

A DISPOSITIONAL APPROACH TO HAZARD PERCEPTION: PRELIMINARY DEVELOPMENT OF THE ENVIRONMENTAL APPRAISAL INVENTORY

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Abstract

Recently more emphasis has been placed on the importance of variables that mediate person-environment relations. This paper describes the Environmental Appraisal Inventory (EAI), which is designed to measure three dimensions of environmental appraisal: (a) threat to self; (b) threat to the environment posed by environmental hazards, and (c) perceived control over environmental hazards. Hazards ranging from proximate indoor threats (e.g., office fumes) to large-scale outdoor threats (e.g., earthquakes) are included. Internal consistency of the EAI is more than adequate. Convergent and discriminant validity is explored using McKechnie's (1974) Environmental Response Inventory and Rotter's (1966) Internal-External Locus of Control scale. Perceived control over the physical environment as measured by the EAI appears to be distinct from Rotter's measure. The EAI has good psychometric properties, represents a previously untapped aspect of person-environment relations, and should prove useful as a mediating variable in several areas of environmental psychology.

Introduction

In recent years there has been a growing awareness of the importance of a range of contextual variables that mediate the reciprocal relationship between the person and the physical environment (Stokols, 1982; 1984; 1987). In order to advance research efforts in this direction, standardized tools that can assess these factors are needed. This paper presents the initial development of an inventory designed to measure one important mediator: the appraisal of environmental stressors or hazards.

Theoretical background

Stress may be seen as being comprised of three components: (a) the stimulus; (b) the individual's appraisal of the situation, and (c) some form of response to the stimulus (Lazarus, 1966). It has long been recognized that the human psychological response to stress is mediated by several factors, including a cognitive appraisal of the threat cues associated with a stressor (Lazarus, 1966). This appraisal process is dependent on characteristics of the situation (Paterson and Neufeld, 1987), the individual, and interactions between individuals and situations (e.g., in cognitive features arising from the situation, such as perceived control and the predictability of the stimulus). Consequently, the appraisal process is not a unitary phenomenon. Rather, the

This research was supported, in part, by a Doctoral Fellowship to the first author from the Social Sciences and Humanities Research Council of Canada.

individual evaluates many elements in the situation associated with the stimulus (e.g., its potential for harm or loss, threat, and challenge) (Lazarus and Folkman, 1984). In addition to this, individuals may make appraisals of coping or response possibilities (e.g., assessment of the extent to which they can effect some control over the stimulus, the costs associated with different response options, etc.).

The term 'stress' has been used to refer to all of these components, as well as to both physiological and psychological phenomena. This has resulted in some confusion in terminology. To avoid this confusion, the word 'stress' is not used in this paper. Instead, environmental stressors (physical stimuli such as noise, natural disasters, etc.) are referred to as *hazards*. An individual's appraisal of a hazard as an impending danger or possible source of harm is referred to as its *threat*. The hazard may also be appraised in terms of the extent to which a person can *control* it. Thus, the appraisals of hazards considered here include two aspects (threat and control) which bear some connections to Lazarus' primary and secondary appraisal concepts.

Appraisal (especially of control) is a mediator that may have considerable impact on environment-behaviour relations in many areas, including noise (Glass and Singer, 1972), crowding (Sherrod, 1974), and malodors (Rotton, Yoshikawa and Kaplan, 1979). Responses to these hazards have been found to vary when elements of the situation are manipulated to change appraisals of them (e.g., when real or perceived opportunities for control have been presented and manipulated as an independent variable). What is not evident in this research is how appraisal as an individual difference variable may influence these responses and interact with perceived control manipulations. This may be due, in part, to the lack of instruments to assess appraisal as an individual difference variable and in part to a tendency to view appraisal as a situationally dependent process that occurs uniquely in each threat situation.

Description of the Environmental Appraisal Inventory (EAI)

The Environmental Appraisal Inventory (EAI) is designed to assess the appraisal of hazards along three dimensions.

