Lay Theories of Spring: Displacement of Common-Sense Understandings of Nature by 'Expert' Ideas

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To explore the interplay between expert and common-sense ideas of nature in lay minds, a social representations approach was applied to a simple cognitive field, namely ideas about when spring begins, and why. Results from content analysis confirmed that an explanation derived from science is displacing common-sense theories of spring in samples of high school students resident in the Niagara Peninsula, Ontario, Canada. However, the 'expert' theory has no real explanatory value for those who hold it, whereas some of the common-sense theories do. These findings may have implications for environmental education and planning when the object is not transmission of knowledge about science for its own sake but a person's competence in thinking about nature as an ordinary citizen.

Introduction

Most children now grow up in an artifactual world and are given an environmental education, if given one at all, based on the 'ecological paradigm' (Keiny & Zoller, 1991). As a consequence they tend to develop no practical understanding of or profound feeling for nature (Nabhan & Trimble, 1994; Noss & Cooperrider, 1994). When they reach adulthood, their lack of experience of foraging for wild plants and animals of the bioregion they live in reduces their ability to read relative biodiversity in local landscapes (Chipeniuk, 1995a). But neither can they extract information from moderately complicated textual sources and use it for their own purposes (Statistics Canada, 1996). Specifically, they have trouble understanding and discussing environmental issues as their governments present them; terms including 'global warming', 'biodiversity', and 'ecosystems' are largely unintelligible to them (Insight Canada Research, 1996). Deprived of personal competence in reading local landscapes, ill-equipped to make sense out of printed information, mature citizens participating in environmental planning exercises then have a choice: struggle to comprehend expert ideas, leave decision-making about nature to the experts themselves, or evaluate options by criteria having nothing to do with nature.

Unfortunately, experts on the environment do not always think like ordinary citizens (e.g., Kaplan & Kaplan, 1989). Even if experts could somehow accurately represent lay thinking to themselves, it is injurious to good citizenship for citizens to rely excessively on experts to do their planning and decision-making for them (Bookchin, 1992; Nagel, 1987; Richardson *et al*., 1993; Tong, 1986). Besides, in democratic societies experts do not vote on behalf of citizens. Citizens vote; and unless citizens can discern long-term consequences of human intervention in natural landscapes by themselves, unless they care about nature in a personal

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way, they may vote for candidates whose policies promise more jobs, more money, or more convenience, not candidates who formulate policy on the basis of expert advice about sustainability. They may pay little heed, for example, to experts who warn that high consumption of hydrocarbons may be bringing on catastrophic climate change. Surveys show that 46% of Canadians who express increased concern about climate change do so because of changes they have seen at first hand; only 2% do so because of their education and reading (Environics Research Group Limited, 1995).

To what extent have 'expert' understandings of everyday natural phenomena penetrated lay thought? What use do laypersons make of expert ideas about biological nature? What happens when expert ideas conflict with common-sense ideas? Hitherto scholars have conducted little research on these questions, partly because of their presumption that whatever goes on in the minds of members of the public, everyone ought to think like experts, but also for lack of an appropriate psychological framework. Now, however, environmental planners are coming to appreciate the importance of bottom-up planning (e.g. Tester, 1994) and they have a new-found respect for popular culture, in traditional if not in Western societies (e.g. Johnson, 1992). Critics deny planners have a right to impose expert thought on public decision-making (Richardson *et al*., 1993). Methodologically, psychologists have developed new approaches to the study of 'social representations' (e.g. Moscovici, 1983) or 'folk' or 'cultural' or 'mental models' (Keesing, 1987), providing insight into how ordinary people sometimes incorporate scientific ideas in social discourse, sometimes act on their own common-sense explanations for various phenomena (Forguson, 1989; King, 1983). Research into how expert knowledge affects the competence of lay thinking about nature is now both urgent and feasible.

