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An Application of Affective-Cognitive Ambivalence Theory in Environmental Risk Attitude: The Case Study of Marion County, Ohio in the U.S.

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Abstract: Using data from 132 telephone interviewees, we examined the role of affective-cognitive ambivalence in forming overall attitude and behavior toward toxic chemical and radioactive waste issues in Marion, Ohio in the U.S. In order to compare attitudinal preference, participants were divided into four A-C groups: action-group (Affective+/Cognitive+), detached-group (A-/C+), concerned-group (A+/C-), and inaction-group (A-/C-). Affective and cognitive components interacted, producing redundant influences on overall attitudes and judgments as frequently observed and postulated in previous attitude studies. The results showed that the action-group who were feeling unsafe and believed that environmental accidents had happened or are happening in Marion were less willing to move to the area than other three groups who were feeling safe and/or doubted reports of contamination and its relation with leukemia. Affective and cognitive components were found to have redundant influences on overall attitude. It was also observed that affective-cognitive ambivalence theory has a great potential for explaining the mechanism by which people form attitudes, especially when people have moderate or positive feelings (e.g. sympathy or eagerness for resources) toward the objects and/or when uncertainty is a major feature of environmental issue under consideration (e.g. global climate change).

Keywords: Affective-Cognitive Ambivalence Theory, Risk Attitude, Environmental issue

Introduction

People are constantly forming, expressing, and modifying their attitudes toward other people, things, and events. Attitudinal preferences can be understood as an outcome of complex interactions between affective (feelings) and cognitive (knowledge and beliefs) components. According to cognitive consistency theories (Festinger, 1957; Heider, 1958) and the tripartite model of attitude structure (Beckler, 1984), affective and cognitive aspects of attitudes used to be positively correlated with each other (Cheong, 2003; Lee and Fortner, 2006). However, recent studies (Lavine et al., 1998; Thompson and Zanna, 1995) revealed that in some cases these two components interact to exert non-redundant influences on overall attitudes or judgments. For instance, Abelson et al. (1982) found that people's voting preferences for political candidates were largely influenced by emotional reactions to the candidates, beyond the cognitive judgment on candidates' ability. In case of wildlife management, the public often rejects or protests against management policies that use lethal chemicals for limiting the number of wildlife such as coyote and deer. The results of previous studies showed that the public agrees with the need for preventing adverse consequences of excessive growth of wildlife populations, such as traffic accidents and spread of contagious disease, while their sympathy for the targeted wildlife may counteract applicable control options available to managers. (Bjerke et al., 1998; Manfredo et al., 1998)

The processes by which people construct attitudes toward environmental risk events are the major concern of this study. Recent research (Allen and Ferrand,; Geller 1995; Lee and Holden, 1999; Pelletier et al., 1998; Stern et al., 1995; Thogerson, 1997) has investigated how people develop and maintain a certain type of environmental attitude and what constitutes such an attitude. Most seem to postulate

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that affective and cognitive bases of attitude are positively correlated or perhaps even ought to be. People responding to environmental risk cases are dealing with two different mental tasks before determining their overall attitudes or judgments. One task is mostly associated with emotional reactions to the idea that their health can be seriously damaged, and the other is involved in cognitive judgments on how certain the cause-effect mechanisms of the case are in terms of environmental health impact.

Based on inductive reasoning from the affective-cognitive ambivalence theory, we initially categorized people or their attitudinal reactions into four groups as follows; A) the action-group (Affective+/Cognitive+) who find themselves in danger and believe that environmental accidents have occurred or are occurring, B) the detached-group (A-/C+) who feel safe (i.e., because of distance) despite their belief that environmental accidents have occurred or are occurring, C) the concerned-group (A+/C-) who find themselves in danger despite or because of their doubt about whether environmental accidents have occurred or are occurring, D) the inaction-group (A-/C-) who feel safe and believe that environmental accidents have not occurred nor are occurring.