1. The appraisal of threat to self scale (Self), which measures the degree to which hazards are perceived to be threatening to the individual.
2. The appraisal of threat to the environment scale (Environment), which measures the degree to which hazards are perceived to be threatening to the environment.
3. The appraisal of control scale (Control), which measures the degree to which personal control is perceived in the face of hazards (i.e., how much control the individual could exercise against a hazard if it became a threat).

The first two scales concern the appraisal of hazards to both sides of the person-environment relationship. The Self scale is analogous to the traditional approach to threat appraisal in which stimuli are evaluated in terms of how threatening they appear to the individual. The Environment scale extends the appraisal from threat to the person to threat to the environment. This form of appraisal has not received much direct attention, although it may be implicated in several of the scales developed by McKechnie (1974) in the Environmental Response Inventory. The third scale (Control) assesses appraisal or perception of control. In addition to its presumed role in the appraisal process, the Control scale was developed to determine whether or not environmental control as a construct differs from locus of control as it has been formulated in measures such as Rotter's Internal-External Locus of Control (1966).

The use of these three dimensions in the appraisal of hazards is not intended to represent all aspects of the appraisal process. Cognitive appraisal is a complex process that involves the evaluation of numerous elements. The three aspects of appraisal selected for this paper reflect the current focus of much of the research in environmental psychology (the Self and Control scales in particular) and also reflect our interest in examining the person (the Self scale) and the environment (the Environment scale) jointly.

The EAI is a 72-item paper and pencil inventory that is based on a set of 24 hazards (listed in Table 3). These environmental hazards were selected to represent a range of types including: (a) natural and technological hazards (e.g., earthquakes versus chemical dumps); (b) global and local scale impacts (e.g., changes to the ozone layer caused by pollution versus smoking in public buildings); and (c) long and short-term impacts (e.g., hazards that accumulate over time, such as acid rain, versus those that usually leave little trace once the source is terminated, such as fluorescent lighting). In contrast to other stress appraisal scales [e.g., the Perceived Stress Scale developed by Cohen, Kamarck, and Mermelstein (1983)] the EAI uses only events from or elements of the physical environment, rather than social or lifestyle stressors. These hazards were selected arbitrarily in an attempt to see what might emerge in this initial, exploratory development stage.

The 24 hazards are each evaluated by the respondent three times—once in each of the above three scales. To ensure that respondents make their own, unique appraisals, each hazard is presented in a general way, avoiding the use of evaluative adjectives or reference to actual disasters. As a result, respondents are free to define and interpret each hazard in their own terms (e.g., the potential scale of impact of each hazard is not specified, no information is provided about the probability of any hazard, etc.). Most respondents will be able to conceptualize all of these hazards because many are commonly experienced in everyday life (e.g., few people have not experienced fluorescent lighting, noise, visual pollution, etc.). Less common hazards (e.g., earthquakes in geologically quiescent areas, etc.) have all received some media attention and thus are comprehensible by most people.

The Self and Environment scales use a seven-point Likert response scale with the response alternatives 'No Threat', 'Minimal', 'Mild', 'Moderate', 'Strong', 'Very Strong', and 'Extreme'. The Control scale also uses a seven point Likert response scale but with the following response alternatives: 'None', 'Minimal', 'Little', 'Moderate', 'Much', 'Very Much', and 'Complete'.

Method

Initial administrations

Between September, 1986 and February, 1987 the EAI and two other inventories, The Environmental Response Inventory (ERI) (McKechnie, 1974) and Rotter's Internal-External Locus of Control (I-E) (Rotter, 1966), were administered to three groups of volunteer subjects from the University of Victoria student body and the general adult population in Victoria, British Columbia. The first group ($n = 45$) completed only the EAI, the second group ($n = 26$) completed the EAI and the ERI, and a final group ($n = 55$) completed all three inventories. The age, sex, and number of years of education for these groups is summarized in Table 1.

TABLE 1
Demographic data by administration group

Group	Tests	N	Age		Sex ^a		Years education	
			Mean	Standard Deviation	Male	Female	Mean	Standard Deviation
1	EAI	45	20.44	10.71	18	25	14.50	1.61
2	EAI, ERI	26	30.73	13.02	6	20	14.88	1.18
3	EAI, ERI, I-E	55	24.44	5.92	20	35	14.0	1.17
TOTAL		126	27.46	9.82	44	80	14.36	1.37
			Range = 19-73				Range = 10-16	

^aN for sex for Group 1 is missing data for 2 subjects.