As part of an inquiry the general lines of which have been reported elsewhere (Chipeniuk, 1995a), a social representations study was designed to explore the interaction between lay ideas originating from formal science and ideas derived from custom and personal experience in a Western society. More specifically, its purpose was to probe the extent to which expert concepts of spring, the north temperate zone season, have displaced or interfered with common-sense ideas in the thinking of a fairly typical group of young laypersons.

Initially, what made lay conceptions of spring an obvious field to investigate was the emphatic manner in which Canadian news media, citing meteorologists, announce that March 20 or 21 is 'officially' the first day of spring, even though March 20 has little to do with traditional English-language ideas of spring. Clearly, there is a popular science-derived 'theory' of spring. At one time elementary school students in at least some of the Canadian school systems learned about the relationship between solar angle and differential heating of the surface of the Earth, but by now, despite the lack of common curricula, the notion seems to have a life of its own. A second reason for choosing conceptions of spring to study was that the English written record on ideas about spring reaches back to times before Copernicus, so one can distinguish between what derives from modern astronomical characterisations of the seasons and what does not. Still another was that lay ideas about when spring begins have a bearing on public sensitivity to climate change and the decline of neotropical migratory bird

populations, which are issues of the day in environmental education and planning.

Methods

The principal method was content analysis in which the enumeration units were instances of 'theorettes', or rudimentary causal explanations (loosely after Forguson, 1989) for when spring begins and what brings it on at that time or how a person can tell it has begun. On a priori grounds, six theorettes were expected: Theorette 1, 'Equinoctial Spring', in which spring begins on or about the vernal equinox, which approximates to March 20; Theorette 2, 'Calendar Spring', in which spring begins according to the month, March, April, or May; Theorette 3, 'Day-length or Sun-height Spring', in which spring begins when the days become noticeably longer or the sun noticeably higher in the sky; Theorette 4, 'Warmth or Snow-melt Spring', in which spring begins when the weather turns warm and snow melts; Theorette 5, 'Biological Spring', in which spring begins when plants leaf out or flower and songbirds return and sing; and Theorette 6, 'Circle Spring', in which spring begins one-eighth year after mid-winter, on or about February 4. From a small pilot, it was apparent that two further enumeration units were required, namely Theorette 7, 'Artifactual or Social Spring', in which spring begins when people start using different articles of clothing or vehicles or when their behaviour changes otherwise; and 'Other'. The coding scheme compounded from these units is presented in Figure 1.

Code	*When spring begins (typical or expected causal explanation in parenthesis)*
Theorette 1 'Equinoctial Spring'	— spring begins on or about the vernal equinox
Theorette 2 'Calendar Spring'	— spring begins in the month of March or April or May (as if the season were fixed by the calendar month)
Theorette 3 'Day-length or Sun-height Spring''	— spring begins when the days rapidly become longer or the sun mounts noticeably higher in the sky (because these phenomena produce an explosion of biological activity)
Theorette 4 'Warmth or Snow-melt Spring'	— spring begins when the weather turns warm or the snow melts (because these phenomena initiate biological activity)
Theorette 5 'Biological Spring''	— spring begins when plants leaf out or flower, songbirds return from the south and sing, or the like (because these phenomena constitute spring)
Theorette 6 'Circle Spring'	— spring begins on or about February 4 (because that is the beginning of the three-month period of the year lying midway between midsummer and midwinter)
Theorette 7 'Artifactual or Social Spring'	— spring begins when people start using different vehicles or articles of clothing or when their behaviour changes in some other way (because these behaviours are essential properties of the warm portion of the year)
Theorette 8 'Other'	— any explanation other than Theorettes 1–7

