The world has generally become more sensitive to the need for renewable energy sources.

However, as human populations continue to grow, material consumption intensifies and production technology further expands; by consequence the quantity and quality of environmental resources keep steadily decreasing. Following the United Nations Environment Program (UNEP, 2002) and the European Environment Agency (EEA, 2003, 2005) there is continuing concern about nature fragmentation and loss of biodiversity, shortages in freshwater availability, over-fishing of the seas, global warming, extreme weather events, urban air pollution, and environmental noise. The recent UNEP (2005) atlas: "One planet, many people" shows vivid pictures of the way in which human settlements and road infrastructure are proliferating in rapidly urbanizing areas throughout the world.

In less industrialized regions of the world the environmental picture is bleak. For example, many communities in Africa, Southern Asia, and South America are strongly dependent on natural ecosystem services such as arable land, water resources, fish stocks, and various forest products. Their day-to-day survival needs make it hard to consider long-term environmental values explicitly. UNEP (2006) reports that in quite a few African countries poverty has increased and life expectancy has gone down, while the environment has deteriorated (see also UNDP, 2005). Poverty is not only devaluing people (Narayan, Patel, Schafft, Rademacher, & Koch-Schulte, 2000), it is also destructive for local environments. In the poorer parts of the world, deforestation, lack of clean drinking water, coastal flooding, and heavy urban air pollution are major environmental problems. Considering increased "bush meat" hunting, Du Toit (2002) concludes that in rural Africa wildlife resources will inevitably be exterminated from unprotected areas.

The Worldwatch Institute (WWI, 2004, 2005) has compiled environmental highlights, negative as well as positive, in the course of 2003–2005. Table 1 displays several examples. Clearly, here, as in WWI's full "year in review"—the negative items are more numerous than the positive items. Inspection and interpretation of the items in Table 1 reveal that many environmental problems basically are social and behavioral problems. For example, the Northern Spanish oil pollution was a failure of human decision making both about technical safety and about a timely harboring of the "Prestige" instead of sending it back to sea. The decline of fisheries reflects a failure of common resource management. Climate change is a long-term

Table 1. Highlights of Environmental Developments 2004–2005 (from WWI, 2004, 2005), as Documented by Scientific Research or Government Reports[a]

Pollution: Oil tanker *Prestige* carrying 77,000 tons of oil splits apart, contaminating Spain's Galicia coastline and unleashing public anger worldwide.

Population: .. by 2050 world population will be 8.9 billion, down from earlier forecast of 9.3 billion.

Climate: Concentration of carbon dioxide, the main global warming gas in Earth's atmosphere, posts largest two-year increase ever recorded.

Fisheries: Industrial fishing has killed off 90% of the world's biggest and most economically important fish species.

Food: AIDS is fueling famine in southern Africa, where 7 million farmers have died from the epidemic.

Transportation: Traffic delays cost U.S. motorists about $8 billion a year in wasted fuel and 3.5 billion hours in lost time.

Climate: Atmospheric concentrations of methane, the second most potent greenhouse gas, have leveled off after two centuries of growth.

Wildlife: .. a surge in demand for skins of tigers, leopards, and other endangered wildlife as the fashion industry once again embraces fur.

Energy: More than 150 countries attend *Renewables 2004,* the largest-ever meeting of government and private-sector leaders focused on achievable renewable energy goals.

Biodiversity: .. if global temperature rises 2–6 degrees as now predicted, 18–35 percent of the world's species could be gone by 2050.

Marine systems: .. the number of oceans and bays with 'dead zones' of water, so devoid of oxygen that little life survives, has doubled to 146 since 1990.

Energy: .. world energy demand will grow 54 percent by 2025, with oil use rising from 81 million to 121 million barrels a day.

Water: .. World Bank is boosting its funding of large dam projects to the detriment of the environment and local peoples.

Toxics: The Stockholm Convention on Persistent Organic Pollutants enters into force to rid the world of 12 hazardous chemicals, including PCBs, doixins and DDT.

Urbanization: .. the world will soon become predominantly urban, with 60 percent of people living in cities by 2030.