Results

Pooling the samples

Two MANOVAs were performed to assess possible differences among the three administration groups.¹ The first compared the EAI scores and demographic data obtained from these three groups. Results of this analysis revealed an overall significant difference [using Wilks Lambda $F(12, 226) = 2.84$; $P < 0.001$]; univariate tests showed that the groups differed on education and age [for education: $F(2, 118) = 4.44$, $P < 0.01$; for age: $F(2, 118) = 5.24$, $P < 0.007$]. However, no significant differences were found among these groups on any of the EAI scales.

A second MANOVA was used to compare the ERI scores for groups 2 and 3. The results of this analysis were marginally significant [using Wilks Lambda $F(8, 63) = 2.08$; $P < 0.051$]; univariate tests revealed only one significant variable [for Need for Privacy $F(1, 70) = 6.12$; $P = 0.02$].

As there were no significant differences on the EAI scales and the ERI scores were only marginally different, the samples were pooled to produce groups based on inventories rather than on administrations (in subsequent analyses special caution is exercised in using the data from the one significantly different scale, Need for Privacy). As a result of this regrouping, the remaining analyses that include the EAI were based on a total of 126 subjects (a combination of subjects from all three administrations). Analyses that include the ERI were based on a total of 81 subjects (a combination of the second and third groups). The I-E was administered only to the final group of 55 subjects; analyses involving this inventory were based on this group alone.

Descriptive statistics for the inventories

Means, standard deviations, and score ranges for the EAI, ERI, and I-E are presented in Table 2. On the seven-point response scale used in the EAI, the Self mean of 3.41 indicated a 'mild' to 'moderate' level of perceived threat to self. The Environment mean (4.30) showed a 'moderate' level of threat to the environment. The Control mean (2.99) suggested that these subjects felt they had 'little' control over these environmental hazards as a whole. All of the means on the ERI scales were within one standard deviation of those reported by McKechnie (1974). The I-E mean score was also

¹ For all tests $P < 0.05$ was used as the significance level.

TABLE 2
Descriptive statistics for the EAI, ERI, and I-E

	Scale	Standard		
		Mean	Deviation	Range
EAI:	Self	3.41	0.96	1.38-5.92
	Environment	4.30	0.93	2.08-6.71
	Control	2.99	1.07	1.17-5.08
ERI:	EA	69.24	8.96	51-96
	PA	78.15	9.69	53-98
	UR	63.38	11.15	35-88
	SS	72.92	9.95	45-92
	ET	65.76	7.82	46-82
	AN	70.84	9.57	45-89
	NP	55.76	8.14	38-84
	MO	63.57	10.59	41-87
I-E:		9.87	3.82	2-18

Note: Score values for the EAI are based on a seven-point response scale with higher values indicating more threat or control, the ERI scores are T-scores, and the I-E score is the sum of responses in the external direction (out of a possible 23).

comparable (within one standard deviation) to those reported by Rotter (1966) for college samples and various general adult samples.

Three *t*-tests were conducted to assess the differences between the EAI means reported in Table 2. All of these differences were significant: (a) Self and Environment $t(125) = -11.86$, (b) Self and Control $t(125) = 3.18$, and (c) Environment and Control $t(125) = -9.90$.

The relations among the three EAI scales are presented in the first three rows and columns of Table 5. Self and Environment, with 37% shared variance, appear to be neither entirely distinct nor redundant. No significant correlations were found between Control and either Self or Environment. Thus, threat to self and threat to the environment are related, as might be expected, but neither appear to be related to perceived environmental control.

The 24 hazards contained in the EAI were rank-ordered by their means to show their relative position on each scale. Table 3 presents these hazards (in the order in which they are listed in the EAI) and the rank-orders obtained for each scale.

