

University of Wollongong
Research Online

Graduate School of Medicine - Papers (Archive)

Faculty of Science, Medicine and Health

1-1-2009

A tale of two towns: Observations on risk perception of environmental lead exposure in Port Pirie and Esperance, Australia

Jane S. Heyworth
University of Western Australia

Chris Reynolds
Flinders University

Alison L. Jones
University of Newcastle, alisonj@uow.edu.au

Follow this and additional works at: <https://ro.uow.edu.au/medpapers>

 Part of the [Medicine and Health Sciences Commons](#)

Citation

Heyworth, Jane S.; Reynolds, Chris; and Jones, Alison L., 2009, A tale of two towns: Observations on risk perception of environmental lead exposure in Port Pirie and Esperance, Australia, 60-73.
<https://ro.uow.edu.au/medpapers/362>

Research Online is the open access institutional repository for the University of Wollongong. For further information contact the UOW Library: research-pubs@uow.edu.au

A tale of two towns: Observations on risk perception of environmental lead exposure in Port Pirie and Esperance, Australia

Abstract

Environmental lead exposure in Port Pirie, South Australia and Esperance, Western Australia led to differing perceptions of risk among these communities. This paper describes our observations of the social and economic context of these cases of environmental lead exposure and how this influenced responses among the community. Lead had been transported out of the Esperance Port since 2005. However, much of the community was unaware of this until it became public as part of the investigation into bird deaths in the local environment. Esperance saw itself as an idyllic rural community, with a sound economic basis, but removed from the problems associated with cities, such as pollution. Once the lead problem was identified, residents became very concerned about their children's health and demanded immediate action. On the other hand Port Pirie residents valued their long history associated with the lead industry. This industry underpinned the local economy. The attention from outsiders was seen as unwarranted and unnecessarily portraying the city as a dirty harmful place. These differences highlight the need for scientists and regulators to acknowledge that both the social context as well as patterns of exposure is integral to the assessment and management of risk.

Keywords

towns, tale, esperance, pirie, port, exposure, lead, environmental, perception, risk, two, observations, australia

Disciplines

Medicine and Health Sciences

Publication Details

Heyworth, J. S., Reynolds, C., Jones, A. L. (2009). A tale of two towns: Observations on risk perception of environmental lead exposure in Port Pirie and Esperance, Australia. *Environmental Health*, 9 (4), 60-73.

A Tale of Two Towns: Observations on Risk Perception of Environmental Lead Exposure in Port Pirie and Esperance, Australia

Jane S. Heyworth¹, Chris Reynolds², and Alison L. Jones³

¹*School of Population Health, The University of Western Australia,*

²*School of Law, Flinders University &*

³*School of Medicine and Public Health, University of Newcastle*

Environmental lead exposure in Port Pirie, South Australia and Esperance, Western Australia led to differing perceptions of risk among these communities. This paper describes our observations of the social and economic context of these cases of environmental lead exposure and how this influenced responses among the community. Lead had been transported out of the Esperance Port since 2005. However, much of the community was unaware of this until it became public as part of the investigation into bird deaths in the local environment. Esperance saw itself as an idyllic rural community, with a sound economic basis, but removed from the problems associated with cities, such as pollution. Once the lead problem was identified, residents became very concerned about their children's health and demanded immediate action. On the other hand Port Pirie residents valued their long history associated with the lead industry. This industry underpinned the local economy. The attention from outsiders was seen as unwarranted and unnecessarily portraying the city as a dirty harmful place. These differences highlight the need for scientists and regulators to acknowledge that both the social context as well as patterns of exposure is integral to the assessment and management of risk.

Key Words: Lead Contamination; Risk Perception; Environmental Exposures; Case Studies

Imagine a town sitting under the shadow of a large lead smelter, its livelihood dependent upon the smelter to the point that the history of both its community and its industry are intertwined and inseparable, a relationship that goes back generations, into the present and beyond. The future of the plant determines the future of the community. However, advances in scientific knowledge now inform the community that this relationship has come at a cost; that there are grave concerns about neurodevelopmental problems among the generations of children of that community who have been chronically exposed to lead released by the plant.

The community is told it has a problem, that many of its children and adults when children were affected and could suffer some neurological deficit. This appears to stigmatise them and single them out from other communities. The requirement for cleaner emissions is an unwelcome cost on an already marginal industry and the smelter owners threaten closure. Many in the community see the risk as small and they are anxious and angry about the unnecessary attention (Cornwall 1989). Denial, anger and the temptation to 'shoot the messenger' are understandable responses.

Imagine a community renowned for its pristine environment, its aqua blue

waters and its white beaches. A place where people have chosen to bring up young children and a peaceful oasis that attracts many visitors. Yet it is visited by a frightening event: more than 4500 birds, many of them purple crowned lorikeets, seemingly fall dead from the sky. Autopsies show that their livers have high lead levels (Western Australian Government 2007). Then it is discovered that lead dust has, for the past 18 months, been shipped from its Port with environmental contamination of lead throughout the adjacent areas.