Forests: .. rising international demand for Brazilian beef is encouraging high rates of Amazon deforestation.

[a]Recently, another alarming item was reported from Krasnoyarsk (Russia) in *The Guardian* (UK): 'Fires in the Siberian forests—the largest in the world and vital to the planet's health—have increased tenfold in the last 20 years and could again rage out of control this summer, Russian scientists warn' (Radford, 2005).

and widespread effect of numerous human activities involving the burning of fossil fuels. Biodiversity is decreasing because of intense livestock farming, agriculture, and logging. Urbanization is stimulated by decreased possibilities of economic security in rural areas.

Following the *Millennium Ecosystem Assessment* (MEA, 2005), over the past 50 years human activities have changed vital ecosystem services more rapidly and extensively than in any comparable period of history. Fifteen out of 24 ecosystem services examined are being degraded or used unsustainably such that they now involve risks of nonlinear changes that will have important consequences for human well-being. Future growing demand for food, water, timber, fiber, and fuel is likely to exacerbate current problems. So far the burden of environmental degradation is particularly borne by inhabitants of sensitive areas in the Middle East, sub-Saharan Africa, and southern Asia. "An effective set of responses to ensure the sustainable management of ecosystems requires substantial changes in institutions

and governance, economic policies and incentives, social and behavioral factors, technology, and knowledge" (MEA Synthesis Report 2005, p. 17).

Developments in Environmental Resource Use

In the wealthier countries of the world, clean-up operations, technological innovations, and economic policies have helped to considerably reduce the environmental impacts of human activities, particularly at the local level of human living environments. In many domains, however, the steady growth in human population, consumption, and technological power is overtaking the environmental improvements achieved. WWI (2006) reports that, in 2005, world population increased by 74 million people to a total of 6.5 billion, oil use grew 1.3% to 83.3 million barrels (or 13.2 million cubic meters) *per day*, global car production (excluding heavy-duty vehicles) reached a total of 64.1 million, while steel production reached a new record of 1.1 billion tons.

Significant growth in environmental resource use is related to the increased use of motor vehicles for passenger and goods transportation since World War II. For the countries of the Organization of Economic Cooperation and Development (OECD) Schipper (1997) reported that the number of vehicle-kilometers per capita has been steadily rising from 1970 onward in Western countries. Carbon emissions correspondingly rose over the same period, with the per capita figure for the United States remaining stable but notably higher than relevant figures for other OECD countries. Considering the near future, the author notes (p. 59): ".. that travel is emerging as the primary leader of growth in carbon emissions in the wealthy, industrialized countries. Lifestyle changes driven predominantly by higher incomes—particularly increased automobility—have consistently led to higher carbon emissions, and the trends in the travel sector show no signs of saturation." The World Business Council for Sustainable Development (WBCSD, 2004) expects that the number of light-duty vehicles on the roads will steadily increase from the 2004-level of 750 million to 1 billion around 2020 and up to 2 billion around 2050. Expanding motorization means greater energy use, increasing air pollution and growing CO_2 emissions, wider-spread environmental noise, and expanding road infrastructure.

For the coming decades, the International Monetary Fund (IMF, 2004) expects particularly high growth of material production and consumption in India and China, together accommodating one third of the world's population. This is expected to cause great increases in the use of raw materials, in land use for housing and industry, in transport infrastructure and the number of motor vehicles, and generally in fossil fuel consumption and the use of nuclear power. The International Energy Agency (IEA, 2005) expects that world energy demand will rise by over 50% in 2030 under a "Business as Usual" scenario, and no less than 37% under a "World Alternative Policy" scenario.

Societal Driving Forces of Environmental Decline

Before we describe the specific research topics of the several articles to follow, this section reviews five societal driving forces of worldwide environmental deterioration. Following a classic formula (Ehrlich & Holdren, 1971), total environmental resource use (involving wasteful emissions) is a multiplicative function of population, consumption and technology. The basic formula reads: Impact = P × A × T, where P stands for population, A for average Affluence (consumption per person), and T for the average resource intensity of the Technology used per unit of production. The development of these driving forces is supported by evolutions in the Institutions in which society is organized, and in society's Culture as expressed in general values, norms, and beliefs (see also Stern, 1992). The time course of the five driving forces may be evaluated as more or less sustainable, as judged by their economic, social, and environmental impacts.

