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## Lead and the Environment: An Approach to Educating Adults

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This study examined the effectiveness of a lead shot environmental education program directed towards adult Cree of the Mushkegowuk Territory. The outcome that was measured was a change in attitude to the lead shot issue, that is, a change of scored state from 0 (participants stating that lead shot was not a problem or they did not know whether lead shot was a problem) to 1 (participants stating that lead shot was detrimental to the environment, wildlife, and/or people of the region). Forty participants randomly selected at the beginning of the study were scored as 0. On follow-up, all people who were available for interview (Elders, 6 of 7; males, 8 of 13; females, 14 of 19) were now scored as 1, illustrating a major change in attitude. Educational strategies (e. g., hands-on activities) developed for adults in the present study have been appropriately modified for schoolchildren.

### **Rationale for the Program**

It is a well-known fact that lead pellets (also called lead shotshell) fired (or spent) from shotguns can be ingested by game birds and can cause lead poisoning and death in birds (United States Fish and Wildlife Service [USFWS], 1988). Other documented toxic effects in birds include a decrease in reproductive capacity, immune suppression, and a decrease in production of red blood cells (e.g. Eisler, 1988; USFWS, 1988), to name just a few. Early in the 1990s, in several countries (e.g., United States, Netherlands), the use of lead shotshell for hunting waterfowl was banned due to the harmful effect of lead on birds (USFWS, 1988; Annema, Booij, & Ros, 1993). In Canada, a nation-wide ban was implemented with respect to the harvesting of migratory birds in 1999 (Canadian Wildlife

Service, August 19, 1997; News Release). As part of a hunter education initiative, the Canadian Wildlife Service included an information pamphlet about lead poisoning and non-toxic zones (i. e., areas where the use of lead shot is prohibited) with the Migratory Game Hunting permit as early as 1990 (Pain, 1992). This dissemination of information was part of an environmental education and awareness strategy. But a large portion of the Canadian hunting population was not informed because Native Canadians do not require a license to harvest wild game. It was not until March 1996, that First Nations of the Mushkegowuk Territory were notified by the Canadian Wildlife Service of the lead shot issue in a one-page FAX (Scheuhammer, 1996; lead shot fact sheet).

Prior to notification by the Canadian Wildlife Service, there had been growing concern among First Nations of the Mushkegowuk Territory that the lead shotshells used in harvesting game birds may have been adversely affecting not only wildlife and the environment but also the health of the people of the region. Concern about human health can be attributed to several studies. Two studies reported elevated blood lead levels in children of the Mushkegowuk region with all usual routes of lead exposure (air, water, soil) being ruled out (Ontario Ministry of Health and the Environment [OMHE], 1989; Ontario Ministry of Health [OMH], 1993). More important, in a study by Hanning et al. (1996), newborn umbilical cord and maternal blood lead levels were found to correlate significantly with the consumption of a traditional diet of game. Lead contaminated wild meats was the probable source of lead exposure in these studies (Tsuji & Nieboer, 1997; Tsuji et al. 1997; Tsuji et al. 1999).

Elevated lead levels in humans is a major concern because even at very low levels, lead acts as a neurotoxin (United States Centers for Disease Control [USCDC], 1991;

International Programme in Chemical Safety [IPCS], 1995). Further, low lead levels in asymptomatic children have been correlated with neuropsychological deficits which is of particular concern to parents and educators because these deficits have been reported to persist, being non-reversible (e.g., Rice & Silbergeld, 1996). The establishment of a "safe" lead level for children has been difficult and it has even been suggested that there may be no safe level of lead exposure (USCDC, 1991, 1997). The lead shot environmental education and awareness program was directed toward adult First Nation residents of the Mushkegowuk Territory and employed several educational strategies, experiential education (i.e., hands-on activities in the natural setting and during traditional activities), being one of them. The outcome that was measured was a change in attitude towards whether or not lead shot was an environmental problem in the region. In addition, the educational strategies developed for adults during this study have been appropriately modified for use by Native and non-Native schoolchildren in the classroom (Tsuji, Karagatzides & Nieboer, 1998).

### **The Mushkegowuk Territory**

The Mushkegowuk Territory is located in the western James and southwestern Hudson Bay region of northern Ontario, Canada. Approximately 10,000 Ojibwa Cree residing in six First Nation communities (New Post, Moose Factory, Fort Albany, Kashechewan, Attawapiskat, and Peawanuck) and one town, Moosonee, inhabit the area. Fort Albany First Nation (52.15N, 81.35W) was the focal community.