Reliability of the EAI

Reliability of the EAI was assessed through an examination of the internal consistency of each scale. Cronbach's alpha for the Self scale was found to be 0.93, for the Environment scale 0.92, and for the Control scale 0.95. These high values suggest a satisfactory level of homogeneity within each scale.

The EAI and demographic variables

Correlations among the EAI scales and the demographic variables (age, sex, and educational level) were computed. As Table 4 indicates, three significant correlations were found: females perceived slightly more threat to the environment from these hazards than did males, males perceived higher levels of control than did females, and perceived control increased with age.

TABLE 3
Rank ordering of the 24 EAI hazards^a

EAI Items	Self	Environment	Control
1. Water pollution	4	5	4
2. Storms (e.g., lightning, hurricanes, tornados, snow)	24	20	22
3. Pollution from cars, factories, and burning trash	3	6.5	7
4. Smoking in public buildings	1	19	1
5. Acid rain	6	4	15
6. Pollution from office equipment (e.g., ozone from photocopiers)	20	22	9
7. Number of people (e.g., crowding, population explosion)	13	8	19
8. Fluorescent lighting	19	24	5
9. Water shortage (e.g., drought, water depletion)	23	9	16
10. Noise	12	21	2
11. Visual pollution (e.g., billboards, ugly buildings, litter)	10	18	3
12. Radioactivity in building materials (e.g., radon gas)	16	13	14
13. Change to the ozone layer caused by pollution	2	3	20
14. Earthquakes	17	14	24
15. Soil erosion	18	12	18
16. Impure drinking water	9	11	6
17. Large fires	15	10	13
18. Floods or tidal waves	21	16	23
19. Germs or micro-organisms	11	17	17
20. Radioactive fallout	5	2	21
21. Fumes or fibers from synthetic materials (e.g., asbestos, carpets, plastics)	14	15	10
22. Chemical dumps	8	1	12
23. Video screen emissions	22	23	8
24. Pesticides and herbicides	7	6.5	11

^aSelf and Environment are ordered from most (1) to least (24) threatening. Control is ordered from most (1) to least (24) controllable.

Validity of the EAI

Construct validity of the EAI was examined using the multitrait approach to determining convergent and discriminant validity [*cf.* Campbell and Fiske's multitrait-multimethod approach (1959)]. In this analysis, the EAI scales were compared with similar and dissimilar scales on McKechnie's (1974) Environmental Response Inventory (ERI) and with Rotter's (1966) Internal-External Locus of Control (I-E). The ERI measures environmental dispositions or 'ways people think about and relate to the everyday physical environment' (McKechnie, 1974, p. 1) along eight scales: Pastoralism (PA), Environmental Adaptation (EA), Environmental Trust (ET), Need for Privacy (NP), Urbanism (UR), Stimulus Seeking (SS), Antiquarianism (AN), and Mechanical Orientation (MO). Rotter's I-E is 'a measure of generalized expectancy' that is 'concerned with the subjects' expectations about how reinforcement is controlled' (Rotter, 1966, p. 10). The intercorrelation matrix for the EAI, the ERI, and the I-E is presented in Table 5.

TABLE 4
Correlations between demographic variables and EAI scales

	Self	Environment	Control
Education	0.02	-0.03	0.14
Age	-0.04	0.06	0.21**
Sex	0.02	0.16*	-0.17*

* $P < 0.05$

** $P < 0.01$

These correlations suggest that the EAI's Self and Environment scales assessing appraisals of threat have a satisfactory level of convergent validity because significant correlations were found with those ERI scales that measure some form of concern about the environment or the way it is used (i.e., the Environmental Adaptation, Pastoralism, Urbanism, and Environmental Trust scales). For example, a significant correlation between the Environmental Adaptation scale and Self and Environment scales was found. Those who believe the environment can, or should, be adapted or modified to meet their personal needs and those who believe technology has the solution to environmental problems tended to view the EAI hazards as less threatening to themselves and to the environment.