To obtain a long-term perspective, the forces P, A, T, I, and C may be traced in their qualitative and quantitative development from the beginning of human presence on earth. In a review of historical transitions, Takács-Sánta (2004) goes along the six evolutionary milestones of Fire, Language, Agriculture, Civilization (States), European Conquests, and the Technological-Scientific Revolution, while describing their main implications for Population, Affluence, and Technology (leaving changes in Institutions and Culture implicit). The author identifies several long-term trends in the environmental impact of human evolution, viz. clearing of more and more natural vegetation for human settlement, increasing separation of human communities from the natural environment, growing technical efficiency and capacity, more intense use of raw materials and fossil energy sources, and proliferation of transport infrastructure and vehicles. As an aside, Takács-Sánta's set of six evolutionary stages may well be enlarged with two more, namely Mass Motorization (from about 1900, and accelerated after 1945) and the Computer Revolution (from about 1965, and accelerated around 1980). One might then describe the environmental implications of all eight evolutionary stages for all five driving forces above, not just P, A and T.

To safeguard and promote environmental sustainability, the total environmental impact of human activities may be reduced via consistent policies aimed at changing the five driving forces mentioned above. Obviously, each driving force itself encompasses several specific factors and opportunities; our treatment here can be no more than an indicative summary of problems and possibilities.

Population. World population is expected to grow from the present 6.5 billion to about 9 billion around 2050, particularly in less industrialized countries (Engelman, Halweil, & Nierenberg, 2002; Hinrichsen & Robey, 2000). For example, UNEP (2006) reports that population growth in Africa is among the highest in the world, with a total of 798 million inhabitants in 2000 compared to 118

million around 1900; for 2025 the expected population is 1300 million people. The United Nations' view is that every human being needs space to live, has the right to mature, and is entitled to a material basis for his or her secure development. With a growing population the acknowledgment of such basic rights implies a further increase in environmental impacts. Although fertility rates have fallen in many countries, population control is an obvious way to prevent the growth of poverty and reduce total environmental impact, but it is a sensitive topic in many cultures and societies. Experts believe that a reduction in population growth will follow improvements in people's standard of living. Social programs to promote "family planning" have been conducted in India, Kenya, and Mexico, in which social-psychological theory has been fruitfully applied (Bandura, 2002).

Affluence. Increasing wealth is an important human aspiration worldwide. Naturally, a basic kind of material security and comfort is necessary in all parts of the world. In the wealthier countries, however, general subjective well-being has not increased much over the past decades, even though incomes and consumption levels have risen significantly (Csikszentmihalyi, 1999; Diener, Suh, Lucas, & Smith, 1999). Expanded consumption has resulted from a gradual transformation of basic needs fulfillment into meeting ever-new temptations ("luxury fever"; Frank, 1999) in, for example, household equipment, exotic holidays, or sports utility vehicles. Such fashions have led to a strong growth in household environmental impacts (Noorman & Schoot Uiterkamp, 1998; Stern, Dietz, Ruttan, Socolow, & Sweeney, 1997).[1] To reduce environmental damage and risks significant changes are needed in consumer behavior, in manufacturers' products and supply of goods and services, and in people's ability to fulfill their needs and values in a gratifying and sustainable way, using broader-than-material notions of quality of life (Ölander & Thøgersen, 1995). However, like Gudmundsson and Höjer (1996) do for motorized transport, Sanne (2002) argues that most consumers are "locked-in" by social structures and processes that strongly induce environment-burdening patterns of consumption. Such reasoning underscores the importance of psychological changes to achieve environmental sustainability.