Although it had been assumed in the past that land-use practices of First Nation Cree living in the Mushkegowuk Territory had deteriorated to the point of being irrelevant,

recent studies in the region have illustrated the continuance and importance of traditional land-use practices (e.g., Berkes et al. 1995; George et al. 1995). Indeed, the harvesting of game birds is still a way of life for Cree of the region. In 1990, it was reported that the waterfowl harvest in the region included 111,612 geese and 21,766 ducks (Berkes et al. 1994). Annual harvests of other game birds have been estimated as follows: 36,569 grouse (Berkes et al. 1994) and 3,486 shorebirds (Thompson & Hutchinson, 1989). A point which now must be emphasized is that acknowledging the fact that Cree game bird harvesting practices in the past were sustainable, it cannot be assumed that present-day harvesting practices are sustainable just because they were in the past.

Traditionally, animals were harvested with snares/traps or bows and arrows throughout the six to twelve annual harvesting seasons. These harvesting seasons corresponded to species abundance and/or accessibility to wild game. With a change of season, there was a change in species harvested. Only enough animals were harvested for subsistence with no animals being stockpiled. In this way, harvesting pressure switched from one game species to another making this harvesting practice sustainable. Considering recent technological and socio-cultural changes, a question of sustainability must be raised (Tsuji, 1999). Technological changes including the use of modern firearms (e.g., semi-automatic shotguns) and high performance shotshells have increased not only the efficiency of the harvest but also the number of game birds harvested. It has been estimated that 34 metric tons of lead pellets are deposited each year in the Mushkegowuk region (Tsuji, Nieboer, & Karagatzides, 1996). Taking into the account the known detrimental effects of lead exposure with respect to wildlife, humans, and the environment

in general, we have to question the sustainability of harvesting practices that continue to deposit enormous quantities of lead pellets into the Mushkegowuk Territory.

### **Method**

The Mushkegowuk Territory "Spent Lead Shot and the Environment" project was a collaborative effort involving individual First Nations (Fort Albany, Moose Cree), First Nation educational organizations (Mundo Peetabeck Education Authority), regional First Nation political organizations (Mushkegowuk Tribal Council, Nishnawbe Aski-Nation), provincial health organizations (James Bay General Hospital), federal health organizations (Moose Factory General Hospital [now known as Weeneebayko General Hospital]), and universities (McMaster, Trent, and Toronto). First Nation members have been involved, since the inception of the project in 1989. They have participated throughout the project, being directly involved in various hands-on activities, such as the collection and processing of several types of samples (teeth, game, vegetation, and soil). This type of experiential education is an important part of the learning process, that is, watching then doing. At least fifty people were involved in the collection and processing of the different samples. Traditional skills associated with the harvesting and preparation of game were highly valued during this part of the program.

In 1995, prior to the beginning of the formal component of the environmental education program which will be detailed, a total of 47 First Nation residents of the Mushkegowuk Territory were randomly selected to participate in the study. Participants were solicited during a two-week period, from the hundreds of people frequenting a commonly used community gathering area, in Fort Albany First Nation. No potential

participant refused to take part in the study. Participants were asked directly or through an interpreter an open-ended question: "Do you think lead shot used in hunting is bad for the animals, environment, and/or people of the James Bay region? Why?" Individuals on the basis of their answer were scored either 1, those who believed lead shot was an environmental problem or 0, those who did not. The latter group was further subdivided into one of three categories: Elders (N=8); males (N=18); or females (N=21).

Formal components of the program included: modified Open Houses (held in Fort Albany First Nation); the establishment of permanent displays (Moose Factory, Fort Albany, Kashechewan, Attawapiskat, and Peawanuck); the production of two booklets of 12 pages each (approximately 3,000 being distributed throughout the region); and the production of T-shirts, sweat-shirts, and caps with the program's logo (Figure 1).

An Open House "is an event at which citizens can drop in at a central facility during announced hours to view displays, ask questions, or discuss issues" (Federal Environmental Assessment Review Office, 1988; p. 42). During the spring of 1996, prior to the spring harvest of waterfowl, modified Open Houses were held in Fort Albany. We use the word modified because time scheduling was not strictly set. One of the authors has found through previous experience that these types of events (workshops, clinics, etc.) are usually not well attended if they are rigidly held during a specific time period. At the Open Houses, translators were available when needed, because unfortunately all material was in English. Some material has been in the process of being translated into Cree syllabics to appear in a regional First Nation publication; however, there have been frequent delays due to unforeseen circumstances.