Figure 1 Coding scheme for social representations of spring

Theorettes 1 and 6 require some elaboration. According to the *Compact Edition of the Oxford English Dictionary*, early speakers of English had names for only two seasons, winter, or the wet season, and summer, the other half of the year. Spring was just the beginning of summer. 'Sing, Cuckoo', an English poem dated to somewhere between AD 1230 and 1310, celebrates such phenomena of spring as the germination of seeds, the blossoming of flowers, and exuberant birdsong, but it starts with the line, roughly modernised, 'Summer is a-coming in' (Anonymous, 1952). The middle of summer was Midsummer's Day, conventionally on June 24 by our own Gregorian calendar. June 24 approximates to the longest day and the one on which the meridian of the sun is highest. Midwinter was taken to be Christmas, December 25, more or less when the days are shortest and the meridian of the sun is lowest. No doubt this scheme was not formalised in the folk mind, but if it had been, the equinox ca. March 20 would have been the beginning of summer.

When the idea of four seasons entered English, evidently in the 1400s and by way of Renaissance French poetry, the word *spring* at first occurred as an element in the phrases 'the spring of the year' or 'the spring of the leaf'. *To spring* had predominantly biological senses such as 'to grow' and 'to be born', though it also meant 'to start'. There has never been any such thing as 'Mid-Spring Day' to correspond with Midsummer's Day or midwinter. If there were, that day would come halfway between Midsummer's Day and midwinter; roughly on the vernal equinox, ca. March 20. As a season fitted into the traditional cycle of the seasons, spring should begin six-and-a-half weeks after midwinter, or more or less on February 4. Not by chance, North American Groundhog Day, with its folkloric rule of thumb for ascertaining whether or not spring is about to begin, approximates this date. Hence Theorette 6.

The notion that spring begins around March 20, Theorette 1, is perhaps a recent back inference from the phrase 'vernal equinox' or 'spring equinox'. What may have happened is that astronomers called the equinox ca. March 20 the 'spring equinox' to distinguish it from the fall or autumnal equinox. With the advent of mass education, ordinary people began to learn a little about astronomy. It would be natural enough for them to assume the earthly season takes its definition from the astronomical event, rather than vice versa.

In addition, North Americans seem to have confused the cycle of the seasons with the nearly circular orbit of the Earth around the Sun. School textbooks and encyclopedias commonly present illustrations of the Earth at four positions in its orbit around the Sun. The point of the illustrations is to show how the tilt in Earth's axis produces differential heating of the surface of the planet at different points along the orbit, those points coinciding with the solstices and equinoxes. From that kind of image it is a short step to conflating the cycle of the seasons with the circle of the orbit and drawing the bad inference that points along the illustrated orbit are apogees and perigees on what is, after all, actually an ellipse.

One last point deserves notice. Social representations typically simplify items of scientific knowledge. Unsurprisingly, then, many laypersons simplify variations in the actual dates of the solstices and equinoxes to 21 across the board: December 21, March 21, June 21, September 21.

Hence Theorette 1, the social representation that spring begins on the vernal equinox, which many laypersons evidently believe always falls on March 21.

In spring 1994 several classes of senior high school students in the Niagara Peninsula of southern Ontario furnished participants for a paper-and-pencil exercise. Among these, the first six classes had a final section added to their tasks, a section intended to inquire into social representations of spring. Instructions for that section were as follows:

> In the space below, please say *when* spring begins, in your opinion, and *why* it begins then. (Your answer need be only one or two sentences long.)

With informants being instructed to limit their responses to one or two sentences, it was hoped most responses would include a token of just one theorette.

Students in the sample reported a mean age of about 17 years and had been resident in the Niagara region for a mean of about 14 years. There were 36 males, 49 females, and 5 informants who neglected or declined to say. Roughly half the participants attended a school serving a large, prosperous town and an equally prosperous agricultural countryside. The rest attended a school on the edge of a city of 130,000 people. Both schools were regarded as good ones by district standards. Participation in the exercise was voluntary. A research assistant who was himself a third-year university student administered the exercise. In his instructions he encouraged frankness rather than any attempt to provide the 'right' answers. Of the 92 returns for the section meant to supply data on theories of spring, 90 were usable, two spoiled.