Similarly, high scores on McKechnie's Pastoralism scale (reflecting a tendency to oppose land development and to be concerned about potential misuses of the environment) were correlated with appraisals of greater threat to the environment. On the ERI Urbanism scale a high score indicates a preference for urban environments; that this scale was negatively correlated with the appraisal of threat to the environment is congruent with the pattern suggested by the Pastoralism-Environment correlation. Finally, the Environmental Trust scale is described as including (among other descriptors) 'trust versus fear of potentially threatening environments' (McKechnie, 1974, p. 17). This scale was found to be significantly correlated with the Environment scale, with low scorers on the Environmental Trust scale rating the EAI hazards as

TABLE 5
Intercorrelation matrix of the EAI, the ERI, and Rotter's I-E

	EAI scales			ERI scales								
	Self	Environ.	Control	EA	PA	UR	SS	ET	AN	NP	MO	
Self												
Environ.	0.61 ^b											
Control	-0.04	-0.09										
EA	-0.21 ^a	-0.30 ^b	0.16									
PA	0.13	0.22 ^a	0.11	-0.35 ^b								
UR	-0.04	-0.24 ^a	0.14	0.45 ^b	-0.27 ^b							
SS	-0.11	-0.06	0.29 ^b	0.14	0.54 ^b	-0.09						
ET	-0.16	-0.32 ^b	0.38 ^b	0.13	0.12	0.14	0.41 ^b					
AN	0.12	0.02	-0.20 ^a	-0.13	0.24 ^a	0.16	0.10	0.11				
NP	0.18	0.12	-0.19 ^a	-0.19 ^a	0.06	-0.12	0.004	-0.16	0.06			
MO	-0.06	-0.01	0.13	0.23 ^a	0.001	0.13	0.23 ^a	0.19 ^a	0.10	0.06		
I-E	0.02	-0.02	-0.20	0.13	0.02	0.09	0.25 ^a	-0.15	-0.18	0.02	0.05	

^a $P < 0.05$

^b $P < 0.01$

more threatening to the environment. Its correlation with the Self scale was in the expected direction but was not significant.

The discriminant validity of the EAI's Self and Environment scales was demonstrated through low, nonsignificant correlations with the ERI scales that do not directly or indirectly address concern about environmental hazards (i.e., the ERI scales of Stimulus Seeking, Antiquarianism, Need for Privacy, and Mechanical Orientation).

The convergent and discriminant validity of the EAI's Control scale was not as easily demonstrated because of the scarcity of scales designed to measure perceived control over the physical environment. The correlations of this scale with the ERI scales reported in Table 5 do, however, offer some insight into the dimensions it measures. Control was significantly related to four ERI scales: Stimulus Seeking, Environmental Trust, Antiquarianism, and Need for Privacy. Higher levels of perceived control were related to a preference for more stimulating environmental experiences, a feeling of competence and security in the environment, a preference for more modern things, and less need for privacy. Nonsignificant correlations were found for the ERI scales of Pastoralism, Urbanism, Mechanical Orientation, and Environmental Adaptation. Of these, perhaps the most surprising finding involved Environmental Adaptation, for which a stronger correlation might be expected. This nonsignificant correlation suggests that perceived control over hazardous environmental events may be a separate construct from the environmental disposition related to adapting or modifying the environment. Perhaps *having* control is different from *desiring* control.

The validity of the Control scale was also assessed using Rotter's (1966) Internal-External Locus of Control (I-E). The EAI Control scale was not significantly correlated with Rotter's I-E, suggesting that these scales may measure different constructs.

Description of high and low scorers on the EAI

From this initial development work certain patterns of high and low scorers on each scale emerged. First, those who tended to see less threat from these hazards (on Self and/or Environment) tended to prefer more urban settings, favor development, trust the environment, see it as adaptable, and believe that technology can solve environmental problems. Second, those who perceived more threat (on Self and/or Environment) manifested more sensitivity to the environment, a pastoral or rural orientation, and opposition to land development. Third, those who saw environmental hazards as more controllable tended to have a preference for modern things, were adventurous, and trusted the environment. Fourth, those who perceived lower levels of control were more antiquarian and needed more privacy. In summary, the relationship between the EAI and the ERI suggested that the appraisal of hazards reflects a technology/development/land use dimension.