How did these communities respond to the discovery of the threats? A risk analysis raises questions of hazard, that is, what impact lead will have on a person or population, and risk, the likelihood of harm to those exposed to lead in these ways. Yet it must also raise questions about the way we respond to risk, which is the focus of this paper. We argue that the environmental lead exposures in these two communities represent two quite different social contexts and patterns of exposure, and the resulting community responses are quite different, both within and between the communities. These differences highlight the need for scientists and regulators to acknowledge that both the social contexts as well as patterns of exposure are integral to the assessment and management of risk; as well, the disjunction between the lay and expert views on risk is not because the lay public is ignorant or irrational (Beecher et al. 2005; Bickerstaff 2004; Slovic et al. 2004). Rather, it is because both expert and lay decisions about risk are determined by experience and context as well as the characteristic of the risk itself. While groups differ in their decisions about risk, neither are necessarily wrong (Reynolds 1989).

This growing convergence of psychological and sociocultural approaches to risk perception acknowledges the

complexity of the interaction of cognitive factors with cultural, social, economic or political context in determining our responses to risk (Beecher et al. 2005; Bickerstaff 2004; Nelkin 1985; Taylor-Gooby & Zinn 2006). Experiential and analytical approaches act in parallel in decision making about risk whereby “people base their judgement of an activity or technology not only on what they think about it but also how they feel about it” (Slovic et al. 2004). For example, while regulators might measure levels of pollutants in air and determine that these are below the level of health concern, residents’ perceptions of risk may be determined more by issues of social justice and their lack of power to maintain their local environment as they would wish it. Residents may suffer health effects but when these present as non-specific health effects, they are more difficult to link to local pollution.

The case studies of environmental lead exposure in Port Pirie, South Australia and Esperance, Western Australia, described in this paper, illustrate how responses to risk were determined not just by the nature of the risk, but also the political, historical and social context in which the issue arose. They are based upon our observations as professionals who were involved in the evaluation and response to these health issues as well as published articles and reports. One, the Port Pirie example, is an historical case study, occurring during the 1980s when the scientific knowledge about the health effects of environmental lead exposure was unclear. The second case study describes a more recent example, occurring during 2007/2008. They both illustrate the range of public responses to a risk controversy and the influence of both the characteristics and the social context of a risk issue.

Background to Case Studies

Port Pirie

Port Pirie is a town of approximately 17,000 people situated at the top of the Spencer Gulf in South Australia (Australian Bureau of Statistics [ABS] 2001). The climate is hot and arid. A lead smelter was first established there in 1889, when lead was sent by rail from the lead mines in Broken Hill, New South Wales (Heyworth et al. 1993). Port Pirie was a single industry town and a substantial proportion of people were employed by the smelter. In the early 1980s concern arose among scientists about the potential health effects of low level exposure to environmental lead in Port Pirie, in particular the effects on mental development in young children. However, the community in Port Pirie was divided over the lead issue (Calder & Collings 1989). The reaction of the majority of the community was to discount the potential health issue. Generations of families have lived in Port Pirie and worked for the smelter. They were loyal to their community, and were particularly concerned about stigma that might result from bad publicity.

Esperance

Esperance is a regional town with a population of about 9500 (ABS 2006). It is located on the Southern Coast of Western Australia. Esperance enjoys the reputation of having a pristine environment and many residents chose to live in Esperance specifically for these reasons. In December 2006 the community noted that birds were falling from the sky (Western Australian Government 2007). The finding of an elevated lead concentration in the livers of these birds (even though in all probability the lead was not the cause of death) prompted an environmental investigation that showed lead dust contamination of the town from the Port. The Port had begun shipping lead carbonate ore in 2005, but

this was stopped by the Port in March 2007 in response to the public concern about the potential lead contamination (Western Australian Government 2007). To community members the bird deaths have become an iconic event, representing the lead contamination issue in Esperance.

Lead standards

The Australian level of concern for blood lead in the early 1980s was 30µg/dL and in 1987 this was reduced to 25µg/dL (Heyworth et al. 1993). In 1993 the National Health and Medical Research Council moved away from the single level of concern to a set of actions in response to a hierarchy of blood lead levels. This was in response to increasing evidence of the health effects of lead at levels lower than 25µg/dL and also the lack of clarity regarding the safe threshold for lead. A goal of less than 10µg/dL was recommended for all Australians and depending upon blood lead concentrations commencing at 15µg/dL, there was a range of graduated responses (NHMRC 1993).

Australian blood lead standards at the time of the Esperance environmental lead issue were under review. However, the World Health Organization (WHO) and the US Centers for Disease Control and Prevention (CDC) have an action intervention level of 10µg/dL as the lowest blood lead concentration requiring intervention in children (Centers for Disease Control and Prevention 2005; International Programme on Chemical Safety [WHO IPCS] 1995).