Coding reliability was tested by having a second coder code initial theorettes for all cases. Intercoder reliability was 0.966 as measured by Krippendorff's (1980) agreement coefficient. That is, in about 97% of the cases the observed co-occurrences would be explainable by the pattern of perfect agreement rather than by what would be expected by chance.

Results

Nearly all responses were easily coded as belonging to one or another of the seven theoretically significant theorettes (Theorettes 1–7). However, many informants gave tokens of more than one theorette. Some also neglected to explain why spring begins when it does, in their view, or they deliberately chose not to say, possibly because they could think of no explanation.

Results are displayed in summary form in Tables 1 and 2. Detailed discussion here is reserved for Theorettes 1 (Equinoctial Spring), 4 (Warmth or Snow-melt Spring), and 5 (Biological Spring). These are not only the theorettes of greatest research interest but the ones instantiated in the largest numbers of cases.

A large proportion of the informants responded with some token of Theorette 1, 'Equinoctial Spring'. Often Theorette 1 was the only or first one mentioned. Overall, it was mentioned quite unmistakably by 30 of the 90 informants, or by 33.3%. In addition, 6 informants adverted to astronomical explanations without using the words 'March 21' or the like. If these are reckoned as reduced variants of Equinoctial Spring, then Theorette 1 could be said to have been deployed by 36 informants of the total, or 40%.

Table 1 Theorettes of spring among senior high school students, Niagara Peninsula, Ontario

Theorette	Times mentioned uniquely	*Times mentioned first*	*Times mentioned subsequently*	*Total number of instances*
(1) Equinoctial Spring	10	17	3	30 (+6)*
(2) Calendar Spring	1	12	1	14
(3) Day-length or Sun-height Spring	0	2	4	6
(4) Warmth or Snow-melt Spring	8	25	22	55
(5) Biological Spring	3	8	36	47
(6) Circle Spring	0	0	0	0
(7) Artifactual or Social Spring	2	1	13	16
(8) Other	1	0	2	3

* +6 = astronomical explanations that do not refer to the equinox or ca. March 20

Table 2 Most frequent permutations of theorettes of spring among senior high school students, Niagara Peninsula, Ontario*

Theorette 1, Equinoctial Spring,, followed by Theorette 4, Warmth or Snow- melt Spring	9 instances
Theorette 1 followed by Theorette 5, Biological Spring	6 instances
Theorette 2, Calendar Spring,, followed by Theorette 4, Warmth or Snow-melt Spring	8 instances
Theorette 2 followed by Theorette 5, Biological Spring	8 instances
Theorette 4, Warmth or Snow-melt Spring,, followed by Theorette 5, Biological Spring	26 instances
Theorette 4 followed by Theorette 7, Artifactual or Social Spring	8 instances
Theorette 5, Biological Spring,, followed by Theorette 4, Warmth or Snow- melt Spring	5 instances

*Includes all permutations occurring in 3 or more cases

Some informants chose not to offer an explanation for why spring begins on March 21, or why they believe it begins on March 21. Most of the others gave garbled astronomical explanations or explanations that were completely illogical (Figure 2).

Tokens of Theorette 1 were added as afterthoughts or consequences to another theorette just twice. In both cases the first theorette mentioned was Theorette 4 (Warmth or Snow-melt).

Theorette 4, 'Warmth or Snow-melt Spring', may be regarded as the theorette of widest currency, since responses from 55 informants (61.1%) included tokens