Permanent displays were placed in areas of high visibility, such as hospitals, community health centers, and community complexes. One display focused on the environment while the other was centered on the people. The first information poster, "Spent lead shot and the environment: the effects on wetlands and wildlife in the Mushkegowuk region" contained eight photoprints illustrating "Lead pellet sampling technique" and "Vegetation sampling technique". This poster highlighted local harvesting areas around the James Bay area where the samples were collected, to give the reader a familiar frame of reference. Visuals showed grit samples (stones that are swallowed by birds to aid in the grinding of food) with and without radiographic evidence of lead shot ingestion. Headings used for additional information were: Lead pellet deposition in Canada; Lead pellet deposition in the Mushkegowuk region; Lead pellet ingestion in several bird species of the Mushkegowuk region; Lead poisoning in waterfowl; The fate of lead pellets in the wetlands of the Mushkegowuk region; Steel shot: A non-toxic alternative to lead; and Policy implications. The educational information was augmented by a factual summary on the known environmental effects of lead. Examples are as follows:

- an estimated 34 metric tons of lead shot is deposited annually in the Mushkegowuk region
- soil and plant samples from Chee Kee Nee Khook contained low levels of lead, thus, lead pellets do not appear to be contaminating the environment
- waterfowl (geese and ducks) of the Mushkegowuk region are ingesting lead shot, thus, a lead poisoning problem may exist

- although steel shot is ballistically different than lead shot, there is no clear ballistic advantage to either lead or steel in bagging waterfowl

The second information poster was entitled, "Spent lead shot and the environment: human health concerns in the Mushkegowuk region". Only one startling visual appeared on the poster, an abdominal view from a radiograph showing lead pellets in the digestive tract of an anonymous resident of the Mushkegowuk Territory. As in the other poster, useful information was presented under main headings: Rationale for the report; Consumption of game killed with lead pellets; Lead pellet ingestion in Cree of the Mushkegowuk region; Contamination of game killed with lead shot; and Policy implications. The factual summary was directed toward known human effects of lead. Examples are as follows:

- In humans, there has been a downward trend in lead exposure levels that are considered neurotoxic (poisonous to the nervous system), with any food contamination by lead constituting a potential health hazard.
- Lead exposure via the ingestion of lead pellets embedded in wildgame (for First Nation Cree of the Mushkegowuk region) is common (15.2%).
- A large portion of the skeletal tissue samples (muscle from bird gizzards) obtained through harvesting of birds with lead shot in the Mushkegowuk area, showed elevated lead levels greater than the level suggested for human consumption.



- People who consume wildgame harvested with lead shot risk lead exposures via the ingestion of tissue embedded lead pellets and lead fragments (tissue-bound lead is of lesser importance).

The two booklets that were produced provided much more background and in-depth information compared to the information posters. Supplemental topics dealt with in the first booklet included: die-offs; signs and symptoms of lead poisoning in waterfowl (behavior, appearance); diagnosis of lead poisoning in waterfowl (lead shot in gizzards, lead residues in body tissues, biochemical changes); and steel shot (physical characteristics, cartridge design, internal/external/terminal ballistics, crippling rates (Tsuji, Nieboer, & Karagatzides, 1996). Meanwhile, in the second booklet, additional information included: potential sources of lead exposure; sources of lead exposure during hunting; lead poisoning in humans (factors affecting the absorption of lead when it is ingested, airborne lead, placental transfer); diagnosis of lead poisoning in humans (blood lead level, tooth lead level); signs and symptoms of lead poisoning in humans (acute and chronic lead poisoning); and tissue and bone embedded lead shot (human health concerns (Tsuji et al. 1996).

T-shirts, sweatshirts, and caps were distributed throughout the region to increase awareness to the multi-faceted lead poisoning problem. The project logo included a stylized Canada goose; this bird is of great cultural and economic importance to the Omushkego Cree. The spring activities associated with the harvesting of the Canada goose has been described as a celebration of life itself being representative of the survival of the family unit throughout the harsh winter months (Hanson & Currie, 1957; Thompson

& Hutchinson, 1989; Cummins, 1992). Furthermore, decreasing numbers of Canada geese have been documented for this region with lead exposure being suggested as one of the factors (Tsuji et al. 1998). A representation of the James Bay region also appears on the logo to provide a frame of reference. Lastly, a message appears on the perimeter of the logo: "Use Steel Shot To Hunt in James Bay. Protect Our Wildlife, Health & Way of Life" (Figure 1). Steel shot is mentioned because it is the only readily available "nontoxic" shotshell (i.e., it does not cause mortality in game birds when ingested), being widely distributed in a variety of types. Furthermore, Morehouse (1992) reports in an extensive review that there appears to be no clear differences in the ballistic performances between lead and steel shotshell used in harvesting game birds.