Perceptions of Risk

Table 1 summarises the key features for each of these cases studies, in particular the factors that appeared to influence views on risk among the populations of Port Pirie and Esperance. In both towns, the unborn child and young children were identified to be most at risk because of:

Table 1: Summary of the lead issues and factors influencing perception of risk related to environmental lead exposure in Port Pirie and Esperance

Port Pirie – early 1980s	Esperance – 2007/2008
Trigger to event Increased international concern about low level lead exposure	Bird deaths
Exposure Lead silicate- more stable in environment	Lead carbonate- greater bioavailability/ more reactive
Potential/ actual Outcome Impact on intellectual development	Impact on intellectual development
Activity Lead smelting	Lead transport
History Long-Nearly 100 years	Short 18 months-2 years
Population at risk Children/Pregnant women	Children/Pregnant women
Relationship to Industry Dependency/Threat of closure	In the main the community was unaware of lead activity/little dependency
Science Debate among scientists about effects on IQ at levels of 25µg/dL or below Potential for confounding and subtle effects difficult to measure	Now agreed there is no threshold and concern now focussed upon effects below 10µg/dL At what levels are effects important?
Length of residence Concern raised by more transient residents	Concern raised across the community, especially parents of young children
Media Stigmatised town as dirty and unsafe	Focused more on failings of government
Economic environment Economic downturn/ higher unemployment	Economic boom/ high employment
Control Low SES areas affected most- livelihood depended upon the smelter	Higher SES areas affected-more voice
Politics Traditional labor seat Local government not supportive of State Health Department intervention	Liberal/National seat in last decade Local government more neutral position
Trust Resentment of state government inference in a local issue	Lack of awareness of lead shipment from Esperance increased the mistrust.

Table 2: Cumulative Blood Lead Levels in Esperance community members by age-group, 19 March to 28 August 2007

Age group in years	0 to < 5	5 to < 10	10 to < 20	20 to < 40	> 40	Total
Number of tests	404	259	319	565	1372	2919
Mean lead levela (µg/dL)	3.0	2.4	1.8	1.9	3.0	2.6
Number with lead level in range 5 – 9 µg/dL	76	21	5	24	203	329
Number with lead level ≥ 10 µg/dL	7	0	0	4	22	33

Note a. arithmetic mean only available

Source: Education and Health Standing Committee Legislative Assembly 2007)

their increased susceptibility, in particular the susceptibility of the developing nervous system to toxins; increased absorption; and general behaviour patterns, including increased hand to mouth activities. Parents in Esperance were concerned about their children's involuntary exposure to lead and the potential for long term effects, including cancer.

In a survey of 1239 children in Port Pirie capillary blood samples were taken and 7% were found to have levels over 30µg/dL, the Australian guideline at that time (Wilson et al. 1986). Fifteen percent had levels over 25µg/dL (Wilson et al. 1986). Table 2 presents the blood lead data for Esperance residents. Venous blood samples were taken from 404 children aged less than five years and seven had blood lead levels over 10µg/dL (Education and Health Standing Committee Legislative Assembly 2007).

Perceptions of risk: Port Pirie

i. Relationship to industry

In Port Pirie, the importance of the smelter to both the individual and the community was well recognised. The smelter was a major employer and both directly and indirectly, many Port Pirie residents owed their existence to the smelter (Maynard, Franks & Malcolm 2005). Hence many feared a close down of the smelter.

Management at the smelter was understandably wary of the implications of the findings of potential health effects of low level exposure to lead and thought that the problem had been overstated (Cornwall 1989). At that time the problem was believed to be one related to historical contamination of Port Pirie, rather than one arising from ongoing emissions from the smelter (Maynard et al. 2003). The smelter management was guarded in its approach as management was aware of the future of the smelter in the world market, where lead prices fluctuated. This influenced the amount of resources that could be committed to upgrading the smelter (Cornwall 1989). However, since 1984 the smelter has introduced substantial new fugitive emission controls and contributed to the State Government's lead decontamination program through the provision of laboratory analyses and disposal of contaminated materials (Maynard et al. 2005).

ii. Science

The uncertainty that is associated with the science in the process of assessing risk often leads to confusion, particularly as scientists or experts argue among themselves about the validity of the evidence. Indeed, substantial controversy surrounded the Port Pirie lead issue and among the scientists opinion about the

harmful effects of exposure to lower levels of lead was divided. For example, Needleman (1988, p. 738) concluded that “careful epidemiologic studies, which have controlled for the important confounders, have set the effect level at 10-15 micrograms/dL”. On the other hand, Pocock, Ashby and Smith (1987, p. 66) concluded that there was “no evidence to support the hypothesis that lead exposure as currently experienced by British children is of any relevance to their intellectual development”.

A key criticism of epidemiological research at that time was the issue of confounding. The effect of lead, if any, was considered to be subtle and blood lead levels were considered to reflect the confounding effects of other socioeconomic factors. Smith (1985) in a review of the literature concluded that:

body lead levels in children do to some extent act as a marker for socially disadvantageous factors, and that when these are controlled adequately, if there are any functional effects due to lead, then these are so small that they cannot be detected with any certainty, and they may not exist at all (Smith 1985, p. 678).

As a result scientists and members of the community argued that the money allocated to solving the lead problem in Port Pirie and elsewhere could have been more wisely spent on those aspects of the environment better known to have effects on childhood development (see, for example, Pocock, Smith & Baghurst 1994).