March 21 without astronomical causes (illogical causation)	
Case 1	'Spring begins around March 21 — it's when the weather gradually starts to change.'
Case 2	'Spring begins on March 21, and it begins because it melts away the snow and prepares the earth for summer.'
Case 3	"Spring begins on March 21. This occurs because it's [the] 'hange of season.'
Case 4	'Spring begins on March 21. It occurs to allow the growth and renewal of plants and trees.'
Case 5	'Spring starts March 21st and it's because it starts to get warmer out and the snow melts and the leaves [*sic*] start to flower and grow leaves and the birds come back.'
Ca. March 20 with astronomical causes	
Case 6	'Spring begins March 21st, because that's the last day that the sun goes around the earth for the last cycle.'
Case 7	'Spring begins March 21 … because … the sun is down [done?] cycling around the earth.'
Case 8	'… Spring begins on March 21st because that's why [sic] the scientists tell us and I believe it.'
Case 9	'Spring officially starts … March 21st … Spring comes when the earth tilts and the sun is above the equator.'
Case 10	'Spring begins about March 21. It is because of the way the earth is positioned according to the sun."
Case 11	'Spring begins March 21 because it has something to do with the alignment of the sun, earth, and moon and I've heard the word equinox used to describe it in some way, I'm not really sure.'
Case 12	'Spring begins officially near the end of March … Spring is caused by the orbit of the earth, the tilt of the earth and the rotation of the earth … When the earth is in a position in which it gets moderate amounts of sun it is in spring.'
Case 13	'… Spring begins on March 22 because all of the sunlight is causing plants to grow …'
Case 14	'March 21st because … the earth's rotation is getting closer to the sun.'
Case 15	'March 21st. The earth's rotation is getting closer to the sun.'
Case 16	'Spring begins March 21, this is so because earth rotation gradually reaches or gets closer to the sun.'
Astronomical causes	
Case 17	'This begins because the earth's orbit gets closer to the sun.'
Case 18	'Spring begins when the sun has reached the point where it gets closer to the earth …'
Case 19	'Spring begins when the earth's axis turns …'
Case 20	'Earth rotation leads to spring season …'
Case 22	'Spring begins about mid April because the earth's orbit is getting closer to the sun and there is more warmth.'
Case 23	'Spring occurs when the world revolves at a certain point around the sun. It happens from late March to late June.'

Figure 2 Explicit causal explanations instantiating Theorette 1 (Equinoctal Spring)

of it. In 19 cases an instance of Theorette 4 was followed by reference to Theorette 5 (Biological). Informants seldom stated explicitly what they took to be the relationship between warmth or melting snow and the return of biological activity, presumably because they considered it self-evident, so it is not possible to say whether they regard returning warmth or snow-melt as somehow producing the onset of biological activity or whether warmth or snow-melt are merely invariable accompaniments of the onset of biological activity. In many cultures, of course, including those of pagan Europe, people have regarded the sun as the begetter of life.

Theorette 5, 'Biological Spring', appears to be widely held but when held it is not so salient, being uniquely mentioned by only three informants, and as the first theorette by only eight. However, it was mentioned as a supplementary theorette by 36 informants, and thus by 47 (52.2%) altogether. When Theorette 5 was the first one offered, it was usually followed by a token of Theorette 4 (five instances).

Discussion

Two common sorts of responses may reflect theories a layperson could use effectively to explain important natural, and especially biological, phenomena of his or her everyday practical experience. The first and stronger of these is the sequence in which reference to Theorette 4, 'Warmth or Snow-melt Spring', precedes an allusion to the phenomena of Theorette 5, 'Biological Spring', because in the minds of many informants warmth or snow-melt are probably understood as producing birdsong, leafing, mating behaviour, and so on, as actually, in some sense, they do. That causality is implied by the order of the theorettes is suggested by the fact that in 26 cases the order is Theorette 4 then Theorette 5, whereas in only five cases is it Theorette 5 then Theorette 4. At any rate, discourse analysts often find sequence playing a role in causal explanations (Antaki, 1994). The second efficacious theory is simply Theorette 5, 'Biological Spring', especially when mentioned alone or first, since it takes the essence of spring to be recurrence of biological activity of defined, crucial sorts. Biological spring is a complex array of phenomena produced by natural kinds, and human psychology takes biological natural kinds to be themselves self-generating (Keil, 1989).