This study was an attempt to examine whether this categorization operates well in a real-world case as hypothesized. If so, what implications does it have for environmental education and risk management. A serious environmental debate has been continuing around Marion County, Ohio in the U.S. since the government investigation report (June 1997) that the leukemia rates among graduates and current students at River Valley High School in Marion County were almost three times higher than would be expected in that population. Here are quotations from two newspaper articles reported in Columbus Dispatch.

> "In August, the health department released results of a second study that showed that leukemia rates in Marion County are 46% higher than national statistics, largely because of a particular form of the disease among women over 60" (Riepenhoff, 1998, p. 6A).

> "A six month investigation of outdoor air quality shows that the air at the River Valley school campus in Marion County is safe to breathe--- safer, in fact, than the air in most Ohio cities. The Ohio Environmental Protection Agency released the results yesterday. Early results from a second air study, by the Army Corps of Engineers, also indicate safe air on the school ground. The two government agencies are looking into possible environmental causes for an unusually high number of leukemia cases among River Valley graduates" (Edwards, 1999c, p. 6B).

Major actions and findings summarized in Table 1 clearly showed how the results of investigations conflict with each other, even increasing uncertainty with respect to possible health impacts caused by toxic chemicals and radioactive wastes.

Materials and Methods

Data collection

The telephone survey was administered over one week by seven members of a graduate level Environmental Communication class. Each student made 20 calls, using a systematic random sampling (e.g. beginning with seven randomly selected pages, every fourteenth listing until the required number of calls was completed). Business numbers were not called. Only individuals over age 18 were invited to answer the survey, and a maximum of two call backs was attempted before a number was discarded. Based on the number of residential listings in the Columbus telephone directory (about 512,200), this method with 132 calls (8 calls discarded later) gives a confidence level of 91%. This study should therefore be considered a preliminary one with potential for expansion.

Design of survey questionnaire

The questionnaire was designed to have four sections. The first section included questions about the respondents' knowledge of the Marion issues. For each of three cognitive items, the participants were to

Table 1. Chronology of the environmental events occurred in Marion County, Ohio, since 1942 (modified from Edwards, 1999a, 1999b, 1999c; Riepenhoff, 1998)

Date	Contents
1942	Marion Engineering Depot constructed on the site where River Valley Middle & High Schools (RVMHS) are currently located.
1948	Under direction of the Atomic Energy Commission, Monsanto begins operation of the Scioto Ordnance Laboratory (SQL), 5 miles north of the Depot.
1967	River Valley purchased the land and built RVMHS.
1994	Radiological investigation conducted by the Army Corps of Engineers indicated normal radiation levels at SQL site.
Jun. 1997	The Corps launches an investigation of River Valley campus after 7 cases of leukemia are documented among graduates, instead of the expected 1.7 cases. The Ohio Department of Health investigates a report of seemingly high cancer rates among River Valley High School graduates and students.
Jul. 1997	Health officials determine that leukemia rates among graduates and students are almost three times higher than would be expected in that population.
Aug. 1997	An environmental sampling reveals a small radioactive source in the schoolyard and undetermined quantities of cancer-causing chemicals in the soil of the football field.
Oct. 1997	A study of leukemia deaths shows that mortality rates increased 122 percent in the city of Marion between 1966 and 1995.
Nov. 1997	Ohio EPA conducts subsurface investigation on the campus, finds carcinogen benzopyrene and concentrations of arsenic in drainage ditches.
Feb. 1998	Five athletic fields are roped off after more contamination is found
Mar. 1998	Ohio EPA ropes off River Valley practice football field after finding chemicals linked to leukemia.
Apr. 1998	Ohio EPA tells school officials not to mow roped-off areas after chemicals linked to leukemia are detected on the athletic fields. School buildings are deemed safe.
Aug. 1998	Health officials determine that leukemia incidence rates in Marion County are 46 percent higher than expected - mostly due to a high rate among older women.
Sep. 1998	Radiation is ruled out as a problem on the school grounds. Arsenic in 1998 ditches will be removed in November.
Dec. 1998	The Corps completes arsenic removal on the River Valley School grounds.
Sep. 1999	No excessive radiation found at River Valley. A survey of two River Valley schools near Marion, Ohio, found no unusual amounts of radiation.
Oct. 1999	EPA steps up search for lead in Marion soils.