## **Results**

The age range in years for the participants were as follows: Elders, 56-74; males, 18-50; and females, 20-50. Of the 47 individuals participating at the beginning of the study, only 15% or seven were scored in category 1, answering that they thought that lead shot used in hunting was detrimental to animals, the environment, and/or people of the James Bay region. Their answers included:

Lead would be bad, if not now, would be a big cost for humans, animals, birds, and the environment in our near future. Lead is poisonous.

Yes. It is harmful to the environment and to the people. Lead shots have proven to be poisonous to the body system, and will be more in evidence as years go by, if one has consumed enough lead.

Seen some documentaries on TV showing geese losing it like the goose would be trying to walk but instead it would stagger around. It couldn't hold its head up. Quite comical but

scary to think that some lead lodged in the meat and when you cook, it makes you wonder what is secreted in the meat.

The other 85% or 40 participants (Elders, N=8; males, N=13; females, N=19) were scored as 0, stating that lead was not a problem or they did not know whether lead was a problem. Answers included:

I don't think so, we been using lead shot for a long while and hasn't caused us problems.

It has been used for so many generations. I do not think it has that much effect.

Traditionally we have been using lead shots for many years. We have no choice but to use lead shots.

In 1997, after the implementation of the lead shot environmental education program, participants were asked the same question (as posed earlier) in a follow-up interview. Not all of the original participants could be located or contacted to participate in the follow-up study. All individuals (28 of the original 40) who participated in the follow-up study (Elders, 6 of 7 [sadly one Elder died]; males, 8 of 13; and females, 14 of 19) were scored as 1, stating that they now believed that lead shot is bad for the environment, wildlife, and/or people of the James Bay region. No statistical procedures were performed to assess statistical significance because the distribution of data for participants at initial and follow-up interviews, was discrete; therefore, statistically significant. In addition, participants who were re-interviewed identified the information posters as the most effective printed method of presenting information. Reasons for the effectiveness of this component of the program included: minimal time was required to read and examine the

posters compared to the booklets; and information was presented holistically (i. e., all material could be visualized in one field rather than sequentially as in the booklets). Perhaps, the information booklets were too detailed and really only useful when more in-depth information was sought. However, the portability of the booklets, to be read at ones own leisure, was mentioned as an advantage.

Of all the participants, the Elders were the only group who after being given new facts/information, reflectively thought about the original question in context with their past experiences. Reflective answers given by the Elders included:

I remember time when I was sick. Took an x-ray and saw lead pellet in intestines. Took medicine and [defecated] out pellet and felt better.

Planes flying usually scare geese but I saw geese that were not scared by the planes. They were acting strange.

It is noteworthy that no other age group used reflective thought in information processing in context with past experiences. It appears that the residential school experience has to a large degree extinguished this traditional method of processing information.

Also, one Elder participant even brought in a goose with a hatchet-breast, a symptom often associated with lead poisoning for examination. Necroscopy showed eroded grinding plates in the gizzard (another sign of lead poisoning), and lead shot was indeed found in the gizzard.

## **Discussion**

The Mushkegowuk Territory adult education "Spent Lead Shot and the Environment" project was successful in affecting an attitudinal change. Participants who were originally scored as 0 (stating either that lead was not a problem or they did not know whether lead was a problem) were at the end of the study scored as 1 (answering that they thought that lead shot used in hunting was detrimental to animals, the environment, and/or people of the James Bay region). Several factors appear to have been of importance:

*1. First Nation members were directly involved in the project from its inception.* Research data were collected for First Nation use and were presented through different mediums to the people of the region. In this way, a major criticism of many research projects involving First Nation communities was removed. As Medicine (1995) has stated:

I know that there is great disenchantment with anthropologists who are accused of "digging up bones" or are not giving research data back to the Native communities. I also find that this latter accusation is true in the fields of health care, psychiatry, sociology, and education (p. 42).