Other theorettes or combinations of theorettes generally do not serve as useful explanatory frameworks for the contemplation of natural biological phenomena. There is no well-defined causal relationship between the vernal equinox (Theorette 1), the calendar months of March, April, or May (Theorette 2), or clothing or human behaviour (Theorette 7) and leafing or birdsong. There is indeed a causal relationship between day length or sun height (Theorette 3) and the biological activity of spring; but only one informant followed reference to Theorette 3 with a token of Theorette 5.

If the theorettes the informants mention uniquely or first really are more salient and potent in their minds, then 30 of 90 informants (33.3%) are strongly inclined to think about spring in a fashion that might assist them in understanding the natural world of living things. That is, they gave responses in which Theorette 5 is mentioned first or uniquely, or in which a token of Theorette 4 is

followed by a token of Theorette 5. The several other informants who referred to Theorette 5 (Biological Spring) as an afterthought to theorettes other than Theorette 4 may be at least somewhat inclined to think of spring as a phenomenon of living things.

In short, a slim majority of informants retain the same common-sense understanding of spring as their linguistic forebears had (Theorette 5, Biological), and something over a quarter but less than a third entertain a compound common-sense theory of spring in which returning warmth and snow-melt (Theorette 4) precede and explicitly or implicitly produce a sudden acceleration in biological activity (Theorette 1) — a simple but *correct* explanation. By comparison, nearly as high a proportion of informants, about two-fifths, are aware of the principal 'expert' theorette for when spring begins and why, namely Theorette 1 or Equinoctial Spring. Among those who make explicit reference to ca. March 20, nearly all have been persuaded that the expert theorette is either the only correct understanding to have of the matter, since that is the only theorette they offer, or the most correct understanding, since it is the first theorette they offer. Very few informants provide a token of Theorette 1 as a second or third theorette. Taken as a whole, these findings indicate that the expert theorette has some sort of superior status in the minds of informants.

If so, however, this state of affairs is unfortunate. In the first place, the expert theorette of spring as most informants express it is scientifically wrong. Informants typically say what causes northern spring is that the Earth reaches some point in its orbit when it is closer to the Sun. In fact, northern spring heating commences when the axis of the Earth has swung some distance back towards a position at which the north pole most directly faces the Sun. As the pole faces the Sun more and more directly, northern regions receive sunshine from a steeper angle and for longer each day than has been the case for the previous several months. Orbital nearness of Earth to Sun has nothing to do with it, much less the rotation of the Earth, another 'explanation' sometimes invoked. Of the 23 explanations listed in Figure 2, 20 are wholly wrong and the remaining three are only vaguely correct.

Secondly, besides being wrong technically, the expert theorette fails to explain natural phenomena as ordinary people experience them in their daily lives. Because informants garble the astronomical imagery of the equinox or merely parrot 'March 21', they cannot trace meaningful causal relations between Theorette 1 and sun angle, day length, warmth, snow melt, or leafing or birdsong.

Thirdly, the expert theorette may be worse than useless. In 10 cases Theorette 1 is the only theorette offered. Conjuring up this inoperative 'explanation' often seems to deter informants from seeking a truly useful explanation.

Finally, the expert theorette cannot even provide a helpful reference point against which to decide whether a particular spring is early or late, because it is disconnected from earthbound events. In southern Canada the vernal equinox, ca. March 20, has no very close relationship with the onset of warm air or snow melt, certainly no more than, for instance, April 1, much less with the onset of plant growth or flowering or the return of migrant birds, which are phenomena of late April, or in most regions May. At any rate, if one believes spring begins

on the equinox, or on March 21, then spring can never be earlier or later than usual.

Of course the results of this study are a snapshot of knowledge in the minds of informants heavily influenced in their answers by what they take to be the expectations of the formal educational system. Further inquiry might demonstrate that older informants somehow improve their understanding of the astronomical causes of spring or they rely more on common-sense conceptions of spring. On the other hand, the informants have already completed close to the Canadian mean for years of schooling. About half of them will pursue formal education no further. Few among those who do go on to university will ever study the scientifically accepted causes of spring. If these results derive from samples drawn from a narrow sector of Canadian society, it is precisely that sector which includes most persons on the threshold of citizen responsibility.