Technology. Given the many technical installations, vehicles, and equipment people use, there is huge potential for materials efficiency, energy saving, waste reduction, and decreasing ambient noise levels (e.g., Von Weizsäcker, Lovins, & Lovins, 1997). However, as Midden, Kaiser, and McCalley (this issue) show, the environmental effectiveness of eco-technologies strongly depends on the way users interact with them. Nieuwenhuis, Vergragt, and Wells (2006) discuss the

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[1] The reader may wish to obtain an estimate of his/her "ecological footprint" through answering the 16 questions of the Ecological Footprint Questionnaire at http://ecofoot.org, designed by the Global Footprint Network in Oakland, California (see www.footprintnetwork.org).

many possibilities for reducing transport's widespread environmental impacts, but they also argue that, in many respects, society is technologically locked into the private motor vehicle system. Unfortunately, the adoption of eco-technology (e.g., cleaner cars) may still lead to overall increases in environmental burden through sheer growth in activity volumes as well as the "rebound effect" (Berkhout, Muskens, & Velthuijsen, 2000; see also Midden et al., this issue). Rebound, or take-back, amounts to the intensification of an activity when its per-unit environmental resource use is decreased. A classic example is the increased use of energy-saving compact fluorescent lamps (CFLs). Rebound is well known since the days of economist Jevons (1865) who worried that Britain's coal supplies might run out *sooner* when the efficiency of coal use would be increased (see Alcott, 2005). The extent of rebound equals the degree to which the increase in demand for a given product exceeds the increase in per-unit efficiency of production.

Institutions. Various institutions and structures foster economic growth as a key goal of human society. The "addiction" to short-term economic growth usually overrides the desire for long-term environmental quality and security (Booth, 2004). In the future, environmental impact may further increase when such institutions remain dominant. Particularly in the industrialized countries, transitions toward environmental sustainability in various sectors require breakthroughs in basic notions of human well-being and corresponding policy goals. Environmental sustainability also requires changes in age-old patterns of thinking about the abundant availability of natural resources—which is no longer the case, and a focus on human survival through controlled environmental exploitation within ecological limits. Following Schmuck and Schulz, (2002, p. 6): "Sustainable development requires an economy directed at improving the quality of life, decoupled from the quantity of consumed resources." Such a goal calls for multi-party debates and managerial arrangements among the various stakeholders of particular environmental goods, such as forests, ocean fish stocks, and countryside areas. Agrawal (2002) as well as Glasbergen and Groenenberg (2001) report specific experiences and possibilities.

Culture. As a pattern of socially shared beliefs and values, norms, and attitudes, culture permeates people's interactions with technology, shapes industrial production and household consumption, and guides procreation and population development. Culture pushes social and economic institutions regulating the demand for and the supply of material goods and services. In many cultures, material possessions and consumption signify people's identity, success, and power in society (e.g., Dittmar, 1992). Personal power, achievement, and self-determination are prominent values of modern society (Schwartz, 1994). One persistent cultural characteristic of human society is environmental shortsightedness in both a physical and a social sense of the word (see further below). However, if the earth's

ecosystems are to be kept livable for present as well as future generations, cultur-ally embedded long-term thinking and greater collectivism (Triandis, 1995) are both needed. Many pro-environmental changes in human activities, organizational structures, and practical facilities may develop more easily when environmental awareness and responsibility are increased, when humans see themselves as being part of nature, and when nonhuman nature is acknowledged to be of prime social and economic interest. Such changes in thinking require significant psychological and sociological transformations.

Specific Topics of Social and Behavioral Research

Against the broader context and background described above, and before the professional considerations in the concluding article, our introduction now turns to the specific research topics of the present issue. Nine papers are following, which elucidate theoretical, methodological, and substantive problems related to environmental sustainability. Their organization loosely follows an extended com-mons dilemma approach (Vlek, 1996; Vlek & Steg, 2002; adapted in Steg & Vlek, in press), which covers the stages of problem diagnosis, policy decision making, practical intervention, and effectiveness evaluation.

