

The Influence of Environmental Knowledge and Values on Managerial Behaviours on Behalf of the Environment: An Empirical Examination of Managers in China

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ABSTRACT. This study explores linkages between what Chinese managers generally know about environmental issues, how strongly they value environmental protection, and different types of behaviours/actions they may take within their organizations on behalf of the environment. From a sample of 305 managers in Guangzhou and Beijing, it was found that both environmental knowledge and values are more predictive of more personal managerial behaviours, such as keeping informed of relevant company issues and working within the system to minimize environmental impacts, than more overt behaviours. Moreover, for these more personal actions, environmental knowledge and values were found to have both main and interactive effects. By comparison, it was found that both environmental values and knowledge had additive effects on managerial tendencies to initiate new programs within their domain of responsibility. Only environmental values was found to have a modest influence environmental advocacy.

Environmental degradation poses a challenge for most policy makers; however, such challenges are particularly broad-ranging and urgent in China (Ross, 1988; Smil, 1993; Edmonds, 1994; Sinkule and Ortolano, 1995; *China Quarterly*, 1998; Lo and Leung, 1998; Ma and Ortolano, 2000). China's natural capital is being depleted at an alarming rate (Lotcpeich and Chen, 1997; Zheng and Wang, 2001). Desertification now claims over 25% of its total area (Li, 2002; *People's Daily*, 2001), while acid rain seriously affects more than 40% (State Environmental

Protection Administration, 2001). Fish stocks have collapsed in all coastal areas and fresh water supplies are reaching crisis levels in much of the northern and western regions (Liu, 2002; Niu, 2003). Moreover, the toll on public health and economic development from pollution is mounting and increasingly being acknowledged by public officials (McElroy, 1998; Banister, 1998; World Resource Institute, 1998). Air pollution is so severe in most urban areas that it is now the leading cause of premature deaths (Xu, 1998). The consequences of pollution even extend to intimacy, as it has been reported that between 20 and 30% of all adult men suffer from either impotence or diminished sperm counts linked to pollution (*South China Morning Post*, 1999, 2000).

In response, China's leaders have taken numerous actions to address these issues since the promulgation of the first draft of the Environmental Protection Law in 1979. This includes proactive measures for preventing pollution such as incorporating environmental considerations in development planning and urban planning, making environmental impact assessments, and charging fees for pollution (Qu, 1992; Sinkule and Ortolano, 1995). In addition, public environmental awareness has been actively promoted through green education and publicity programs organised by environmental agencies at different levels (Xie, 1997; Lo and Leung, 1998). The increasing political commitment of the



Beijing leadership to environmental protection has also led to the official adoption of "sustainable development" as the national strategy for long-term development, the formulation of China's "Agenda 21" for the next century with numerous major programs and action plans for achieving sustainable development (Zhang, 1997, 2000).

These initiatives have generally been backed up with resources and declarations of rigorous enforcement. This is evident in a noticeable increase in the proportion of GNP devoted to investment for environmental protection, from 0.73 percent of the GDP in the Eighth-Five Year Plan (1991–1995) to 0.93 percent in the Ninth (1996–2000) (National Environmental Protection Agency, 2000) and the reported closure of 84,000 heavily polluting enterprises (Beijing Review, 1996, p. 6). These trends toward sustainable development are likely to continue as Premier Zhu Rongji stressed "qualitative" economic growth — first in his government report in 2000 and then in the nation's first Five-Year Plan in the 21st Century. This response is not only due to increased awareness of the economic and social costs from pollution, but also due to a pre-occupation with their global image (China Environment Year Book Editorial Board, 2000, 2001). This has been driven in part by their long battle to gain WTO membership, but also their need to greatly improve the environment around Beijing leading up to the Olympics in 2008 (Lo and Chung, 2003).

The more enigmatic side of this issue is that while China's policymakers now readily admit to this environmental debacle and are convincingly committed to doing something about it, devising an effective package of measures will be extremely difficult as many factors block the way. First, although the authorities have passed many regulations, enforcement has proven difficult (Chen, 2002; van Rooij, 2002). This can be attributed to such matters as China's "fragmented bureaucracy", limited financial resources, conflicts of interest at local levels, as well as propensities toward corruption (Lieberthal, 1995; Sims, 1999; Ma and Ortolano, 2000). Second, rapidly escalating levels of consumption in many urban areas in combination with the extremely high

levels of population density further exacerbate the problem (Zhou, 1997). Although affluence takes many forms, at the rate Chinese are trading in their bicycles for automobiles their country is expected to surpass the United States as the leading contributor of greenhouse gases within the next two decades (Wang, 2001). Third, China remains highly dependent on coal and older technologies to keep its state-owned enterprises afloat (McElroy et al., 1998; Smil, 1998; Vermeer, 1998). Finally, although much of the urban population may be experiencing benefits from globalization, a number of cities and most of the rural population appear to be headed for even greater poverty (Zweig, 1997; Oi, 1999). Sustainable development in China will ultimately have to reverse the current trend of economic polarization and embrace greater social equity (Elkington, 1998; Hart, 1997).

Although one can certainly anticipate that the Chinese authorities will promulgate additional decrees and regulations, given this combination of urgency and enigma, considerable emphasis must also be placed on the broad range of non-regulatory approaches involving both economic and communicative mechanisms (Wang and Lu, 1997; Panayotou, 1998). In this regard, one group whose participation will be especially vital for the implementation of various communicative approaches in China is its managers. Obviously, managers of large firms need to be actively engaged in programs related to eco-efficiency, recycling, and various forms of partnerships. Equally important, however, is that the major pollution problems in China, as elsewhere, are more often the result of the aggregation of a multitude of small behaviours rather than from major spills, accidents, or other newsworthy events (Smil, 1992; Edmonds, 1994; Banister, 1998; Ma and Ortolano, 2000). Indeed, the intention behind many non-regulatory mechanisms (e.g., taxes, rebates, eco-labels) is to have more modest effects on the multitude (Stavins, 2000).

Although the effectiveness of well-designed economic instruments can be safely assumed (i.e., through their influence on peoples' pocketbooks), that of communicative approaches is more often taken simply as an article of faith.

As one major example, the overall effectiveness of ISO 14001 in improving companies' environmental performance, although widely touted, remains largely unproven (Fryxell and Szeto, 2002). The same can be said for most broad educational campaigns (e.g., energy and water conservation, anti-littering, anti-smoking). Not only it is relatively difficult to undertake effective research to confirm the linkages between environmental education, environmental knowledge and environmentally-oriented behaviours, it is probably also true that challenges to the value of education run some risk of upsetting numerous vested interests.

While it is certainly not our purpose to refute linkages between environmental knowledge and managerial behaviours on behalf of the environment, the strength of such a linkage between environmental knowledge and organizational behaviours in China certainly warrants empirical investigation (Yu and Dong, 1997; Liu, 1997). Accordingly, the purpose of this study is to examine the relationships between Chinese managers' environmental knowledge, their values regarding environmental protection, and various types of actions they may take in their companies on behalf of the environment. These matters will be examined in two contrasting settings – Guangzhou, the economic hub of manufacturing in Guangdong province in the South, and Beijing, the nation's capital city in the North. Recent social surveys suggest that environmental awareness is emerging in each of these cities (Lo and Leung, 1998; Xi and Xu, 1998). At the same time, both of these cities have experienced double digit economic growth over the past decade, are experiencing serious environmental degradation, and have been struggling with various policy mechanisms to address a multitude of related problems (Lo and Leung, 2000; Lo and Chung, 2003).

Background

Managers and pollution

There can be little doubt that managers have a disproportional – and usually negative – impact

on the natural environment. One need only point to massive ecological disasters such as Bhopal and the Exxon Valdez incidents or cite massive infrastructure projects, such as the Three Gorges dam project (China) to appreciate both the scope and extent of this impact. However, and as stated previously, the aggregated influence of a multitude of large and small businesses' decisions/actions taken on a daily basis is even greater. Examples of the latter would encompass such mundane events as selecting modes of transport, designing products, maintaining equipment, packaging goods, and waste disposal. In addition, the business community often has considerable influence on government and its policies. A recent example of this can be seen in the Enron bankruptcy debacle and its alleged influence on energy policies.