Overall, possession of the expert theorette disables or disempowers the citizen mind in its efforts to understand spring. Citizens with this theorette in mind understand spring as commencing at a certain time, ca. March 20, not susceptible to human influence. The expert theorette therefore interferes with the ability of a citizen to detect manifestations of climate change personally; and the citizen who fails to notice signs of climate change personally, one expects, will be less supportive of policies and plans intended to lessen climate change than the citizen who does.

Results from the study as a whole show that in one simple but important realm of cognition involving nature, 'theories' derived from expert science are displacing common-sense theories. On close examination, the results also demonstrate that lay theories derived from expert science can hinder rather than help laypersons in their efforts to make sense out of phenomena which, as good environmental citizens, they should have some causal explanation for. Certain common-sense theories, on the other hand, adequately account for natural phenomena as people actually experience them.

Other studies have arrived at similar conclusions. Kempton (1987), for example, decides that the technically 'wrong' folk theory of home heat control is probably more functional for users and better at saving energy than the 'expert' one. Forguson (1989) argues that common-sense theories in general have excellent explanatory and predictive value for life in a real world. Chipeniuk (1995b) concludes that concepts such as that of the ecosystem have little reality in the minds of the university educated, much less others. Collectively, these and other investigations into lay thought cast doubt on the wisdom of current assumptions about environmental education and planning. Where is the evidence that ordinary citizens understand and deploy scientific concepts as scientists do? Researchers in environmental psychology and education are at a loss even to specify what constitutes useful knowledge of nature among members of the public (Chipeniuk, 1995a). Where the purpose of environmental education is to improve standards of environmental citizenship, perhaps programmes to rehabilitate and build on common sense would be more effective than programmes which aim to instill technical principles, however simplified.

Often environmental planners speak of the need to 'educate the public' about ecology or other fields, as they couch their planning exercises in a scientific

framework which, by its very nature, is contrary to common sense (Atran, 1990; Moscovici & Hewstone, 1983)). Ehrenfeld (1993), however, himself a conservation biologist, invites environmental experts to reconsider their almost invariably top-down relationship with the public. He implies that it is not so much members of the public who need to be educated about science as experts who need to learn respect for what ordinary citizens are capable of knowing and do know. Certainly there is something naive about the belief that because science provides the best understanding of nature for technical purposes, it must also provide the best understanding of nature for individuals in their daily lives. This is the logic of sympathetic magic. So far environmental educators and planners have accepted at face value the uncritical opinion natural scientists have of the suitability of their technical concepts for personal use by lay citizens. They owe it to their own specialisations to be sceptical and to consider less obvious alternatives.

How are researchers to go about finding these alternatives? In a modest way, the present study suggests that treating Western populations as having their own folk sciences may be productive. After all, Theorette 5, Biological Spring, descends from cultures not so different from the ones ethnographers work with today. If modern speakers of English reproduce a traditional understanding of climate, no doubt they reproduce traditional understandings of other aspects of nature. In fact, they certainly do. To study these vestiges of folk culture, researchers concerned with environmental education in local Western communities might adopt the methods of ethnobiologists, who specialise in investigating knowledge of nature in traditional societies. As a point of departure, Martin (1995) has recently issued a manual of basic ethnobotanical methods. Berlin (1992) describes ethnobiological field techniques in relation to universals of human cognition. By the standards of the Huambisa of Amazonia or the Kalam of New Guinea popular nature lore in southern Canada, at least, is pathetically degenerate, but both research reports and surveys of public knowledge of science tend towards the conclusion that the average citizen cannot rely on personal knowledge of formal science in making decisions on environmental matters. Describing and analysing informal science in modern societies may be the first step in building local environmental competence from the ground up.

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