answer if the statement was true (+) or false (-) and then express how certain they were of their answer, where 1 meant very uncertain and 4 meant very certain. Possible scores for this section ranged from -12 when the participants thought that all three statements were false and they were very certain of their answers, to +12 when the participants when the participants thought that all three statements were true and they were very certain of their answers.

The second section consisted of an item about concern with environmental health impacts of toxic chemicals and radioactive wastes that were suspected of being in the area of study. The third section included items that were intended to measure how participants perceived the certainty and tangibility of the Marion issues. The concepts of perceived certainty and tangibility were adopted from a recent study (Lee and Fortner, 2000), which had attempted to classify environmental issues, focusing on the subjectivity in environmental perceptions. Unfortunately, this third section had to be excluded from final analysis because communication of the meaning of the "tangibility" concept to the respondents was difficult and resulted in low credibility of data. The final section focused on basic demographic characteristics of the participants, including gender, education level, age, the number of family members and children, and zip code.

In order to establish content validity, the questionnaire was reviewed and assessed by three professors and five doctoral students who are studying in Environmental

Communication and Education. In addition, seven members of a graduate level Environmental Communication class reviewed and evaluated the questionnaire both during and after the development of the instrument. For face validity, the questionnaire was pilot-tested with 35 people and revised through class discussion. All advice and comments were reflected in the content and form of the questionnaire.

Data analysis

As a baseline, a descriptive analysis was conducted for each variable, and correlation tests (Pearson's r) were performed among variables that were pertinent to the research questions. T-tests were examined if there were any significant differences in knowledge, feeling, and attitudinal preference between males and females, between families with and without children, and between high- (college or higher) and low (up to junior college) education groups. One-way ANOVA was also performed in order to compare environmental concern, knowledge level, and willingness to move to Marion County among the four A-C groups and by residential areas.

Results

Among 138 participants included in analysis, 132 (95.7%) answered that they had heard of the Marion issue before. This higher rate might be related to frequent appearances of the issue in mass media such as the daily newspaper (Columbus *Dispatch*) and evening news programs as listed in Table 1. Data from the six participants who replied that they had not heard of the Marion issue were discarded since they were judged as unqualified for further analysis.

Demographic information

The respondents comprised 60 males (45.5%) and 72 females (54.5%). The average number of family members was 2.7, and about 55% of the families had a child or children. Their ages were distributed in the ranges from 18 to over 55, averaging within the range of 30-45 (Mean = 42.5). The majority (N = 109, 82.6%) of participants were reported to hold at least a college degree or the equivalent. Most participants (N = 91, 68.9%) were living in suburban areas, and the numbers of participants dwelling in urban and rural areas were 29 (22.0%) and 12 (9.1%), respectively.

Affective component

In terms of the role of affective components in forming attitude, one direct question was asked, that was "How serious do you think the Marion issue is, if 1 means not serious at all and 4 means very serious?" The mean score was 3.7, and 105 (82.7%) of total 127 valid respondents answered that the Marion issue was serious or very serious. This skewed response pattern made it difficult to apply the affective-cognitive ambivalence structure to the Marion issues since the number of samples who held a moderate or positive feeling about the issues was very small. Therefore, attitude groups of similar size were constructed to increase applicability of statistical analysis. Using the median value of 3, samples were divided into two groups: Less concerned group (LCG, N = 64) who scored 3 or lower, and more concerned group (MCG, N = 63) who scored 4.