In Asia, the influence of business interests may be just as extreme and even more varied. In Hong Kong, property developers arguably hold the government hostage, resulting in such inane policies as the subsidization of dumping construction waste in rapidly depleting landfills and aggressive land reclamation. Elsewhere in Asia (e.g., Indonesia, the Philippines) these relationships are considerably "murkier" occurring within the realm of "cronyism" and are visibly more damaging – both environmentally and socially. In China, on the other hand, the lines between business and government have become highly intertwined, especially at the township level where, for example, local governments essentially direct township enterprises for profits that, in turn, provide resources for government operations (Lieberthal, 1995; Rock, 2002).

As much as managers have previously been castigated as environmental villains, many observers are concluding that they must also be its salvation. As Hart (1997, p. 75) put it, "Like it or not, the responsibility for ensuring a sustainable world falls largely on the shoulders of the world's enterprises, the economic engines of the future." Although the business community has traditionally had relatively less political "clout" in mainland China (Guthrie, 1999), with the possible exception of the State-owned sector "business" is arguably the only entity that possesses the creative energy and the resources to

determine whether or not China moves onto a more sustainable path of development. This is evidenced by the increasingly prominent new business elite in the rapidly emerging private sector, the invitation of entrepreneurs to join the Communist Party and in the sheer energy of the multitude of small, private businesses that are to ubiquitous in China (Pearson, 1997).

Managerial behaviours on behalf of the environment

Managers' environmental knowledge and values are of little practical interest unless they lead to (or explain in a methodological sense) actions or behaviours that mitigate their organization's impact on the environment. As di Norcia (1996, p. 784) put it, ". . . an environmental ethic cannot be satisfied merely with the espousal of general care for nature . . . commitment itself must result in performance of the appropriate ecologically beneficent practices."

Environmentally significant behaviour can be defined by either its impact or intent (Stern, 2000). Thus, for example, clearing a forest (impact) has a very significant impact on an eco-system, while the act of using cloth diapers may be driven by good intentions (even though the advantages over paper diapers are debatable). Stern (2000) argues in favour of an intent-oriented definition if one's purpose is to understand peoples' decisions based on their beliefs and values.

One can consider such behaviours within an organization along a continuum of visibility within the organization. The least outwardly visible form of behaviours on behalf of the environment would be to gather information or to utilize *existing* organizational procedures so as to improve their environmental performance (i.e., through frequent equipment maintenance, reuse of materials, or simply turning off machinery when not in use). Such actions that work within the existing system carry relatively little risk nor would the practicing manager be called to account. At a more visible level, managers may initiate various programs/projects within their domain of responsibility. This could include projects that could save energy, reduce pollution,

improve resource productivity, or reuse waste streams. Depending on the capital allocation, such projects may or may not require approval of one's superiors. However, regardless of the size of the expenditure new projects the manager is accountable for the success of the project and greater risk is incurred. At the most visible level, managers could advocate on behalf of the environment outside of their immediate domain of responsibility by calling attention to environmental issues/problems to their superiors. Clearly, such actions are considerably more visible (and personally risky) within the organization. This typology corresponds to the categorization of pro-environmental behaviours put forth by Stern (2000) of "environmental activism", "other environmental significant behaviours (specifically including actions through organizations), and "private sphere environmentalism" (those more private actions).

Environmental knowledge

Environmental knowledge can be defined as a general knowledge of facts, concepts, and relationships concerning the natural environment and its major ecosystems. Thus, in simple terms, environmental knowledge involves what people know about the environment, key relationships leading to environmental aspects or impacts, an appreciation of "whole systems", and collective responsibilities necessary for sustainable development. A closely related concept is "environmental literacy". However, as currently used this term carries rather strong normative implications – even embracing deeper spiritual elements (Golley, 1998).

Given that managers greatly influence the consumption and condition of natural capital, the elevation of environmental knowledge among managers and, by implication their ability to process such information, would appear to be inherently desirable (Kaplan, 2000). As Ashford (1993, p. 277) stated, "The key to success in pollution prevention is to influence managerial knowledge of and attitudes toward both technological change and environmental concern." Given their aggregated impact on the environ-

ment and emergent public interest in the environment, it is unfortunate that most Chinese managers and business students have had effectively no formal training to improve their environmental knowledge, although this is just beginning to change (WRI, 2002). It should be pointed out, however, that this gap is not peculiar to Asia as evidenced by a 1991 study of American business executives which reported that a majority (67%) believed that environmental issues were extremely important, yet only a handful (7%) were confident that they actually understood the environmental issues that their company was facing (Newman and Breeden, 1992). Although this study is dated, there is little reason to expect this situation is that much improved over the past decade.

For managers to understand the relationship between decision alternatives and outcomes related to the environment, they need fundamental scientific and practical knowledge about a broad range of issues which could include such considerations as: (1) An appreciation of the current situation (i.e., the condition of the local environment and global interrelationships); (2) The value of natural capital to firms' operations. This would encompass the negative impact and risks of degraded resources on operations; (3) The personal consequences of a degraded environment (e.g., personal health risks); (4) The range of alternatives available to solve a problem or attain a goal (e.g., technological options); (5) The causal linkages between actions implied in various decision alternatives and the outcome set; and (6) The relative overlap among desired outcomes (i.e., instances where environmental performance and economic performance are compatible).

Thus, managerial motivations to act on behalf of the environment are presumed to be contingent upon environmental knowledge in making these assessments and in directing actions. This is in conformance with the "reasonable person model" proposed by Kaplan (2000) in his critique of altruism as an effective and durable basis for pro-environmental behaviours. In brief, this view suggests that people will engage in behaviours on behalf of the environment when they perceive an alignment with their long run well-being and

when they have control over the situation. De Young (2000) takes this notion a bit further to attribute pro-environmental behaviours to intrinsic satisfactions derived from the attainment of competencies. Both the alignment of personal interests or intrinsic satisfactions derived from competence, would logically be informed by environmental knowledge.

Thus, it is hypothesized that:

H1: Environmental knowledge is positively related to managerial behaviours on behalf of the environment.

Environmental values

Values define priorities that are crucial for the resolution of ethical dilemmas (Hosmer, 1987). As previously mentioned, for managers to change their actions and behaviours to be more environmentally sensitive, they must also value environmental outcomes because decisions related to environmental issues and problems often involve tradeoffs in the context of incomplete information and complicated technical and social causal linkages. Although the effect of environmental values has been linked to pro-environmental behaviours motivated by altruistic motives, such values would also play a role in such behaviours that are more linked to self-interest that would be more likely found in a managerial setting (Kaplan, 2000). Choices in a context of complexity, uncertainty, interconnectedness, extended consequences of actions, and diverse stakeholder views must be coped with and reconciled (Schmidheiny, 1992; Shrivastava, 1995). Environmental values will inform such choices via beliefs and pro-environmental personal norms (Stern, 2000).

Such values are usually embedded within a larger belief system, "worldview" or paradigm of the individual. Regarding environmental issues, two "ideal types" of paradigms have been identified (Catton and Dunlap, 1980). The first – the dominant social paradigm or "DSP" – has long been in place in Western society. The DSP is purportedly anchored in the following convictions: (1) Economic growth relying heavily on technological advancement; (2) The sanctity of

private property rights, (3) The existence of fluid and efficient markets; and (4) Laissez-faire government (e.g., Gladwin et al., 1995; McLaughlin, 1993).

In some countries and regions of the world, this dominant paradigm appears to be giving way to an alternative, termed the new environmental paradigm or "NEP" (Dunlap and Van Liere, 1978). The elements of this paradigm are principally grounded in a belief that humans are equal members of a larger natural world (Andersson and Bateman, 2000) rather than having dominion over it. From this premise it follows that: (1) limited natural resources should impose restrictions on economic growth; (2) some technological scepticism is warranted; and (3) that humans must learn to live in harmony with nature. There is some empirical evidence from a multi-country study that ones' adherence to these paradigms is related to a perception of the changes needed to alleviate environmental problems (Kibourne et al., 2001). However, we are unaware of studies in Asia.