Within this context the decision makers took a precautionary approach, considering it inappropriate to wait for more conclusive evidence in order to take action (Wilson et al. 1986). The lead decontamination program commenced in 1984 and comprised four components: surveillance of blood leads in children; decontamination of houses in high risk areas; greening; and health promotion

(Calder & Collings 1989). The smelter also introduced several program to reduce the transfer of lead to the environment (Maynard et al. 2005).

iii. Length of residence

Concerns among the Port Pirie community were often raised by people who had recently moved into the area and who would be located there for a limited period of time. These residents were concerned about the impact of the very visible lead industry on their children’s health. However, not all of the community shared these concerns. They had invested their whole lives in the city and were, therefore, committed to the city. There was also the implication that they, having grown up in Port Pirie, were also affected. They resented the inference that Port Pirie residents were ‘less intelligent’ or that they had put their children at risk.

iv. Media

Many in the community resented the stigma of a dirty town that was attached to Port Pirie through its portrayal in the national media. Still as late as 2004, the mayor was quoted in *The Weekend Australian*, 18-19 September, as saying: “We’re not polluted, we’re an industrial city but we’re also a commercial city and a rural city. The media keep portraying us like we were at the turn of the century”. Local media on the other hand were very loyal to Port Pirie.

v. Control

The areas of highest risk in Port Pirie were those areas closest to the smelter and these were also the most socially disadvantaged areas of the city (Calder, Maynard & Heyworth 1994). Often people had little choice but to live in these areas because they were convenient to the workplace and to services such as transport, schools and shops. In addition, they contained the oldest and most affordable housing. The

people in these areas had limited control over their environment and lacked the power to change that environment.

vi. Economic environment

The period 1982 to 1984 was a time of economic downturn and high unemployment and it was not surprising that people were concerned first about their financial wellbeing, rather than a possible effect on their children's health, particularly as much scientific uncertainty surrounding the issue. As McMichael (1989, p. 15) points out, there is a "risk that communities - particularly when preoccupied by short-term threats of unemployment or disruption of a way of life - will disregard their own longer term environmental health issues". It is reasonable to assume that some members of the community would see the threat of unemployment as having a greater impact on the development of their child than would low level lead exposure.

vii. The political agenda

Port Pirie had been a traditional safe Labor seat, although there was one pro-labor independent in the 1970s. The then State Opposition Spokesman for Health had been particularly vocal in his views on the need for action on the lead pollution problem in Port Pirie. Hence, when there was a change of Government to Labor in 1982, the lead problem became prominent in the political agenda (Calder & Collings 1989). However, this led to substantial conflict between local and State governments. Local government was concerned about jeopardising its relationship with the city's major employer. It was also very aware that many of its ratepayers were unconvinced that a problem existed (Calder & Collings 1989). Indeed the Mayor, who was employed as the corporate affairs officer with BHAS, the smelter's operator, had been vocal in his lack of support for any action on the

lead issue (Cornwall 1989). For example, the Mayor was quoted in the *Weekend Australian*, 2-3 July 1983, "that Port Pirie is a very healthy city ... there is no real lead problem here ...".

viii. Trust in government departments

A number of authors argue that there has been a general decline in the trust of bureaucracies (Barnett, Cooper & Senior 2007; Brown 1989; Covello 1989; Nelkin 1985; Taylor-Gooby & Zinn 2006). While the South Australian Health Commission had the role of assessing the controversial scientific information and determining an appropriate course of action, much resentment was expressed by the many in the local community about the interference by the bureaucracies in Adelaide, who knew nothing about living in Port Pirie. Many residents on one hand considered the government's intervention "a waste of time and public money" (Maynard, Calder & Phipps 1993). On the other hand, a smaller group of residents were calling for action to reduce lead exposure. Those who participated in the government program often faced hostile reactions from other residents (Maynard et al. 1993). The Health Commission had the unenviable task of finding common ground between different interest groups.

There was much debate about the best course of action to reduce lead exposure, including the creation of a buffer around the smelter and wharf area. The final decision was to implement the lead decontamination program described above. This decision was determined not only by the science but was strongly influenced by the lack of acceptance of the health issue as well as the political environment. Because of the widespread lack of trust, the South Australian Health Commission established a shopfront in Port Pirie, the Environmental Health Centre. While the focus was on the lead issue they chose a broader name to try

and engage the community. They also encouraged employment of local residents; in particular the director of the Centre was a local person.

Perception of risk - Esperance

The lead issue in Esperance illustrates the difference between a defined period of lead dust pollution from a Port's practices versus ongoing lead dust generation and pollution at Port Pirie. Like Port Pirie it provides an example of the influence of both the characteristics and the social context of risk.

i Material benefit

The importance of the port of Esperance to both the individual and the community was recognised, but in contrast to Port Pirie it is not the dominant industry. In contrast to the Port Pirie workforce, a much smaller proportion of the population of Esperance were employed at the Port.

At the time of greatest angst, staff and families of the Esperance Port faced anger and on at least one occasion, spitting from residents. Many of the staff also had children and described the difficult nature of the dissonance between concern as a parent and working at the Port.

ii. Science

The toxicity of lead was well established with no safe threshold for lead for children being identified. Lanphear et al. (2005) collated data from seven international population-based prospective studies and found that a rise in blood lead from 2.4 to 10µg/dL was associated with an estimated IQ fall of 3.9 points. However, the relationship was non-linear with a greater decrease in IQ points in the lowest ranges of blood lead concentration. While there is some controversy surrounding opinion about the harmful effects of exposure to lower levels of lead, the increasing body of evidence regarding the possibility of more subtle effects of lead

levels below 10µg/dL on neurobehaviour and cognition is generally acknowledged (Canfield et al. 2003; Lanphear, Dietrich & Auinger 2000).