Many environmental problems may be characterized as a commons dilemma (Edney, 1980; Hardin, 1968; Ostrom, 1990). This is a social situation in which a collective cost or risk is generated via the combined negative externalities of numer-ous individuals who act rather independently from one another. In other words, in a commons dilemma the external effects of numerous individually optimal ("rational") decisions may combine into a collectively suboptimal ("irrational") situation, which actually nobody wants. Vivid present-day examples are the ex-ploitation of fishing grounds by various ship owners, metropolitan air pollution through motorized transport, and large-scale damage to natural ecosystems by ex-panding recreation and tourism. Commons dilemmas are increasingly difficult to appreciate and to manage, the greater the number of individual actors (immediate benefit seekers) and the smaller the negative external effect of each actor. Thus, almost unknowingly, a large group of actors could be gradually "stealing the com-mons from the goose" without being held accountable for it. Commons dilemmas are particularly intractable when driven by large institutional and cultural patterns, as discussed above.

Much research on commons dilemmas is focused on factors that would pro-mote social cooperation for safeguarding common resources. Recent conceptual-izations, research methods, and empirical conclusions are given by Gärling, Biel, and Gustafsson (2002), and by Ostrom et al. (2002). Basic questions about any commons dilemma are: What is the problem and how serious is it? Should any-thing be done about the problem and which policy goals should be adopted? Which

practical interventions are possible and how could they be effectively applied? What would be the environmental and human quality-of-life effects of policy interventions and would these be acceptable for subjects? These questions follow the four model stages mentioned above.

Given the breadth of the commons dilemma model, not all four stages can be represented in one journal issue. Research topics actually addressed under "problem diagnosis" are environmental risk judgment and noise annoyance, and the evaluation of urban environmental quality and nature experiences. Topics falling under "practical intervention" are behavioral processes and motivations, and environmental behavior change, including technology–behavior interactions. One article reports on practical lessons from five multidisciplinary research projects. The concluding article is concerned with psychology's potential for analyzing and supporting long-term environmental quality management. The model stages of "decision making" and "effectiveness evaluation" are delineated at the end of this article. The various topics of the present issue are briefly described as follows.

Environmental Risk, Stress, and Annoyance

Recognizing a commons dilemma begins with appreciating actual deteriorations of common goods. One question here is how sensitive people are to slowly developing environmental risks whose actual outcomes may occur far from the subject's "here and now." There are many reasons for people to give short-term individual interests more weight than long-term common goods. "Short-sightedness" (i.e., temporal and spatial discounting) and problem denial are especially powerful factors in underweighting collective interests (Bazerman, Wade-Benzioni, & Benzioni, 1996; Vlek & Keren, 1992). Gattig and Hendrickx (this issue) present empirical results about environmental risk perception, in which judgmental discounting of remote consequences does not seem to be as pronounced as it is for other (e.g., health or financial) risk domains. The authors conclude that appealing to the public's long-term preferences may work, and that policy makers should be cautious in applying insights from standard economic decision theory.

A related question is how sensitive people are to particular environmental stressors, and which policy measures could be recommended for prevention, abatement, and mitigation. Miedema (this issue) gives an overview of the impact of environmental noise, with a focus on noise annoyance. Although noise is not persistent in the sense that noise and its effects would disappear when the sources are eliminated, actually it is a persistent stressor because noise is strongly related to driving forces that are difficult to change, such as increasing population, growing transportation, and crowding in urban settings. The results presented are useful in finding optimal ways of reducing noise-induced effects through diminishing noise exposure.

Evaluation of Urban Environment and Nature Experiences

Apart from being mostly concerned about the "big issues" of global air pollution, climate change, and diminishing biodiversity (Uzzell, 2000), many people are increasingly sensitive to the quality of their own living environment and the availability of natural areas. Local disputes about the need for, and the environmental impacts of infrastructural projects, such as airport expansion and new roads or railways, reflect participants' worries about imminent reductions in their own quality of life.

One question here is how well ordinary citizens evaluate urban living environments in comparison to experts. Bonnes, Uzzell, Carrus and Kelay (this issue) report about multi-attribute evaluations of urban environmental quality by experts and laypersons, showing how their evaluations of urban green (biodiversity) may differ while those of urban air pollution may be in agreement. A related question is how important nature is and how nature experiences may affect people's general well-being. Van den Berg, Hartig, and Staats (this issue) discuss the various effects of nature experiences on human health and well-being, and they emphasize the importance of "nature for people" for the sustainable development of a rapidly urbanizing world. The conclusions from this work, like those of Bonnes et al., are highly relevant for long-term environmental policies in urban and countryside areas. Planners may also profit from the conceptual framework and a corresponding research agenda proposed by Van Kamp, Leidelmeyer, Marsman, and De Hollander (2003).