In much of Asia, with the possible exception of Japan, it would appear that the dominant paradigm (i.e., DSP) is very well entrenched within the business community, especially in such places as Hong Kong and Taiwan (Devall and Sessions, 1985; Ng, 1991; Lo, 1995). However, because of five decades of communist ideology the business paradigm in mainland China may be considerably different and much less crystallized. While the single-minded emphasis on military and economic development has dominated environmental considerations through the 80's, the strength of the second and third elements of the DSP have only recently been revived. At the same time while laissez-faire government as a principle is seldom espoused, but is now very certainly strongly evident in the marketplace. In summary, Chinese values regarding the environment have been buffeted by a variety of potent themes in recent times. In addition, it must be pointed out that traditional Chinese values emphasize a harmonious relationship between man and nature and collectivism over individuality. Thus, the so-called "new environmental paradigm", as it emerges in China, will likely have very ancient influences.

Thus, it can be hypothesized that:

H2: Environmental values are positively related to managerial behaviours on behalf of the environment.

Although we have hypothesized independent, direct effects of environmental knowledge and values on managerial actions to promote the environment, an interaction of these influences seems likely (Stern, 2000). This is to say that environmental values *in the presence of* environmental knowledge is likely to have a particularly strong influence on actions or behaviours to promote the environment. This may be most obvious in the case of environmental advocacy, as managers would be more prudent in promoting environmental issues within their organization if they can also provide factual knowledge about the benefits of such actions to the firm (i.e., knowledge). Thus, we hypothesize that:

H3: Environmental values in the presence of strong environmental knowledge will have a greater influence on managerial actions on behalf of the environment than when a manager is deficient in such knowledge.

Methodology

Sample and data collection

The data for this study was collected both in Beijing and Guangzhou. Both locations were chosen in large part because the authors have established close links with local research institutes that have the access necessary to conduct a survey, after having undertaken environmental studies in these two cities for almost a decade. In addition, they are economically the most advanced cities with a highly developed enterprise sector having a GPD ranked second and third in China just behind Shanghai. At the same time, however, both are large urban settings with over 6 million people that have extremely stressed environments due in part to having experienced double digit economic growth for the past decade. Beijing is under the instructions of the

national leaders (and, hence, their blessing) to eliminate the negative image of being one of the most polluted cities in the world in staging a "Green Olympics" in 2008 (Lo and Chung, 2003). Guangzhou on the other hand is operating under local policy directives to pursue a "green city" status (Lo and Leung, 2000). Beyond these rough similarities, these two locations offer contrasting contexts for this study: people in Beijing are well-known for their pre-occupation with "political correctness", while citizens in Guangzhou are famous for what might best be described as a "materialistic and pragmatic" approach (Ikels, 1996).

The data was collected from practicing managers in a broad range of enterprises with assistance from the Beijing Academy of Social Sciences and the Guangzhou Academy of Social Sciences between March and November 2001. Prior to the administration in mainland China, an earlier version of the questionnaire had been administered to MBA and DBA students studying in Hong Kong as a basis for class discussion. This led to several refinements in the survey; however, this data was not sufficiently comparable to use as part of this study.

The Beijing survey was deliberately designed to obtain relatively equal distribution of four major industry types – light manufacturing, printing, chemical products, and electronics. A limit was also set on having no more than three personnel at managerial ranks from a single enterprise. From a self-compiled list of known manufacturing plants in these industries, a subgroup was randomly picked and contacted regarding participation in this study. Within those participating facilities, managers were randomly sampled within each. Altogether in Beijing, 158 enterprise personnel from 53 enterprises were approached. By comparison, in Guangzhou enterprises were selected from a broader range of industries. Altogether, 164 managerial personnel at both high- and middle-levels in 44 enterprises were contacted.

In administering this survey in both locations, trained research assistants actually visited managers and stayed with them throughout its administration. This provided the advantage that the research assistant could answer questions

while increasing the response rate. Small gifts were also provided as an inducement to participation. Subsequently, follow-up checks were conducted to ensure that each manager was actually visited, and to verify the name of the interviewer and the length of the interview. After the elimination of a few unusable questionnaires in each locality, a total of 305 cases were obtained – a combined response rate of 95%.

Measures

Environmental knowledge. Along with the neglect of the environment in business education, little effort has been made to develop regionally appropriate measures of environmental knowledge. Among more global efforts, the World Business Council for Sustainable Development (WBCSD) currently provides a self-assessment of environmental knowledge on its website (<http://www.foundation.no/sdc>). Visitors that take this test and pass it receive a certificate. However, this test is lengthy, local issues are not covered, and no evidence of reliability or validity is provided. Other efforts are either seriously dated, unreliable out of context, or both. For example, Maloney et al. (1975) proposed a 15-item instrument to measure environmental knowledge. Later, Benton (1994) encountered unacceptable internal consistency in using this scale ($\alpha = 0.38$). A number of other scales are less useful for research purposes, having been designed for other purposes (e.g., to capture reader interest). For example, the publication *World Wastes* proposed a five-question self-assessment entitled "Test your environmental knowledge". Such approaches are fairly typical and point to the need for a more flexible, current instrument with desirable measurement properties.

As a result and recognizing the need for some local content, a "test" of 40 questions was created, drawing from a range of sources including concepts or information that the authors felt managers in the region should be aware of, a *South China Morning Post* (Hong Kong's main English language daily) supplement on pollution (Jan. 28th, 2000), numerous articles

from the *China Daily*, and information provided from local EPD officials. The items were intended to enquire about global and regional issues, as well as both broad concepts and specific facts about the environment. Because some items focused on local issues, there were somewhat different "right answers" in the two samples. EPD officials in Beijing and Guangzhou reviewed this instrument and offered suggestions for improvement.

Each item had four choices, from which the respondent was to select "the best answer". Correct choices were awarded 2 points and, for many questions, partial credit of 1 or 0.5 points was given for choices with less merit. These weightings were arrived at by a panel of local experts from the EPDs and academic community. Post-hoc analysis of the items using item assessment routines led to the elimination of some items (e.g., those with negative item-to-total correlations). The resulting scale of 30 items had an α statistic of 0.741 across both samples (this instrument and scoring key are provided in Appendix 1).

Managerial actions/behaviours. Eleven questions were written to address managerial actions and behaviours on behalf of the environment. For each item, the respondents indicated their agreement or disagreement on a 7-point Likert-type scale. Three general categories were measured that spoke to different levels of organizational visibility: (1) Information and maintenance-oriented behaviours. Managers may rather quietly engage in behaviours on behalf of the environment that may or may not be readily apparent to their coworkers and superiors. For example, they could gather information about the environment that is pertinent to their business or industry or run operations in a manner consistent with current practice but more environmentally sound. For all of these items, the manager may not be easily recognized as having an environmental agenda. Thus, these represent politically safe and less obtrusive options for managers to practice environmental protection. At the same time, such actions are less consequential. The mean of these five items was taken from a scale with an α reliability statistic of 0.74:

- "When I skim the newspaper, I often read articles that appear to address the environmental impacts of my company and industry."
- "I make it a point to stay up-to-date about changes in environmental laws and regulations related to this business."
- "I put a lot of effort into being aware of the environmental aspects and impacts of my business."
- "Prior to making decisions with environmental implications, I prefer to obtain the opinions of environmental or community groups."
- "I ensure that equipment is properly maintained and running as efficiently as possible."

(2) Initiating Programs and Taking Action. A manager may more visibly take action or initiate programs on behalf of the environment that are within his or her sphere of responsibility. While these actions are more visible, relatively more consequential and are apparent to the managers' subordinates, they need not involve a great deal of discussion or controversy by virtue of being within the manager's area of responsibility. The mean of two items measuring this propensity was calculated and had an α reliability statistic of 0.70. These two items were:

- "I take action where possible to reduce the amount of resources used in my company's processes."
- "I take measures to recycle waste in areas I'm responsible for."