At the start of 2007, the WHO and US CDC were using an intervention level of 10µg/dL as the lowest blood lead concentration requiring intervention in children. The relevant Australian guidelines for lead in blood had been rescinded in 2005, but these also identified 10µg/dL as the lowest blood level requiring intervention (NHMRC 1993). No update has been released as yet. The lack of clear guidance from the federal government enhanced the confusion surrounding the issue.

As children are more susceptible to the adverse effects of lead (Manton et al. 2000; Woolf, Goldman & Bellinger 2007), an ongoing blood lead surveillance program was established in Esperance for children five years of age and under, and also pregnant women. Children five and under were included in the Esperance surveillance program because results from a prospective study in Boston showed blood lead levels at two years of age were more predictive of cognitive deficits than later blood lead concentrations (Woolf et al. 2007). Levels of concern for blood lead levels for pregnant females are 5µg/dL or greater (Gardella 2001). As a result a blood level of 5µg/dL was chosen as the action level by the Western Australian Department of Health to give a margin of safety that would ensure inclusion of those who would be at risk of nearing the WHO intervention level of 10µg/dL (Western Australian Government 2007).

Comparison of the general population lead data in Esperance (Table 2) with published data on recorded blood lead levels in other populations suggest there were not high levels in the population. The most recent Australian National blood lead survey in 1996 by the Australian Institute of Health and Welfare found a mean lead level of 5.8µg/dL in a random

sample of children – 93% recorded below 10µg/dL (Australian Institute of Health and Welfare 1996). The average blood lead level for Swedish children aged 7-11 years from 1995-2001 was 2.1µg/dL for children not living near industrial sources (Stromberg et al. 2003). The Esperance figure for 5-10 year olds is slightly higher at 2.4µg/dL.

iii. Length of residence

Concern in Esperance was raised across many sectors of the community, and included residents of long standing as well as more recent arrivals (Professor Alison Jones, personal communication, June 2008). Newcomers expressed the view that they had specifically chosen Esperance as a pristine location in which to live and work.

iv. Media

The focus of the media in Esperance was more on the role of government agencies and their perceived shortcomings. Local media were vocal on behalf of lead activist groups in the area, and the local member of parliament (a former general practitioner) was also active in media approaches. Examples of headlines included “Esperance lead pain ignored”; “Fearful mum a statistic” and “Officers face grilling over lead”. However, there was concern that the publicity regarding lead pollution would adversely affect tourism in Esperance.

v. Control

The areas of highest risk in Esperance were those areas closest to the Port and these are also higher socioeconomic areas, as well as being the most socially active areas of the town with many children’s playgrounds, and the Esperance foreshore. These people had had little control over their environment becoming polluted, but they had a greater voice than those affected in Port Pirie. In

addition, they could draw upon the experience of Port Pirie and other lead affected communities. The public pressure on this issue resulted in ceasing the shipping of lead carbonate and thus ongoing exposure was limited to that from lead that had already contaminated the environment. This is critically different from the exposure scenario in Port Pirie where the residents faced an ongoing exposure scenario from the point source.

A sense of personal control was important in Esperance, even though it was acknowledged that the Port activities were the source of the problem. As a result, parents were provided with advice as to what they and their families could do (Department of Health Western Australia 2007; Western Australian Government 2007). This included not drinking rainwater, undertaking wet dust mopping, and washing hands before eating.

vi. The political agenda

For the past 18 years, the Federal and State seats in which Esperance is located have been held by conservative parties. After the lead problem was identified, a Parliamentary enquiry was held to deal largely with issues of apparent delay in recognition of poisoning and lack of trust in the Port Authority and various government agencies (Western Australian Government 2007).

vii. Trust in government

The lead pollution in Esperance was characterised by high level of mistrust community members had for government agencies (Education and Health Standing Committee Legislative Assembly 2007; Jones 2009). There were a number of possible contributing factors to this, including lack of community knowledge about the Port exporting lead carbonate in the first place, contamination of a pristine environment and the time lag from first bird deaths until the problem was identified. During

the initial phases of the Esperance lead issue risk assessment and communication focused on a blood lead intervention level of 10µg/dL given current WHO and US CDC guidelines. In an attempt to provide reassurance, Australian data were used to make historical and recent comparisons. However, this failed to acknowledge and address more recent (and readily available) literature of probable effects at levels lower than 10µg/dL (Canfield et al. 2003; Lanphear et al. 2005).

A range of strategies were employed to communicate about risk with the Esperance community. This ranged from one to one discussion by phone, or in person with health professionals, a telephone information line, advertisements in local newspapers, a newsletter distributed to each household and community open days where each agency was represented. The mistrust of government agencies was such that an independent expert toxicologist was used for risk assessment and communication. Simple direct messages that acknowledged the fears raised by parents and provided an action plan, appeared to work best.