Table 2 showed that there was a significant difference in the perceived significance of the Marion issue between male (Mean = 3.03) and female (Mean = 3.46) participants: $t = -2.82$, $p < .01$). However, no differences were found between families with and without children ($t = -1.09$, $p = .28$) and with different education levels ($t = .22$, $p = .83$) in the perceived significance. Results of ANOVA also showed that there was no significant difference in the risk perception by participants' residential area: $F = .16$, $p = .85$.

Cognitive component

The summated scores of three items were calculated to measure how much the participants believed that environmental accidents had happened or are happening in Marion County. The mean score of knowledge was 7.24 (S.D. = 4.29) with minimum of −4.0 and maximum of 12. This result indicates that the participants were quite familiar with the Marion

Table 2. Mean comparisons (t-tests and ANOVA) of perceived seriousness by gender, education level, and residential area

Compared by (n)		Mean[a]	SD	T- or F-value	sig. (2-tailed)
Gender	Male (58)	3.03	1.01	-2.823	0.006*
	Female (69)	3.46	0.70		
Education	High (75)	3.25	0.92	0.221	0.825
	Low (52)	3.29	0.82		
Residence	Urban (28)	3.32	0.82	0.164	0.849
	Suburban (89)	3.23	0.91		
	Rural (12)	3.36	0.81		

[a]1 = not serious at all; 4 = very serious
*: $p < .01$

issue (were certain of their answers) and strongly believed that environmental accidents had occurred or are occurring. The number of those who scored zero or negative points was only 17 (13.2%) among 129 valid samples. So, by using the median value, that was 8, samples were divided into two groups: Less knowledgeable group (LNG, N = 59) who scored 8 or lower, and more knowledgeable group (MNG, N = 70) who scored higher than 8.

T-test results revealed that there was no significant difference between male and female participants in their knowledge of the Marion issue: t = –.93, $p = .36$. No significant difference in knowledge level was found between families with and without children nor between education groups: t-values = .61 and .21, respectively. No difference was observed among three residential groups: F = .89, $p = .42$.

Attitudinal preferences

Attitudinal preferences were measured on the basis of how the participants themselves respond to the Marion issue. A descriptive analysis revealed that the majority (N = 95, 73.6%) of the respondents answered that they would not be willing to move to a new home near River Valley since it did not appear safe. As a yes (+1) / no (–1) choice was combined with certainty scores ranging from 1 (very uncertain) to 4 (very certain), their "attitudinal preference" scores varied from –4 to +4 with an average of –1.7 (S.D. = 2.86). Among 95 concerned subjects, 81 expressed a high level of confidence that they made a right choice. These results seemed to imply that most participants were convinced that the Marion situation was a real threat to health conditions of themselves and their family.

T-test results revealed that female participants and a higher education group were significantly less willing to move to Marion County than their counterparts (Table 3). However, there was no significant difference in willingness to move toward Marion between families with and without kid(s). According to one-way ANOVA results, rural residents (Mean = –3.64) were much less willing to move toward Marion than urban (Mean = –2.48) and suburban (Mean = –1.71) residents. Differences among these three groups were found significant at a confidence level of 0.1, $p = .06$.

Roles of affective and cognitive components

The primary objective of this study was to examine if affective-cognitive ambivalence hypothesis explains people's risk attitude of a real-world environmental issue. Affective (seriousness of the Marion issue) and cognitive (knowledge of the issue) components had a moderately positive correlation (r = .404, $p < .001$). This result indicated that most of the samples maintained a univalent structure between affective and cognitive bases in constructing attitudinal preferences. In addition, attitudinal preferences were found to have similar extent of correlations with affective and cognitive components: r = –.253 and –.256, respectively.