(3) Environmental Advocacy. At a much more visible level a manager can take a more proactive position to champion the cause of the environment more broadly in the organization. The mean of these three items measured the extent that respondents were vocal in advocating on behalf of the environment in their firms and had an α reliability statistic of 0.80. These three items were:

- "I often find that I'm speaking out on behalf of environmental issues in my company."
- "I am often the one to bring environmental problems to the attention of top management."
- "I make a point of incorporating energy efficiency ratings of products into any purchase decisions."

The pattern matrix from an oblique rotation of a principle components analysis of these items is provided in Table I. The result is favourable, in that each item loads clearly on the factor it was intended to represent, *a priori*.

Managerial values. The 11-item scale developed by Dunlap and Van Liere (1978) was used to measure how strongly the respondents adhered to the “new environmental paradigm” (NEP). These items were measured on a 5-point Likert-type scale and yielded an α statistic of 0.65. It

might be pointed out that this level of internal consistency was not as high as we would have preferred. However, in an intercultural context a decision to use an existing scale entails some risk and this value is reasonably close to the heuristic of 0.7 recommended by Nunnally (1978). Moreover, as we have previously pointed out, Chinese value systems related to the environment have been subject to such extremely diverse influences in recent times that they might be expected to be somewhat less internally consistent.

TABLE I
Principal components analysis of environmental actions/behaviours (Oblimin rotated pattern matrix)

Items	Components		
	Environmental advocacy	New program initiation	Information and maintenance
(1) I make it a practice to incorporate energy efficiency ratings of products into any purchase decisions.	<u>0.762</u>	-0.133	0.100
(2) I often find that I'm speaking out on behalf of environmental issues in my company.	<u>0.828</u>	-0.147	-0.009
(3) I am often the one to bring environmental problems to the attention of top management.	<u>0.856</u>	-0.206	-0.034
(4) I take action where possible to reduce the amount of resources used in my company's processes.	0.162	<u>0.804</u>	-0.055
(5) I take measures to recycle waste in areas I'm responsible for.	0.138	<u>0.791</u>	-0.047
(6) Prior to making decisions with environmental implications, I prefer to obtain the opinions of environmental or community groups.	0.116	-0.055	<u>0.725</u>
(7) I ensure that equipment is properly maintained and running as efficiently as possible.	0.206	-0.325	<u>0.772</u>
(8) I put a lot of effort into being aware of the environmental aspects and impacts of my business.	0.388	0.146	<u>0.486</u>
(9) When I skim the newspaper, I often read articles that appear to address the environmental impacts of my company and industry.	-0.142	0.320	<u>0.669</u>
(10) I make it a point to stay up-to-date about changes in environmental laws and regulations related to this business.	-0.078	0.359	<u>0.644</u>
Component correlations			
(1) Environmental advocacy	1.000		
(2) New program initiation	0.192	1.000	
(3) Information and maintenance	0.444	0.300	1.000

Control variables. Several variables were included as controls: (1) Gender was included as a control variable because Western research indicates that females are somewhat more likely to adhere to the NEP (Egri and Herman, 2000; Zelezny et al., 2000). This variable was coded as "0" for males and "1" for females, respectively. (2) Age was included as a control variable because the era in which one is brought up – especially in mainland China – is important in shaping environmental values. (3) Education was included, given its obvious relationship to knowledge and, less obviously, to value clarification. This was coded as an ordinal scale from 1 (primary school) through 6 (doctorate degree). We had also intended to control for marital status and "philosophical orientation" (i.e., religion), but invariance in the responses to these items was such as to preclude their use [95% percent reported being married (of those 80% reported having one child) while 85% professed "atheism"].

Results

The descriptive statistics are provided separately for each sample in Table II. The means, standard deviations, and correlations for the Guangzhou sample are reported to the left and below the

diagonal; those for the Beijing sample are above and to the right. Comparisons of the means of the two samples reveal three significant differences: (1) The Beijing sample has substantially more females (40%) than in the Guangzhou sample (20%); (2) The Beijing sample also has significantly lower values for environmental knowledge. Because two items in this assessment had somewhat different correct answers in Beijing and Guangzhou, we recalculated the score without these items and confirmed this difference ($p < 0.001$); and, (3) The Beijing sample also had significantly lower values for the NEP scale ($p < 0.01$).

The question of whether these differences are due to systematic differences in the samples or actually reflect somewhat greater environmental knowledge and values in Guangzhou is an intriguing one that warrants more systematic study. Given Guangzhou's relatively close proximity to Hong Kong, we might speculate that one influence on this could be their greater exposure to international media coverage on global environmental issues. In fact, the international orientation has been increasingly salient in local newspapers, particularly the *Pearl River Environmental News* (*Zhujiang huanjing bao*) that is widely subscribed to by local business enterprises (personal interviews with officials of the

TABLE II
Descriptive statistics for environmental knowledge, environmental values and behaviour scales^{a, b}

Variable	Mean	s.d.	1	2	3	4	5	6	7	8	Mean	s.d.
	Guangzhou (<i>n</i> = 151)										Beijing (<i>n</i> = 154)	
(1) Environmental advocacy	5.17	0.99		0.14	<u>0.27</u>	-0.02	0.01	-0.04	0.01	-0.04	5.07	0.50
(2) New program initiation	5.44	1.04	<u>0.49</u>		<u>0.48</u>	0.02	<u>-0.18</u>	0.13	<u>0.39</u>	<u>0.18</u>	5.55	0.71
(3) Information and maintenance	5.43	0.76	<u>0.67</u>	<u>0.52</u>		-0.01	0.05	0.13	<u>0.17</u>	<u>0.25</u>	5.37	0.51
(4) Gender (0 = male; 1 = female)	<u>0.20</u>	0.40	<u>-0.21</u>	-0.14	<u>-0.17</u>		<u>-0.20</u>	<u>0.19</u>	-0.01	-0.06	<u>0.40</u>	0.49
(5) Respondent's age	44.85	7.70	0.06	0.12	0.13	-0.01		-0.09	<u>-0.23</u>	-0.11	44.13	7.38
(6) Level of education	3.57	0.88	-0.06	-0.10	0.00	0.04	-0.10		-0.01	0.10	3.63	0.83
(7) Environmental knowledge	<u>33.47</u>	7.15	<u>0.20</u>	<u>0.21</u>	<u>0.32</u>	-0.12	0.10	0.13		<u>0.41</u>	<u>30.02</u>	9.79
(8) Environmental values	<u>41.71</u>	5.11	<u>0.23</u>	<u>0.32</u>	<u>0.40</u>	-0.09	0.09	0.04	<u>0.37</u>		<u>39.92</u>	5.23

^a The correlations for the Guangzhou sample are given below and to the left of the diagonal; the correlations for the Beijing sample are in the upper, right portion.

^b Underlined and boldfaced correlations are significant at the $p < 0.05$ level (2-tailed). Underlined and boldfaced means are significantly different in the two samples, $p < 0.01$ (2-tailed).

Guangzhou Environmental Protection Bureau, 1999–2001).

At the same time, the means related to *managerial behaviours on behalf of the environment* in the two samples revealed *no* significant differences. Generally speaking, the predominant value of around 5.0 to 5.5 would indicate that the average respondent “slightly agreed” or “agreed” with the most of items. Given the potential for social desirability bias in such questions, it is likely that these values report a somewhat higher incidence of such behaviours than is actually the case. Nevertheless, we take this to be a positive finding and an indication of a strong predisposition toward actions on behalf of the environment in these managerial samples. Assuming these managers are representative of the larger population, this would appear to bode well for various governmental initiatives that require a measure of managerial cooperation and suggest that the business community could play an even more proactive role in environmental protection given the appropriate package of incentives.