Discussion

The determination of what level of risk is acceptable to a particular society is made through a complicated process that involves the interaction of science, perceptions, risk communication strategies, values and different societal interests (Steensberg 1989). The examples of environmental lead issues in Port Pirie and Esperance illustrate on several fronts how risk is embedded in a social context, which in itself is dependent upon the time period in which the risk occurred. Whilst scientists assess risk objectively through a formal risk assessment process, their value judgements as to what level of risk is acceptable to society are probably no better than those of other citizens.

Indeed, the differing responses to these lead case studies exemplify this. In Port Pirie where the pollution was visible and the exposure of children apparent, there was not widespread community support for government intervention. On the other hand, in Esperance where the extent of pollution was less and exposure among children was also limited, the community demanded a prompt and active response from government. There was a much higher degree of outrage associated with what was seen as an unwarranted exposure in their community.

The circumstances of exposure affected the risk perception in many ways. In Esperance the Port quickly ceased shipping lead carbonate in response to public concern, but in Port Pirie, where there had been a long commitment to the lead industry and lead dust production, exposure continued. In Esperance, a much smaller percentage of the population had active engagement with the Port. In Port Pirie on one hand, the lead smelter was central to the economic welfare of that society (Maynard et al. 2005). Hence, the prevailing view of the community towards the lead industry was favourable and the health risk associated with the activity was judged to be low. On the other hand, in Esperance where the view was not favourable the risk was seen to outweigh any benefits of the lead industry.

A critical element of the social context of risk is the distribution of risk. The wealthier foreshore areas were most affected in Esperance and this sits in contrast to Port Pirie, where the poorest areas were most affected. Here the risk was predominantly borne by blue collar workers whose livelihoods were dependent on the smelter. Their response was to discount the risk because their history of connection with the smelter and Port Pirie had not led to any apparent health effects in themselves or their

children. The health impact of cognitive development was subtle and had no physical symptoms hence the community could see no proof of harm. Within Esperance the households affected were in the more wealthy areas of town and several householders were members of the lead action or other environment groups, or active in local or state government. They had limited connection to the Port and as this was a time of economic boom, there was little threat to their livelihood. Hence the Esperance community had a greater voice in expressing concern about the lead issue. In addition they expressed concern about the long term insidious effects of lead on their children.

In both communities trust in authorities was influential in the communities' response but led to differing responses. In Port Pirie, trust seemed to have been lessened as a result of the increased disillusionment with the regulatory environment; the lack of connection of state and federal governments with the community and the disagreements among experts about the health effects of lead. Lack of communication was a key feature in diminishing trust for the Esperance community. The lack of community awareness that approval had been given to ship lead out of Esperance led to considerable angst. The approval licence had included several conditions in order to minimise the potential for lead contamination, but these had neither been adhered to by the company nor were they policed (Education and Health Standing Committee 2007; Jones 2009). Added to this was the apparent lack of communication between government departments. The Department of Environment and Conservation had given approval with conditions, but the Department of Health appeared to have limited knowledge or input into this approval process (Education and Health Standing Committee 2007; Jones 2009).

It is not surprising that there were many differing responses to the lead issue in these two townships. McGee (1999) found that the response to contamination in the lead mining community of Broken Hill, New South Wales, was largely determined by whether people believed they were directly affected, for example, parents of young children, whereas former and current mine workers thought the contamination was an acceptable part of working and living in Broken Hill. Magill (1989, p. 51), in describing the village of Seascale, a village virtually entirely dependent on the Sellafield nuclear installation, also noted the striking differences in opinion amongst the community. She describes the village as:

Not in the grip of endemic fear; neither is it one in which there is little concern, expressed only by an insignificant, irresponsible or clueless minority, or where it is unanimously repressed by an employment conscious workforce. Rather there is a breadth and diversity in local 'risk attitudes' ...

Inevitably this leads to the difficulty of identifying the diverse range of opinions amongst the public and the inability to please everyone. The decision makers are left with the problem of deciding the criteria on which to act. That is, do they act for those who are most at risk, those with most at stake, those with the most adverse reaction, or those who are most politically dangerous.

Environmental health issues, in particular, have highlighted the shortcomings in evaluating risk as simply technical or scientific matters that can be resolved by more and better science. The science is essential, but decisions about toxic exposures often need to be made when there is a lack of information available on the effects of chronic, low level exposure to environmental pollutants. The neurocognitive impact of lead exposures, both historically and now

for levels below 10µg/dL is an example of this. Further, the uncertainties of scientific data, such as, inadequate data for low level exposure or extrapolation from high to low dose exposure or from animal to human, have led to divergent conclusions on the magnitude of risk. For example, much controversy surrounded the potential effects of low level exposure to lead in the early 1980s, when the lead issue in Port Pirie arose. Many scientists had considered the relationship between environmental lead exposure and intellectual development to be unproven, whereas others scientists considered the evidence sufficient to compel authorities to action. These different interpretations, in turn, led to questions about the objectivity of the risk assessment process.

There is often a lack of a common language between the scientists who interpret hazards and the worried non-experts, and this can create a barrier to

understanding. The traditional scientific experts' gauge of the extent of a local health problem may often fall short of residents' concerns and expectations and fail to take into account cultural and historical awareness (Reynolds 1989). Though these two groups differ, neither is necessarily wrong.