Behavioral Processes and Environmental Motivations

Commons dilemmas (see above) often are dynamic situations developing over time, whose outcomes may depend on several behavioral factors and processes. Thus, the actual development of a given commons dilemma is hard to study experimentally. The computer simulation of multi-person, multi-factor commons dilemmas has emerged as a complementary strategy for understanding and managing the growth and decline of common resources as a function of individual consumer behaviors. Jager and Mosler (this issue) demonstrate the usefulness of computer simulations for studying environmental resource dilemmas. Their data show that the fate of common resources is significantly related to distinct behavioral phenomena, such as short-sightedness, habits, and social imitation. They also show how useful it may be to form an *a priori* (simulated) idea about common resource use, so as to optimize the provision and utilization of common goods.

Lindenberg and Steg (this issue) offer a new perspective on the determination of environmental behavior, postulating that this is influenced by multiple motivations or goal frames. The authors distinguish among hedonic (pleasure), gain (benefit–cost), and normative (morality) goal frames, which may determine

people's information processing and attitude formation. Lindenberg and Steg emphasize that human behavior depends on multiple motivations that may or may not be conflicting. They also discuss how behavior change policies may be based on goal-framing theory.

Environmental Behavior Change and Technology

For averting the threat of environmental resource depletion, a variety of approaches toward changing user behaviors have been proposed, such as providing technical alternatives, regulatory rules, financial incentives, information, social examples, and/or organizational change (e.g., De Young, 1993; Geller, 2002; Geller et al., 1982; Gardner & Stern, 2002; Steg & Vlek, in press; Vlek, 2000). Whichever strategies are considered, their effectiveness largely depends on a proper diagnosis of, and tuning toward actual behavior determinants: Which goals and motivations are pertinent, and to what extent are these conflicting?

Changes in human behaviors may be encouraged by addressing individual persons' and groups' knowledge, beliefs, and preferences, for instance, through marketing, advertising, and information strategies. However, such "demand-side management" may have limited effects. Behavioral changes and adaptations may also be induced by modifying choice situations through "supply-side management," that is, via changes in entire provisioning systems, in physical infrastructures and technology, as well as in pricing.

Gärling and Schuitema (this issue) evaluate coercive and noncoercive approaches toward the reduction of car use in metropolitan areas. The authors conclude that necessary but unpopular coercive measures may become more acceptable when they are combined with noncoercive measures such as providing attractive travel alternatives and public communication programs. Midden, Kaiser, and McCalley (this issue) explore four roles of technology, respectively, as intermediary, amplifier, determinant, and promoter of environmentally significant behaviors. The authors show how the environmental effects of technical installations, vehicles and equipment significantly depend on actual user behavior, and how the latter in turn may be shaped, enhanced, or constrained by specific features of the technical environment. One conclusion is that the (enduring) net effects of technical solutions to environmental problems are largely unclear without considering the different perceptions, understandings and uses different people associate to them.

Multidisciplinary Research and the Future of Environmental Psychology

Given the complexity of many environmental problems, sufficient communication and cooperation among researchers from various disciplinary backgrounds is inevitable. This is more easily said than done, as is already apparent from Midden

et al.'s article. Schoot Uiterkamp and Vlek (this issue) discuss practical lessons from five multidisciplinary projects of environmental research. The authors distinguish among multi-, inter- and trans-disciplinary research, implying needed collaboration among different scientists as well as between scientists and policy makers, and they recommend organizational changes in university research.

In concluding the present issue, Gifford evaluates the current status of (environmental) psychology in view of the long-term environmental quality problems society is facing. The author identifies seven themes, which are also reflected in the present issue. Substantively, Gifford suggests that more research attention be given to "big issues" such as habitat destruction and the rapid extinction of various animal and plant species. The author shares the view that multidisciplinary collaboration should be conducted at different levels of analysis—from micro to macro, or from local to global. And, "If the field is to have the kind of effects on the real world that it has always sought, it must move toward a more serious engagement with policy-makers." This links up with one conclusion by Dabelko (2006, p. 1), worrying about the science–practice interface in global change: "Scientists should better analyze and understand the dynamics of the science–practice process as scientists, but also as communicators and participants in that process."