A few differences in the correlations warrant some comment. It appears that the three categories of managerial behaviours on behalf of the environment are more strongly intercorrelated in Guangzhou than in Beijing. Indeed, the high correlation ($r_{x,y} = 0.67$) between advocacy and “keeping informed” in Guangzhou may raise some questions about the ability to discriminate between these two dimensions of behaviour in that sample. This same correlation, however, is relatively modest ($r_{x,y} = 0.27$) in the Beijing sample. An additional observation is that the variances for the managerial behaviours are significantly tighter among the managers in Beijing. This is especially noticeable for environmental advocacy, where the standard deviation is only one-half that of the Guangzhou sample. Although it should not be expected that the two subgroups would be identical given that somewhat different sampling frames were used in collecting the data, it is certainly possible that Beijing managers actually are more homogeneous. This would be consistent with the generally held view that Guangzhou has a relatively more liberal social and economic environment than Beijing where views are seen as being more

politically and ideologically shaped (Vogel, 1989; Ikels, 1996; Cheng, 1998, 2000).

As an initial step in the analysis we performed a statistical test of whether or not the hypothesized relationships were different in the two subgroups. Our reasoning was that if significant differences did not exist in the relationships between the two samples, then it would be more efficient to combine them into a single analysis. Accordingly, we used structural equation modelling and a χ^2 difference test to test the null hypothesis of equal relationships in the Beijing and Guangzhou samples (Arbuckle and Wothke, 2001). Accordingly, we posited a model where environmental knowledge, environmental values and an interaction term (i.e., their product term) predicted each dependent variable (i.e., the three types of managerial behaviour). This model was freely estimated, simultaneously for the two groups. Subsequently, the model was then re-estimated with equality constraints imposed for the relationships in both samples and the change in χ^2/df was noted. In this case the $\Delta\chi^2 = 13.58/9$ df does *not* permit a rejection of null hypothesis. Because no statistical difference was detected in the hypothesized *relationships* in the two groups, the cases were combined together in a single sample for subsequent analysis.

The regression analysis for this combined sample proceeded in three, hierarchical steps: Initially, only the controls were entered into the model. This was followed by the two main effects and, in the final step, the interaction term (i.e., the product of environmental knowledge and environmental values) was added. In order to minimize the potential for multicollinearity, the main effects – environmental knowledge and environmental values – were centered prior to the creation of the interaction term as suggested by Aiken and West (1991). The results of these regression models are provided in Table III.

Although not formally hypothesized, the dearth of significant relationships involving the control variables warrants some comment. This is surprising in that some of the relationships are intuitively appealing. For example, we certainly expected education to be related to environmental knowledge. However, it should be

TABLE III
Regression coefficient of model predicting managerial actions and behaviours^{a,b}

Independent variables	Dependent variables								
	Environmental advocacy			Initiating programs and taking actions			Information and maintenance-oriented behaviours		
(n = 305)									
(a) Control variables									
Gender (male = 0; female = 1)	-0.082	-0.059	-0.058	-0.015	0.022	0.024	<u>-0.122</u>	-0.079	-0.076
Age	0.026	0.035	0.040	-0.004	0.020	0.021	0.059	0.073	0.075
Education	-0.045	-0.057	-0.060	-0.006	-0.025	-0.025	0.045	0.020	0.019
(b) Independent variables									
Environmental knowledge		0.067	0.095		<u>0.198</u>	<u>0.211</u>		<u>0.106</u>	<u>0.142</u>
Environmental values (NEP scale)	<u>0.114</u>		0.106		<u>0.157</u>	<u>0.157</u>		<u>0.282</u>	<u>0.277</u>
(c) Interaction term									
Interaction of env. knowledge and values			0.110			0.071			<u>0.176</u>
(d) Model information									
R ²	-0.011	0.034	0.046	0.000	0.089	0.094	0.020	0.133	0.163
ΔR ²		<u>0.023</u>	0.011		<u>0.088</u>	0.005		<u>0.113</u>	<u>0.030</u>

^a Cell entries are standardized coefficients

^b Underlined and boldfaced correlations are significant at the $p < 0.05$ level (1-tailed for positive, hypothesized relationships; 2-tailed for control variables, interactions and R² change).

remembered that average age of the respondents is mid-40s. As a result, the respondents are rather distant in time from their formal education and, with the exception of environmental engineering programs, environmental issues received little attention in previous times. In addition, business education is a relatively recent phenomenon in China (although now growing at an extremely rapid pace) and, so far, the incorporation of environmental content has been the exception in business curricula.

It is, perhaps, somewhat less striking that relationships between gender and managerial behaviours on behalf of the environment were marginal as communist *ideology* places considerable emphasis on gender equity and this may have had an influence on managerial behaviours. At the same time, however, it is clear that Chinese

culture is far from androgynous and, clearly, gender inequities do exist in society. Lastly, it is observed that age is also inert in our models suggesting that significant inter-generational differences are not strong in these relationships (although a significant and negative *bivariate* relationship between age and environmental knowledge is observed in the Beijing sample). As the sample averaged 44 years old (with two-thirds being between 37 and 53), we would also speculate gaps may eventually emerge with the disproportional influences of the internet and other communications technologies on young people in China.

The hypotheses involving the main effects of environmental knowledge and values are tested in the second step of the hierarchical regression procedure. As these tests imply a positive direc-

tionality, one-tailed tests will be used. The first hypothesis was supported in that fairly potent coefficients were found for environmental knowledge in predicting both information and maintenance-oriented behaviours and the initiation of programs and taking actions within one's domain of responsibility. The coefficient for the relationship between environmental knowledge and a manager's advocacy of environmental issues within their organization, however, was not significant.

The second hypothesis anticipated a relationship between environmental values and managerial behaviours on behalf of the environment. This relationship was uniformly supported for all three forms of behaviours, although it is noted that the coefficient for environmental advocacy was marginally significant.

It is noteworthy that the predictive power of these models decreases with the visibility of the managerial action on behalf of the environment. For the relatively covert activities of keeping informed and working within the system, the model explained 16.3% of this category of behaviour. However, the explanatory power diminishes substantially to 9.4% for the more visible behaviour of initiating new programs within one's domain of responsibility and, finally, to a paltry 4.6% for environmental advocacy. The general observation here is that the influence of both environmental knowledge and values wanes with the visibility of the action.

The third hypothesis anticipated interaction effects between environmental knowledge and environmental values in influencing managerial behaviours on behalf of the environment. Such an interaction was found, but only for the least overt category of behaviours related to information acquisition and maintenance. In order to facilitate the interpretation of this result, a plot of this interaction is depicted in Figure 1.

This figure reveals an ordinal interaction (i.e., lines not crossing) where there is a strong, positive slope to the line corresponding to respondents with high environmental values and a slightly negatively sloping line for managers with lower environmental values. Managers with strong environmental values *in the presence of environmental knowledge* reported, by far, the highest

incidence of this category of behaviour. On the other hand, managers reporting low environmental values actually appear to exhibit somewhat less frequency with the acquisition of environmental knowledge (although the slope of this line is not significant). Overall, our interpretation of this plot is that environmental knowledge appears to be both activated and directed by environmental values (as measured by the NEP scale). By comparison, environmental knowledge in the absence of environmental values appears to lie rather dormant within the minds of those managers.

Discussion

The purpose of this study was to investigate linkages between environmental knowledge, environmental values, and managerial behaviours on behalf of the environment in China. Several findings from this study merit further discussion. Most obviously, this study confirmed that environmental knowledge and environmental values do influence Chinese managers' behaviour in their organizations. This finding, in itself, is not surprising as the relationships between knowledge and behaviours and between values and behaviours are axiomatic. Having said this, perhaps the more revealing finding of this study is that environmental knowledge and values – as operationalized in this study – leave much environmentally-focussed managerial behaviour *unexplained*. This also extends to the control variables, for which we found no significant relationships with the dependent variables that persisted through each step of the regression analysis. We will first highlight some of the relationships observed and then offer some speculation regarding influences that may be exogenous to our model.