For both Esperance and Port Pirie the sense of place was important in determining the responses to the lead issues. The Esperance community saw itself as an idyllic rural community, with a sound economic basis and access to resources, but removed from the problems associated with city living. Port Pirie residents valued their long history associated with the lead industry. It was a pillar of the economy. The attention from outsiders was seen as unwarranted and unnecessarily portraying the city as a dirty, harmful place. The differing contexts influenced the responses to these two lead issues.

References

- Australian Bureau of Statistics 2001, *2001 Census QuickStats: Port Pirie City and Dists (M) (Local Government Area)*, <<http://www.censusdata.abs.gov.au/ABSNavigation/prenav/ViewData?producttype=QuickStats&subaction=-1&areacode=LGA46450&action=401&collection=Census&textversion=true&breadcrumb=WLP&period=2001&navmapdisplayed=false&>>, 3 July 2008.
- Australian Bureau of Statistics 2006, *2006 Census QuickStats: Esperance (Urban Centre/Locality)*, <<http://www.censusdata.abs.gov.au/ABSNavigation/prenav/LocationSearch?locationLastSearchTerm=Esperance&locationSearchTerm=Esperance&newarea=UCL508800&submitbutton=View+QuickStats+%3E&mapdisplay=on&collection=Census&period=2006&areacode=UCL508800&geography=&method=Place+of+Usual+Residence&productlabel=&producttype=QuickStats&topic=&navmapdisplayed=true&javascript=true&breadcrumb=PL&topholder=0&leftholder=0¤taction=104&action=401&textversion=false&subaction=1>>, 4 July 2008.
- Australian Institute of Health and Welfare 1996, 'Improving the health of Australians', *Australia's Health*, <<http://www.aihw.gov.au/publications/health/ah96/ah96-c03.html>>, 21 July 2008.
- Barnett, J., Cooper, H. & Senior, V. 2007, 'Belief in public efficacy, trust, and attitudes toward modern genetic science', *Risk Analysis* vol. 27 no. 4, pp. 921-33.
- Beecher, N., Harrison, E., Goldstein, N., McDaniel, M., Field, P. & Susskind, L. 2005, 'Risk perception, risk communication, and stakeholder involvement for biosolids management and research', *Journal of Environmental Quality*, vol. 34, no. 1, pp. 122-6.
- Bickerstaff, K. 2004, 'Risk perception research: Socio-cultural perspectives on the public experience of air pollution', *Environment International*, vol. 30, no. 6, pp. 827-40.
- Brown, J. 1989, 'Introduction: Approaches, tools and methods', *Environmental Threats Perception, Analysis and Management*, London, Belhaven Press.

- Calder, I.C. & Collings, M.T. 1989, 'The Port Pirie lead decontamination program', *Health Promotion: The Community Health Approach*, Proceedings of the 2nd National Conference of the Australian Community Health Association, ACHA, Sydney.
- Calder, I.C., Maynard, E.J. & Heyworth, J.S. 1994, 'Port Pirie Lead Abatement Program, 1992', *Environmental Geochemistry and Health*, vol. 16, nos 3/4, pp. 137-45.
- Canfield, R.L., Henderson, C.R. Jr., Cory-Slechta, D.A., Cox, C., Jusko, T.A. & Lanphear, B.P. 2003, 'Intellectual impairment in children with blood lead concentrations below 10 microg per deciliter', *New England Journal of Medicine*, vol. 348, no. 16, pp. 1517-26.
- Centers for Disease Control and Prevention 2005, *Preventing Lead Poisoning in Young Children*, CDC, Atlanta.
- Cornwall, J. 1989, *Just for the Record*, Wakefield Press, Adelaide.
- Covello, V.T. 1989, 'Communicating right-to-know information on chemical risks', *Environmental Science and Technology*, vol. 23, no. 12, pp. 1444-9.
- Department of Health Western Australia 2007, 'Managing possible lead dust in and around the home', <http://www.public.health.wa.gov.au/3/893/2/esperance_recov.pm>.
- Education and Health Standing Committee 2007, *Extent of Lead Pollution in the Esperance Area*, State Law Publisher, Perth.
- Education and Health Standing Committee, Legislative Assembly 2007, *Inquiry into the Cause and Extent of Lead Pollution in the Esperance Area*, Government Printer, State Law Publisher, Perth, Western Australia.
- Gardella, C. 2001, 'Lead exposure in pregnancy: A review of the literature and argument for routine prenatal screening', *Obstetrical and Gynaecological Survey*, vol. 56, no. 4, pp. 231-8.
- Heyworth, J.S., Calder, I., Roder, D., Baghurst, P. & McMichael, A. 1993, 'Evaluation of the Lead Decontamination Programme in the lead smelting town of Port Pire (South Australia)', *International Journal of Environmental Health Research* 3pp. 149-160.
- International Programme on Chemical Safety (WHO IPCS) 1995, *Inorganic lead: Environmental Health Criteria, No. 165*, World Health Organization, Geneva.
- Jones, A. 2009, 'Emerging aspects of lead poisoning in childhood', *Emerging Health Threats Review*, vol. 2, <doi: 10.3134/ehth.09.003>.
- Lanphear, B.P., Dietrich, K. & Auinger, P. 2000, 'Cognitive deficits associated with blood lead concentrations, 10microg/dL in US children and adolescents', *Public Health Reports*, vol. 115, no. 6, pp. 521-9.
- Lanphear, B.P., Hornung, R., Khoury, J., Yolton, K., Baghurst, P. & Bellinger, D.C. 2005, 'Low level environmental lead exposure and children's intellectual function: An international pooled analysis', *Environmental Health Perspectives*, vol. 113, pp. 894-9.
- Magill, S. 1989, *Risk perception and public: Insight from research around Sellafield*, Belhaven Press, London.
- Manton, W.I., Angle, C.R., Stanek, K.L., Reese, Y.R. & Kuehnemann, T.J. 2000, 'Acquisition and retention of lead by young children', *Environmental Research*, vol. 82, pp. 60-80.
- Maynard, E., Thomas, R., Simon, D., Phipps, C., Ward, C. & Calder, I. 2003, 'An evaluation of recent blood lead levels in Port Pirie, South Australia', *Science of the Total Environment*, vol. 303, nos 1-2, pp. 25-33.
- Maynard, E.J., Calder, I.C. & Phipps, C.V. 1993, *The Port Pirie Lead Implementation Program: A Review of Progress and Consideration of Future Directions (1984-1993)*, South Australian Health Commission, Adelaide.
- Maynard, E.J., Franks, L.J. & Malcolm, M.S. 2005, *The Port Pire Lead Implementation Program: Future Focus and Directions*, Department of Health, Government of South Australia, Adelaide.
- McGee, T. 1999, 'Private responses and Individual action: Community responses to chronic environmental lead exposure', *Environment and Behavior*, vol. 31, pp. 66-83.
- McMichael, A.J. 1989, 'Setting environmental exposure standards: The role of the epidemiologist', *International Journal of Epidemiology*, vol. 18, no. 1, pp. 10-6.
- Needleman, H.L. 1988, 'The persistent threat of lead: Medical and sociological issues', *Current Problems in Pediatrics*, vol. 18, no. 12, pp. 697-744.
- Nelkin, D. 1985, *Introduction: Analysing risk*, Sage Publications Inc., Beverley Hills.