ANOVA with four groups showed that affective and cognitive components appeared to interact to create redundant influences on attitudinal preferences (Table 5). That means those who found themselves in danger

Table 3. Mean comparisons (t-tests and ANOVA) of attitude preference by gender, education level, and residential area

Compared by		Mean[a]	SD	T- or F-value	sig. (2-tailed)
Gender	Male (52)	-1.40	2.88	2.316	0.022**
	Female (69)	-2.55	2.55		
Education	High (71)	-1.51	3.05	-2.698	0.008***
	Low (50)	-2.84	2.03		
Residence	Urban (27)	-2.48	2.43	2.891	0.059*
	Suburban (83)	-1.71	2.92		
	Rural (11)	-3.64	0.67		

[a]-4 very unwilling to move to Marion County; +4 very willing
*: $p < .1$; **: $p < .05$; ***: $p < .01$

and believed that environmental accidents have occurred or are occurring, were least willing, among four groups, to move toward Marion County. Table 5 also showed that those who had affective-cognitive ambivalent structures such as the detached-group (A-/C+) or concerned-group (A+/C-), expressed a moderate level of willingness that is weaker than the inaction-group (A-/C) but stronger than the action-group (A+/C+). Differences in the attitude score between the detached-group (Mean = –2.52) and the concerned-group (Mean = –2.17) demonstrate that a cognitive component had a greater influence on overall attitude than an affective component did.

Table 4. Correlations among affective (perceived seriousness), cognitive (knowledge), and attitudinal preference (willingness to move in Marion County) scores (N = 120)

	Affective	Cognitive
Cognitive	.404*	NA
Attitude	-.256*	-.253*

*: $p < .01$

Table 5. Comparisons of attitudinal preference scores among four affective-cognitive groups (N = 120; Between group comparison: F = 2.213 [df = 3], $p = .09$)

Affective groups	Cognitive groups		Means
	More knowledgeable	Less knowledgeable	
More concerned	A: -2.70 (39)	B: -2.12 (17)	-1.73 (64)
Less concerned	C: -2.52 (25)	D: -1.23 (39)	-2.52 (56)
Means	-1.50 (56)	-2.63 (64)	-2.10 (120)

Note: A: action-group; B: concerned-group; C: detached-group; D: inaction-group.

However, no conclusive judgment on statistical significance of the observed difference can be made without extensive further studies since the samples' responses were so skewed toward a positive side in both cognitive and affective aspects.

Discussion

This study was intended to apply the applicability of affective-cognitive ambivalence theory to a real-world environmental risk issue: the unusually high rate of leukemia in Marion County, Ohio in the U.S. The Marion issue was selected because there were continuing debates on the issue and the area was not far from where research was conducted. However, results of the study seemed to instruct us that more attention should have been paid to the issue selection process since the public can hardly hold positive feelings about environmental accidents like chemical contamination.

First it can be said that Columbus residents were quite familiar with the Marion issue, were very concerned about it, and considered it as a real threat to their health. Uncertainty associated with the issue and debates between Marion County residents and government agencies seemed to be magnifying the public's concern with health impacts of toxic chemicals and radioactive wastes that might be buried in the area.

The literature (Burger et al., 1999; Flynn et al., 1994; Ginsberg and Miller, 1982; Riechard and McGarrity, 1994) has reported that females exhibit

higher perceptions of (environmental) risks than males. The results appear to confirm this observation. It was, however, unexpected that a lower education group was more concerned with the Marion issue than was a higher education group.

Unlike what was hypothesized, affective and cognitive components were found to have redundant influences on overall attitude. The action-group who were feeling unsafe and believed that environmental accidents had happened or are happening in Marion were less willing to move to the area than other three groups who were feeling safe and/or doubted reports of contamination and its relation with leukemia. For those who experienced affective-cognitive ambivalence, cognitive components seemed to play a primary role in attitude formation over affective components, but it could not be properly tested since the size of sample was such that interpretation can only be applied to the sample group.

Two revisions in research design could have produced somewhat different results from what we achieved. First, knowledge questions should have made uncertainty of the issue more visible to the participants, for instance, by quoting arguments of both sides. Second, regional coverage of the survey should have expanded beyond City of Columbus so that relationship between the extent of anxiety or fear and geographical distance could be integrated into analysis. Therefore, we think that judgment on the value of affective-cognitive ambivalence as an explanatory theory needs more time, and expect for expanded studies to be done soon.

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