First, this study found evidence that Chinese managers self-report engaging in a broad range of behaviours on behalf of the environment. This was evidenced by the means in both samples that ranged from a low of 5.07 (for environmental advocacy in Beijing) to 5.55 (for initiating new programs within their domain of responsibility – also in Beijing). While we remain somewhat

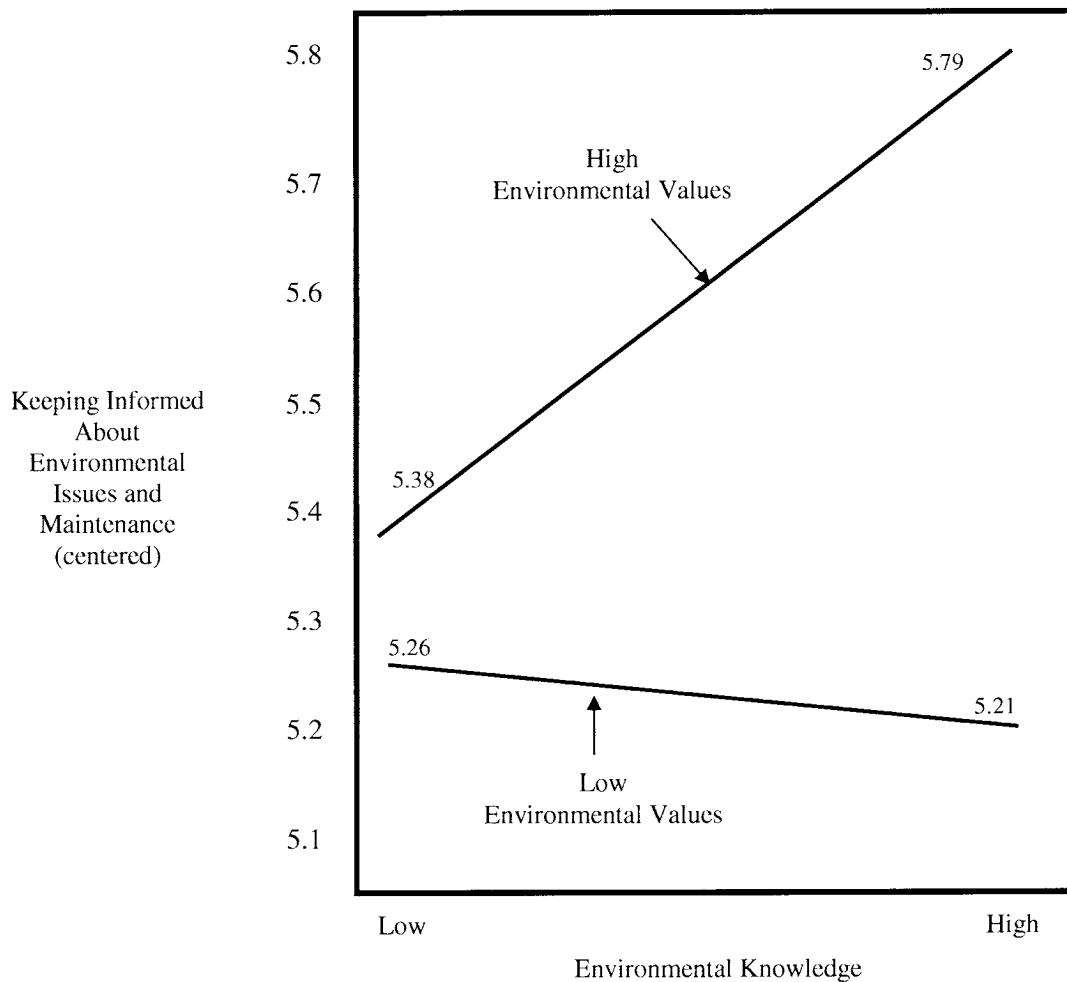


Figure 1. Plot of the interaction between environmental knowledge and environmental values on managerial actions related to keeping informed about environmental issues and maintenance-oriented behaviours (Predicted values are provided at the end of each line. These represent the predicted values of the dependent variables based on high and low values of environmental knowledge and environmental values one standard deviation above and below their means).

sceptical of how closely these self-reports mirror actual behaviours, we would accept that such behaviours are probably more pervasive in Chinese organizations than we had anticipated.

We would draw a similar conclusion for the measure of environmental values. Our finding that Chinese managers profess relatively strong environmental values is consistent with recent findings of Fryxell and Lo (2001) that Chinese managers reported high levels of adherence to various environmental ethics. Taken together, this would suggest a propensity on the part of most Chinese managers to support environmental initiatives if given an appropriate opportunity.

It is more difficult to make any statements regarding performance on the environmental knowledge instrument as we lack referent groups for comparison. However, it would be expected that this stock of knowledge should grow in the current climate as the central authorities continue to prioritise environmental programs, provide more information about environmental issues of importance to managers, and local governments, most notably those in Beijing and Guangzhou, further tightened their grips on the regulatory control of industrial pollution in the last few years (Lo and Leung, 2000; Lo and Chung, 2003).

Second, the influence of environmental knowledge and environmental values on managerial behaviours in these samples appears to diminish as managerial behaviours become more visible. One rather plausible explanation for this relationship is Chinese managers are often quite constrained in their ability to determine priorities or act outside of their prescribed domain. In addition, when such behaviours become more visible, there are attendant risks or obstacles. This may be especially true in a Chinese context where managers are culturally less outspoken and organizations are generally more hierarchical (Ralston et al., 1992). In the presence of greater risk, the bonds between knowledge, values and actions would logically diminish. It was observed, however, that the relationship involving environmental values was somewhat more persistent in that a weak relationship with environmental advocacy was detected, whereas the influence of environmental knowledge had more clearly diminished at this level. These findings may also provide a suggestion of a hierarchy of managerial behaviours on behalf of the environment. That is to say, managers probably begin with the least visible types of behaviours and “move up” to more visible behaviours over time as both their confidence and authority increase.

Third, it was also found that the *form* of the relationship between environmental knowledge and environmental values appears the change with each broad category of managerial behaviours. For environmental advocacy, only a modest, positive relationship with environmental values was found. On the other hand, for managers’ propensity to initiate programs or take actions on behalf of the environment, the relationship with environmental knowledge emerges to be even somewhat more influential than environmental values. Presumably, such decisions require greater alignment with organizational goals such that managers must marshal such knowledge to defend such projects.

In the case of information and maintenance-oriented behaviours, a rather strong interaction effect was found. In terms of this interaction, we would speculate that environmental values appear to be a necessary condition for environmental knowledge to shape these less conspicuous and

routine managerial behaviours. In the absence of such values, however, environmental knowledge appears to have relatively little effect on such behaviours. On the other hand, environmental values *if uninformed by knowledge about the environment* appear to remain as good intentions in pursuit of proper direction. This would be consistent with Stern’s expectation that proenvironmental behaviours are usually determined by multiple variables, often in interaction.

Finally as previously mentioned, the explanatory power of the models is rather anaemic considering that the linkages between knowledge, values and behaviours would normally be expected to be both strong and robust. Part of the reason could be methodological. That is to say that much stronger relationships actually exist, but that we were unable to detect them in this study. Normally, this would be the result of a lack of statistical power; however, a sample of 305 would normally be considered adequate to detect even moderate effect sizes. A more likely methodological culprit could be related to measurement issues. For example, we were disappointed in the internal consistency we obtained from the Dunlap and Van Liere (1978) scale. Clearly, such measurement issues could have attenuated the relationships; however, we don’t believe that this is the whole story.

In our opinion, the weakness of the linkages between environmental knowledge, environmental values and managerial behaviours on behalf of the environment can, at least partially, be attributed to the relatively more hierarchical culture of most Chinese organizations. To the extent that engaging in activities that lack approval or are seen as peripheral to organizational goals, pursuing one’s personal agenda may be perceived as carrying undesirable risks. Relative “helplessness” has been described by Kaplan (2000) as a “pivotal issue” in explaining a lack of follow through in the context of environmentally responsible behaviour. It is also quite likely that organizational obstacles and resource constraints pose impediments that could further weaken these relationships. In a recent study by Fryxell and Lo (2001) managers were asked for reasons why various environmental programs were not effectively implemented. Resource

limitations and the high cost of such programs were most often mentioned.