- National Health and Medical Research Council (NHMRC) 1993, *Revision of the Australian Guidelines for Lead in Blood and Lead in Ambient Air* (rescinded).
- Pocock, S.J., Ashby, D. & Smith, M.A. 1987, 'Lead exposure and children's intellectual performance', *International Journal of Epidemiology*, vol. 16, no. 1, pp. 57-67.
- Pocock, S. J., Smith, M. & Baghurst, P. 1994, 'Environmental lead and children's intelligence: A systematic review of the epidemiological evidence', *British Medical Journal*, vol. 309, no. 6963, pp. 1189-97.
- Reynolds, C. 1989, Editorial. 'Legislation and the new public health: Introduction', *Community Health Studies*, vol. 13, no. 4, pp. 397-402.
- Slovic, P., Finucane, M.L., Peters, E. & MacGregor, D.G. 2004, 'Risk as analysis and risk as feelings: Some thoughts about affect, reason, risk and rationality', *Risk Analysis*, vol. 24, no. 2, pp. 311-22.
- Smith, M.A. 1985, 'Intellectual and behavioural consequences of low level lead exposure: A review of recent studies', *Clinics in Endocrinology & Metabolism*, vol. 14, no. 3, pp. 657-80.
- Steensberg, J. 1989, 'Environmental health decision making: The politics of disease prevention', *Scandinavian Journal of Social Medicine*, Suppl. 42, Parts 3 & 4, pp. 121-295.
- Stromberg, U., Lundh, T., Schutz, A. & Skerfving, S. 2003, 'Yearly measurements of blood lead in Swedish children since 1978; An update focusing on the petrol lead free period 1995-2001', *Occupational and Environmental Medicine*, vol. 60, no. 5, pp. 370-2.
- Taylor-Gooby, P. & Zinn, J.O. 2006, 'Current directions in risk research: New Developments in psychology and sociology', *Risk Analysis*, vol. 26, no. 2, pp. 397-411.
- Western Australian Government 2007, *Response of the Western Australian Government to the Western Australian Legislative Assembly Education and Health Standing Committee in Relation to the Cause and Extent of Lead Pollution in the Esperance Area*, Government of Western Australia, Perth.
- Wilson, D., Esterman, A., Lewis, M., Roder, D. & Calder, I. 1986). 'Children's blood lead levels in the lead smelting town of Port Pirie, South Australia', *Archives of Environmental Health*, vol. 41, no. 4, pp. 245-50.
- Woolf, A.D., Goldman, R. & Bellinger, D.C. 2007, 'Update on the clinical management of childhood lead poisoning', *Pediatric Clinics of North America*, vol. 54, no. 2, pp. viii, 271-94.

Correspondence to:

Jane Heyworth
School of Population Health
Faculty of Medicine, Dentistry and Health Sciences
The University of Western Australia
35 Stirling Highway
Crawley, Western Australia, 6009
AUSTRALIA
Email: jane.heyworth@uwa.edu.au