Concluding Remarks

In view of the general issues and the specific topics discussed above, the social and behavioral sciences have a challenging research agenda, covering environmental risk judgment and responses to various stressors, the determinants of environmentally significant behaviors, the individual and social effects of different environmental conditions, and the design and evaluation of effective behavior change programs for safeguarding environmental resources. For society at large, problem analysis, policy decision making, and behavioral intervention programs are particularly important with regard to climate change as resulting from forced global warming (see Lorenzoni, Pidgeon, & O'Connor, 2005). This huge environmental commons dilemma is strongly rooted in large-scale fossil fuel use through a multitude of motorized installations, vehicles, and equipment (remember the current 83.3 million barrels of worldwide oil use, each day). Without significant technical and/or behavioral changes, further population growth and increasing affluence will intensify current motorization and thus the associated emissions of greenhouse gases.

In the present journal issue not all major topics of sustainability research could be discussed. One topic deserving more research attention is environmental decision making—a crucial task in managing any commons dilemma. Unaided decision making often suffers from cognitive limitations and biases (Gilovich, Griffin, & Kahneman, 2002; Hammond, Keeney, & Raiffa, 1998; but see Gigerenzer, Todd, & ABC, 1999) as well as social distortions such as in groupthink (Janis,

1982). Organizational decision making may be less balanced because of power relations and the political and psychological need to stick to early-adopted development strategies. Focal points for environmental decision research are problem definition, multi-attribute scenario evaluation, multi-party decision making, and long-term risk judgment. Investigators may profit from the long tradition of behavioral decision research (see also Van der Pligt, 1988), and they may utilize a wealth of methods and experiences about methodical decision analysis (e.g., Von Winterfeldt & Edwards, 1986). Specifically for environmental decision making, Dietz (2003) lists six decision quality criteria (see also Edwards, Kiss, Majone, & Toda, 1984); Brewer and Stern (2005) present an inventory of problems and possibilities.

Another important topic is the "effectiveness evaluation" of environmental policies, which may involve more or less costly behavioral changes as well as changes in environmental conditions. Behavioral and/or environmental changes may significantly affect human well-being, and this can be evaluated in terms of specific changes in human quality of life. Quality of life may in turn be evaluated against the background of existing taxonomies of human needs and values, such that sustainable development is linked to the Brundtland (WCED, 1987, p. 43) admonition to meet the needs of the present without compromising future needs fulfillment. Schwartz's (1994) values structure and other listings of QoL variables (e.g., Poortinga, Steg, & Vlek, 2004) are a suitable basis for practical measurement instruments. Gatersleben (2001) reports on QoL effects of household energy savings. Steg and Gifford (2005) provide a review focused on transport and environment problems.

As an enduring societal problem, environmental sustainability covers urban living environments, natural resources, wildlife and recreation areas, and—in an overarching way—the ambient climate and weather conditions for all forms of life. Winter and Cava (2006) clearly warn that conflicts over natural resources and environmental conditions are threatening peace and stability among nations and may do so increasingly in the near future. To ensure environmental security and sustainability, the overall policy goal certainly must be to reverse the trend of gradual environmental deterioration, locally as well as globally. Some key aspirations are: (1) safeguarding the availability of basic resources, (2) protecting human health from environmentally risky conditions, (3) ensuring sufficient quality of human living environments, (4) protecting natural areas with their wildlife, and (5) promoting greater harmony between humanity and (other) nature. The many human–behavioral objectives derived from such general goals provide plenty of work for environmental policy makers in such varied domains as energy generation, livestock farming and food production, household consumption, tourism, and transportation. Adopting such objectives at different scale levels is the policy maker's responsibility. How adopted objectives may best be approached, and which conditions must be fulfilled to ensure policy effectiveness, are matters of

multidisciplinary research and development, in which the role of the social and behavioral sciences must be significantly extended.

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