A final explanation for the poor explanatory power of these models could be found in a more universal gap between environmental values and actions. For example, evidence from various marketing studies suggests that consumers appear to profess a stronger desire to purchase environmentally friendly products than they appear to actually reflect at the cash register (e.g., Ellen, 1994; Morris et al., 1995). Similarly, many people from industrialized countries who report valuing the environment and are aware of the implication of global warming persist in avoiding public transport in favour of their automobiles.

Having pointed out that the strength of these relationships was more modest than expected, however, should *not* imply that they are unimportant. For one thing, the model for the least obtrusive actions (i.e., those implemented by working within the system) explained 16% of its variance, which we would assert is meaningful. In addition, we would argue that even though other relationships found in this study are modest, the *aggregated* effect of millions of managers undertaking such actions in their day-to-day affairs should be highly important for China's environment.

Given this, an additional issue is how education – and business education, in particular – can enhance both managerial knowledge *and* values toward the environment in China (i.e., as this study suggests that both these elements are important and interact). In our opinion, given the state of the environment in China and the priority given to mitigating these problems by the Government, the goals of such education should be to increase the incidence of pro-environmental behaviours among managers in ways that are directed at the most serious problems, are durable (i.e., in the sense of persisting over time) and are generalizable (i.e., capable of being transferred across issues).

Of these, the issue of how to impart environmental knowledge to students is probably the easier to address, and especially in the context of China (China Environment News, 1998; State Environmental Protection Administration, 1998).

This is because the transmission of “facts” is a relatively straightforward proposition that educational institutions have historically managed to accomplish fairly well and, given the combination of rather receptive students driven by a fierce competition for educational opportunities, such content need only find its way into curricula – a process that should begin in elementary education. The transmission of such knowledge to *business* students and managers is more complicated by the fact that environmental content has to compete with various functional areas (e.g., accounting, finance, operations) that are already well entrenched and may, in some cases, be antithetical to what is often seen as a peripheral “business and society” issue. Equally important would be the *processing* of information to create knowledge that represents a higher-order learning objective. Interestingly, this study would suggest that this is self-reinforcing. That is to say that knowledge promotes information gathering behaviours that, in turn, would lead to greater knowledge. Thus, there is a “multiplier effect” at work.

As pointed out by Lieberthal (1995) policy directives in China are only swiftly implemented in China when three conditions are present, viz., when all top leaders agree on the issue, all top leaders give the issue priority; and, the degree of compliance is measurable. Such conditions related to environmental content may develop in business education in China, in that a formal decision to include environmental business subjects in the MBA programs has recently been adopted by the national MBA committee at a recent meeting in Shanghai (personal communications with the Deans of business schools at Beijing University, Tsinghua University and Renmin University).

From a business education perspective, undoubtedly the greater challenge would appear to be the inculcation of environmental values to future managers within the context of business education. Although much of the groundwork for value formation is established within a family and community structure, Perry's (1970) work on cognitive and ethical growth would suggest that students' values are partially malleable during the

college years. In this regard it is somewhat difficult to anticipate how malleable Chinese business students may actually be. On the one hand, Chinese students may be relatively more open to *externally* imposed priorities than their Western counterparts (although it would probably be inappropriate to call these values). It is probably also fair to say that the indoctrination of values would be considered more legitimate within higher education in China than in Western industrialized countries. It is also possible that students' value systems may be relatively less rigid due to the array of influences and traditions they have been exposed to, especially in light of the relatively more obvious evidence of environmental degradation that is, quite literally, in their faces.

At the same time Chinese business schools would be much more resource constrained in using more active and involving pedagogies such as field projects, experiential exercises and case studies that have been shown to be more promising in terms of value clarification (i.e., than straight lecture). Clearly such methods are more resource intensive and may require the development of new curriculum materials. Hopefully, a prudent amount of China's rapidly increasing GDP along with some international support can be channelled toward such ends. China's State Environmental Protection Administration's active support in greening domestic business programs and the World Resource Institute's leading effort in helping Business Schools in China to organize teaching material in business-related environment subjects since the second China BELL (Business-Environment-Leadership-Learning) Conference in 2001 being among the most encouraging developments in this aspect.

Having said this, these findings of this study also indicate that Chinese managers would like to do more but appear to be constrained by many factors. This would also suggest that business education and management training that addresses these constraints could be very beneficial in enabling pro-environmental behaviours. This would also be consistent with the arguments of Kaplan (2000) that such behaviours are most

effectively engendered by the peoples' participation in problem solving associated with self-interest (as broadly defined) and much less so by pleas to their altruistic tendencies. De Young (2000) similarly argued that the attainment or demonstration of competencies provides ample intrinsic motivation for behaviours on behalf of the environment. Top level programs on strategic thinking and leadership can also address environmental issues. This is reinforced by a recent study by Chinander (2001) that demonstrates that the communication of environmental objectives and the "deployment of accountability to operating personnel and managers encourages pro-environmental behaviours.

Limitations

When all data for a study are drawn using a single instrument and from a single person, concerns are legitimately raised about a mono-method, mono-source bias. However, to the extent that such bias exists, it almost always serves to strengthen the relationship among variables and usually does so in an even manner. Consequently, the low explanatory power of some models would appear to suggest that such biases are not particularly strong in this study. Moreover, such influences would probably not operate differently in the two sampling locations, so that comparisons between the samples would be unaffected. Finally, because the measure of environmental knowledge took the form of a rather challenging "test", it would be extremely unlikely that such bias would have accounted for relationships involving it. Thus, although it is impossible to rule out the presence of mono-method bias, with the possible exception of the relationship between environmental values (i.e., the NEP scale) and self-reported behaviours which may have been vulnerable to this influence, it would not appear to threaten the other findings.

A second limitation of this study speaks to its external validity. Although, we did take measures to broadly sample from industries, it would be ambitious to think that one could generalize these finding to the whole of China based on two

locations. It may be relevant, however, that Beijing and Guangzhou are very different in terms of their locations and, it is also claimed, their cultures. We would make no claims in favour of the broader generalizability of these relationships.

Conclusion

In conclusion, this study looked at the influence of environmental knowledge and environmental values on different forms of managerial behaviours on behalf of the environment. It was found that these relationships were similar for samples of managers in Guangzhou (Southern China) and Beijing (Northern China). It was found that both environmental *values* and environmental *knowledge* influenced Chinese managers' behaviours on behalf of the environment and that this influence abated with more visible actions. Moreover, the form of this relationship appeared to be different depending on whether the behaviours are relatively unobtrusive, involved initiating new programs, or advocacy.

From this study and given the seriousness of

environmental problems in China, it is suggested that environmental education – and especially business education – needs to incorporate learning objectives associated with elevating both environmental knowledge *and* environmental values among present and future managers. In addition, because the managers in the sample appeared to espouse strong environmental values, business education that more broadly empowers managers to initiate projects and espouse their values would also make a contribution. A final point would be that although environmental education has an important role to play, it must be considered as but one of many mechanisms that will be required to move such a large country – and a most critical one in terms of the global environment – toward more sustainable managerial practices.