Discussion

These initial results show that the EAI, although still in its preliminary stages, holds promise as an internally consistent and valid instrument for assessing how environmental hazards are appraised both as threats and in terms of their perceived control. Although the sample for this study was somewhat limited, several interesting findings demonstrate the value of the EAI for assessing environmental hazard appraisal.

First, the pattern of intercorrelations among the three EAI scales suggests that the perception of threat from hazards and perceived control over them are separate constructs.

Second, the appraisal of threat to oneself and to the environment are related. This is not surprising because threats to the environment often do also pose a risk to persons in that environment.

Third, a significant difference was found between the Self and Environment means with hazards in general appraised as more threatening to the environment than to the self. This dependence of hazard appraisal on the context of the analysis (i.e., to self or the environment) is apparent not only in the mean differences between Self and Environment, but also in the patterns (rank orders) of hazards within the scales. For example, smoking in public buildings was judged the strongest threat on the Self scale and was seen as the most controllable hazard but was judged 19th out of 24 as a threat to the environment. Water shortage (e.g., drought, water depletion) was ranked 9th as a threat to the environment but only 23rd as a threat to the individual. This contextually based difference is in line with past research on risk perception (Slovic, Fischhoff, and Lichtenstein, 1982).

EAI control is not I-E control

These results suggest that perceived control of the physical environment (at least physical hazards) may not be the same as perceived control in the traditional sense: a nonsignificant correlation was found between Rotter's I-E and the EAI Control scale. Examination of the I-E items shows that it is more directed toward control in *social* contexts (e.g., parenting, politics, etc.) whereas the EAI Control scale addresses control of the *physical* environment. Furthermore, the Control scale essentially asks respondents to appraise the extent to which they perceive control to be a possible response to a hazard. In contrast, Rotter's I-E seems to place its focus more on how outcomes occur (i.e., whether they result from something inside or outside the person). These differences suggest that traditional locus of control measures may not be appropriate for assessing perceptions of control in the physical environment, although they have been frequently used for that purpose.

Control of the physical environment has not received much attention as an individual difference variable, although it has been heavily researched as an independent variable and as a situational perception. We encountered some difficulty in obtaining measures that could be used to adequately demonstrate the construct validity of the Control scale. Consequently, the validity of this scale received the weakest support and is an area in need of further research. Nevertheless, an important speculation arising from these findings is that the EAI assesses perceived control over the *environment*, and thus may differ from other approaches to perceived control.

Further research and potential applications

The EAI is still in the early development stages, but it shows promise. The scale needs additional validation research including the use of multimethod validity assessments and tests of its ecological validity. This could incorporate comparisons of groups with known differences, studies of changes following treatments, etc.

The patterns of the EAI items in Table 3 suggest that there may be types or groups of hazards that are appraised in similar ways (e.g., technological versus natural hazards). We anticipate that useful EAI subscales will be developed. Two examples might be a

Large Natural Hazard subscale including earthquakes, storms, floods, etc., and an Indoor Workplace Hazard subscale including noise, number of people, etc.

The EAI should also facilitate a better understanding of how individuals differ in hazard appraisal and how these differences are related to patterns of response to hazards of all kinds from physical settings. For example, it could be used to determine whether hazard victims appraise hazards differently from non-victims, whether emergency response officials differ from non-officials, or whether cross-cultural differences in hazard appraisal exist. This could usefully extend the existing research (reviewed by Cvetkovich and Earle, 1985) that shows that differences in perceived control lead to different responses to hazards, and that the public and experts may not perceive risks from hazards (such as nuclear energy) in the same way (van der Pligt, 1985).

Another use of the EAI might be to chart hazard appraisal over time and/or in response to certain events [Wober and Gunter (1985) observed differences in hazard perception in response to television viewing]. Does perceived risk decline with time after a disaster? How does hazard appraisal relate to media coverage of potential threats, such as nuclear power plants, or new discoveries about the extent of damage to the earth's ozone layer?

In keeping with a contextual analysis of environment-behaviour relations, the EAI should serve as a useful mediating variable in stress or hazard research.

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Manuscript received August 1987

Revised manuscript received 2 September 1988