*2. Harvesting of game birds is a way of life to the Omushkego people of the western James Bay region.* Thus, any activity (e.g., the use of lead shotshell) that adversely affects the environment and/or wildlife (and by extension cultural and economic well being of Native society) is of concern. It should be stated that game samples that were collected by First Nation members were part of their normal harvest. That is, game was not collected solely for research purposes; there was no wastage of wild meat. For example, after grit

was removed from the gizzard of birds, gizzards were further cleaned and typically returned to the people, to be consumed. As Martin (1993) maintains:

Well-planned Aboriginal adult education programs must...teach material that is of relevance and interest to the student but must do so in a manner that is culturally appropriate (p.171).

We believe both these goals were accomplished in the present program.

*3. Hands-on education was incorporated into the learning experience through various activities, such as the collection and processing of game specimens.* In this process, data that were generated and later presented were not an abstract construct; people were able to relate to the information presented because the people had been part of the actual process. The actual act of local collection and processing of samples reinforced the relevance of the project to the people. In other words, a point of reference was established. The in-the-field activities also helped to contextualize the experience. In the discipline of psychology, it is firmly established that knowledge is better remembered in the context it was originally learned (Godden & Baddeley, 1975; Norman, 1988). Further, the elaboration of knowledge during the learning process has been shown to enhance both comprehension and retrieval of information (Norman & Schmidt, 1992).

*4. Although not a planned part of our program, cooperative learning/peer teaching became an important component.* Even if a person was not directly involved with the project, it was most likely that the person would know someone who was directly involved. Moreover, people who were directly involved facilitated learning by demonstrating to other people

what was collected and processed, and explaining why the activities were important to the lead project. This was apparent when people would bring specimens to the investigative team, even though we had not personally solicited them. When we originally demonstrated to our "research assistants" how to process the organs and tissues required for the study, after observing our technique, our assistants would demonstrate more efficient ways of doing the tasks. It should be mentioned that the effectiveness of cooperative learning/peer teaching has been firmly established in the field of medicine (see e.g., Berkson, 1993; Vernon & Blake, 1993) and reported in the Native education literature (see e.g., Miller & Thomas, 1972; Lipka, 1990).

*5. Modified Open Houses appeared to have provided a good vehicle for disseminating information.* Since no strict time-lines were adhered to, the atmosphere was relaxed. Information cannot be thrust upon a person. The posters and booklets presented information that First Nation members had directly helped to collect and/or generate. Most information dealt directly with regional lead shot concerns. Establishing local relevance is always important before generalizing to national and global concerns.

*6. All information was presented from a holistic viewpoint, that is, interrelationships were stressed.* First Nation use of lead shotshell in the Mushkegowuk Territory was examined with respect to pollution of the environment (soil and plants), wildlife health concerns (lead poisoning of game birds), human health concerns (wildmeat contamination and human ingestion), and policy considerations (switch to non-toxic alternatives, socio-economic concerns). A holistic approach to learning where there is no compartmentalization of material has been shown to be effective in innovative medical curricula (see e.g., Berkson,

1993; Vernon & Blake, 1993) and been described as culturally appropriate for Native North Americans (see e.g., Pepper & Henry, 1986; Moore, 1987).

An interesting aspect of this education study is that Elders, once presented with relevant information, changed their minds about the detrimental effects of lead, as shown by the change in scored state from 0 to 1. Elders even used the knowledge that was gained from exposure to the lead shot education program and related their past experiences, in light of their new knowledge (i. e., reflective thought). One Elder even put the new knowledge to work, bringing in a goose she (correctly) believed to be lead poisoned (Tsuji et al. 1998). Obviously, as Stiegelbauer (1996) contends, part of being an Elder is "continuing to learn as a teacher" (p. 38). Compare this process of learning to that in the non-Native society, where there is a saying: "It is hard to teach an old dog new tricks".

One shortcoming of the project is that resource material has yet to be translated to Cree syllabics. Once this is accomplished, hopefully, the First Nations of the western James Bay region will have enough data to make an informed decision to discontinue the use of lead shotshell for the harvesting of all game due to wildlife and human health concerns.

Lastly, noting the success of the adult environmental education project, several of the projects' hands-on activities have been appropriately modified for schoolchildren. These educational activities have been described by Tsuji, Karagatzides & Nieboer (1998). Activities include: the examination of soil/sediments for pellets in the field; the examinations of grit(stones used for the grinding of food by birds) for pellets either manually and/or radiographically; and the determinations of grit size. The depth to which



an educator intends to examine the lead shotshell issue determines the educational level that is appropriate (elementary or secondary).

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