Acknowledgements

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Appendix 1

Environmental knowledge scale

- (1) Why has the disposal of wastes caused problems for freshwater and marine ecosystems?
 - * (a) All ecosystems have a limited capacity to absorb waste
 - # (b) Neither type of ecosystem can tolerate industrial waste
 - (c) Both types of ecosystems are too old to adapt their "sink" capacity
 - (d) Scientists have not yet solved the "limited sink" problem

- (2) In industrialized countries (e.g., North America and Europe), the largest environmental impact from ground transport results from?
 - (a) Cars with four people driving on long recreational trips
 - (b) Full commuter buses and trains
 - ^ (c) Heavy trucks distributing goods
 - * (d) Unaccompanied drivers travelling to and from work

- (3) Which of the following has declined by 50% worldwide since 1938 according to leading endocrinologists?
 - (a) Follicle Stimulating Hormone (FSH)
 - (b) Thyroxine (T4)
 - * (c) Sperm counts
 - ^ (d) Immunoglobulin G (i.e., gamma globulin)

- (4) The Environmental Protection Department says that [CITY NAME] will run out of landfill space by:
- | <u>Beijing</u> | <u>Guangzhou</u> |
|----------------|--|
| (a) 2003 | * 2001–2002 |
| (b) 2004 | ^ 2006–2008 |
| (c) 2005 | 2008–2010 |
| * (d) 2006. | There is plenty of space for landfills |
- (5) The concept of “ecological footprints” refers to a measure of?
- (a) Benefits from promoting walking as a transport alternative
 - ^ (b) Costs from excessive consumption of natural resources
 - (c) Production capacity of specific resources per capita
 - * (d) Consumption based on the use of natural resources per capita
- (6) What is the main economic benefit to a business from reusing and recycling materials?
- * (a) Less cost in waste disposal
 - ^ (b) Less insurance risk in transporting hazardous materials
 - (c) Cost of packaging is reduced
 - ^ (d) Penalties from illegal waste dumping are avoided
- (7) Design for environment (DfE) refers to environmental management tools that help achieve what benefit?
- (a) Guidelines for new standards
 - (b) Guidelines for a product’s extra visual and functional qualities
 - * (c) Improved environmental performance throughout a product’s life cycle
 - ^ (d) Improved product performance on quality criteria
- (8) Business performance in the 21st century will likely seek what has come to be known as a “triple bottom line” of?
- (a) Community, NGO and employee needs and expectations
 - * (b) Economic, ecological and social needs and expectations
 - (c) Environmental, conservation and ethical investment expectations
 - (d) Insurability, credit and overall debt ratings
- (9) The sustainable challenge results most from which of the following sets of factors?
- (a) Exhaustion of both uncontaminated resources and new markets
 - (b) Removal of subsidies and regulations on resources use
 - (c) Decline in human population and disposable income levels
 - * (d) Exhaustion of resources and irreversible damage to life support processes from wastes
- (10) Sustainable development is usually defined as, “meeting the needs of present generations without . . . ?
- (a) curtailing growth rates.”
 - # (b) reducing access to natural resources by future generations.”
 - (c) causing shareholders to discount future investments.”
 - * (d) compromising the ability of future generations to meet their own needs.”
- (11) Sound environmental management is basically about business:
- ^ (a) Anticipating trends and effects of social and cultural concerns
 - * (b) Continuously reducing the environmental impact of their processes, products and services
 - (c) Restructuring priorities to minimize the impact of regulations
 - (d) Continuously promoting all operational sites as environmentally sensitive
- (12) When and where was the UN Earth Summit held?
- (a) Cairo, 1990
 - * (b) Rio de Janeiro, 1992
 - (c) Stockholm, 1994
 - (d) Istanbul, 1995

- (13) Which of the following has the largest impact on air quality in [CITY NAME] during the winter months:
- (a) Ozone
 - * (b) RSPs
 - (c) Nitrous oxide
 - (d) Sulphur dioxide
- (14) What is Agenda 21?
- (a) A comprehensive action plan to implement sustainability in 21 benchmarking firms
 - * (b) A global action plan to implement sustainability for the 21st century
 - (c) A global list of 21 sustainability policy items for government action
 - (d) A globally agreed list of 21 chemicals to be phased out in the next century
- (15) How much of the Earth is freshwater (not including that locked in ice or snow)?
- (a) 7%
 - ^ (b) nearly 3%
 - (c) 5%
 - * (d) less than 1%
- (16) Technological “leap-frogging” allows developing countries to?
- * (a) Go straight to cleaner and safer technology
 - (b) By-pass the bureaucratic confusion of unwarranted regulations
 - (c) Establish networks of cleaner production sites
 - (d) Develop SMEs as suppliers to technologically advanced countries
- (17) Why are companies auditing the environmental quality of suppliers?
- (a) Compliance with environmental regulations requires it
 - (b) Best competitive prices can then be negotiated.
 - * (c) Their own environmental performance is at risk
 - # (d) International standards, such as ISO 14001, require it
- (18) “Full cost accounting” involves . . .
- * (a) Recording and considering the environmental and social costs of a firm’s economic activities
 - (b) Assessing the environmental savings from waste reduction
 - (c) Disclosing sensitive details of all social actions
 - (d) Covering all expenses fully
- (19) What is the ISO 14000 series?
- (a) A process standard defining toxic impacts
 - (b) Standards for total quality environmental management (TQEM)
 - * (c) A series of documents specifying the elements of a certifiable Environmental Management Systems (EMS) and other good practices
 - (d) New publications related to the WTO (World Trade Organization)
- (20) What is the main message of “The Tragedy of the Commons”?
- * (a) Unconstrained use of common properties (i.e., public goods) governed by short-term economic rationality leads to common economic ruin (i.e., “freedom in a commons brings ruin to all”)
 - (b) Maximizing the benefits from common properties requires some social subsidization
 - (c) Agricultural systems relying on inorganic fertilizer must eventually collapse
 - (d) State-owned enterprises, which are doomed to fail, should be privatized

- (21) Biodiversity is the?
- (a) Number of living species (including bacteria)
 - * (b) Natural variety of biological matter (animals, plants and microorganisms)
 - (c) Cultural diversity based on the location of ecosystems
 - (d) Variety of products able to be biologically absorbed in ecosystems
- (22) One main *potential* advantage of biotechnology is?
- * (a) Reduced dependency on pesticides
 - (b) Less farming risks through monocultures
 - (c) Increased yields from flood prone regions
 - (d) Decreased risk of species loss
- (23) What is the main greenhouse gas and its cause?
- * (a) Carbon dioxide from burning fossil fuels
 - (b) Methane from coal mining
 - (c) Methane from agricultural livestock
 - (d) Nitrous oxide from burning fossil fuels
- (24) Certification to ISO 14001 means that:
- ^ (a) A facility's environmental performance must improve
 - # (b) That top management is committed to environmental performance
 - * (c) That the company has an environmental management system in place with specified elements
 - (d) That a firm's products/services are environmentally friendlier than its competitors' products/services
- (25) The main aim of environmental benchmarking is to?
- (a) Identify the profitability of environmental investments across divisions
 - ^ (b) Compare the performance and life-cycle impacts of new technologies
 - (c) Evaluate the least-cost option for complying with environmental standards
 - * (d) Identify ways of improving the environmental performance of operations, systems and processes
- (26) The "precautionary principle" states that:
- * (a) With serious threats, a lack of full scientific certainty should not be used as a reason for postponing measures
 - (b) We must use care when disposing of hazardous materials
 - (c) Siting of chemical plants should be located away from populated areas
 - (d) A company should generally not release information to the public unless required to by law
- (27) Pollution taxes and charges, tradable pollution permits and resource quotas, deposit-refund systems, performance bonds, resource saving credits, differential prices, and the removal of subsidies are examples of
- (a) Unwise government intervention
 - (b) Statutory regulation
 - * (c) Economic instruments
 - (d) Administrative law
- (28) Acid rain now seriously affects ____% of the mainland China's land mass.
- (a) 5%
 - (b) 15%
 - # (c) 25%
 - * (d) 40%

(29) What is the major toxic metal found in local rivers?

- * (a) Aluminum
- (b) Cadmium
- (c) Mercury
- (d) Arsenic

(30) What is the percentage of raw sewage that is treated in [CITY NAME]?

<u>Beijing</u>	<u>Guangzhou</u>
(a) 15	* 13
(b) 20	^ 20
^ (c) 25	28
* (d) 30	35

* = 2 points; # = 1 point; ^ = 0.5 point.

$\alpha = 0.7405$ for combined samples on total test score.

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