



In the orchard: Farm worker children's moral and environmental reasoning

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ABSTRACT

In this study, farm worker children ($N = 40$) in 2nd and 5th grade were interviewed about (a) their conceptions and judgments of pesticide exposure and (b) their reasoning about the moral standing of nature. First, results showed that all participants negatively judged pesticide exposure based on moral obligatory criteria. Yet, most children accepted pesticide use in the orchards where they lived. Their reasoning was either based on assumptions that certain practices eliminated potential harms or coordination of potential physical harms with concerns for financial security. Second, participants expressed biocentric considerations (wherein nature is accorded moral standing) when reasoning about harms to nature. The results provide evidence of biocentric reasoning earlier than previously shown in the developmental literature, and indicate a developmental shift in the form of biocentric reasoning. Finally, the results offer support of a new methodology for disentangling human considerations from environmental moral reasoning.

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Introduction

There is increasing evidence that experience with the natural environment plays a critical role in children's physical, emotional, intellectual, and moral development (Kahn & Kellert, 2002; Karpiak & Baril, 2008; Melson, 2001; Myers, 2007; Wilson, 1984). However, many natural environments are compromised due to toxic chemicals and other pollutants (Bullard, 1990; Wals, 1994). Farm worker children face a particular form of the resulting problem. Namely, while the orchard provides farm worker children with a wonderful opportunity for direct experiences in nature, the orchard also exposes them to comparatively high levels of harmful pesticides. Thus, the purpose of this study was to investigate farm worker children's reasoning about this problem. In turn, this investigation aimed (a) to advance basic research on the development of children's environmental moral reasoning, (b) to apply moral-developmental theory to real-life contexts with moral import, and (c) to help give voice to a particularly understudied and vulnerable population.

Four specific questions structured this study. First, do farm worker children as young as seven years old understand that they live around pesticides, and that those pesticides can cause harms to humans and nature? Research has indicated that farm worker children are exposed to pesticides at rates 3–9 times higher than non-agricultural children living in the same areas (Arcury, Grzywacz, Davis, Barr & Quandt, 2006; Fenske, Lu, Barr & Needham, 2002; Loewenherz, Fenske, Simcox, Bellamy & Kalman, 1997). Moreover, this rate of exposure far exceeds the maximum exposure levels established to minimize

human health risks (Arcury et al., 2006; Fenske et al., 2000, 2002; Loewenherz et al., 1997). While the risks associated with pesticide exposure are well established (Dilworth-Bart & Moore, 2006; Koger, Schettler and Weiss, 2005; McCauley et al., 2006; Sanborn et al., 2004), relatively little research exists about how farm workers, let alone their children, understand these risks. The research that does exist suggests that farm workers often underestimate the potential risks (Arcury, Quandt & Russell, 2002; Elmore & Arcury, 2001; Quandt, Arcury, Austin & Saavedra, 1998). For example, Arcury and colleagues found a surprising proportion (20–30%) of farm workers did not believe that pesticides posed a significant risk to themselves or their children (Arcury, Quandt & Russell, 2002).

In light of the risks associated with pesticide exposure in farm worker children, it is important to know their understanding of pesticides and the associated risks. Research in related domains suggests it is possible that farm worker children may be aware of the potential harms. For example, children understand that oil spills and pollution cause threats to human and environmental health (Kahn, 1997; Kahn & Friedman, 1995), suggesting that harms from toxins are well within the realm of children's understanding. In the present study, we expected that the farm worker children would be able to describe what pesticides are and be aware that pesticides are used in the orchards. In line with previous research on children's understanding of harms from environmental pollutants, we expected that farm worker children would recognize that pesticides could harm people and nature, even if they did not believe that they themselves were subject to these harms. Moreover, it was expected that children would care that such harms might occur.

If farm worker children are aware of the potential harms from pesticides, do they bring moral judgments to bear in reasoning about pesticide exposure? To address this second question, the study drew

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on the social-domain literature in moral development that distinguishes moral issues from those that are personal or conventional (Nucci, 1981; Smetana, 1985, 1995; Turiel, 1983, 1998; Turiel & Davidson, 1986; for a review see Helwig & Turiel, 2002; Smetana, 2006). The moral domain refers to obligatory judgments that are prescriptive, generalizable across relevant contexts, not contingent on rules or conventions, and based on justifications of fairness, rights, and welfare. In contrast, the conventional domain refers to contextually or culturally relative judgments that are contingent on rules or authority, and are based on justifications of shared practices that coordinate the functioning of social systems. Whereas, the personal domain refers to judgments based on personal predilections and interests. Researchers have consistently found that children apply moral criteria when reasoning about harmful or unjust acts perpetrated against individuals or groups (Helwig & Turiel, 2002; Killen, 1990; Smetana, 1981, 1985, 2006; Smetana, Schlagman & Adams, 1993; Turiel, 1983, 1998, 2002; Turiel & Davidson, 1986; Wainryb, 1991). Children apply the same moral reasoning when making judgments about harms caused by environmental pollutants (Howe, Kahn & Friedman, 1996; Kahn, 1997; Kahn & Friedman, 1995; Kahn & Lourenço, 2002). Thus, consistent with the above research, we expected that children would reason that pesticide exposure was wrong based on the above moral criteria.

But if that is the case, how do these children reconcile that they live in an orchard that exposes them to harmful pesticides? Here we sought to explore farm worker children's judgments and reasoning about pesticide use in the orchards where they live. Real-life contexts are typically less straightforward than hypothetical scenarios and children's reasoning, and resultant judgments, often reflect the multiple concerns present in actual situations (Smetana, 2006; Turiel, 2002, 2008; Wainryb, Brehl & Matwin, 2005). As a result, judgments and reasoning about actual contexts may differ from those provided in hypothetical contexts. For example, Turiel (2008) found that children (grades 1, 3, 5, and 7) provided more negative judgments about hypothetical moral situations than actual moral events. Thus, in the present study, while we expected that farm worker children would negatively judge hypothetical scenarios involving exposure to pesticides, it was unclear whether and to what extent these concerns would bear on their reasoning about actual pesticides use.

To address this issue, we first explored whether farm worker children understood the potential risk for pesticide exposure by inquiring about their practices when pesticide were being used and their understanding for why they engaged in these practices. In line with previous findings that farm workers tend to underestimate the potential harms from pesticides (Arcury, Quandt & Russell, 2002; Elmore & Arcury, 2001; Quandt, Arcury, Austin & Saavedra, 1998), we expected that farm worker children would similarly underestimate their risk. We then sought their judgments about actual pesticide use in the context of their immediate orchard environment. This issue was largely exploratory and, as such, we were particularly interested in the various considerations that farm worker children brought forth when making judgments about actual pesticide use. Finally, we explored the correspondence of their judgments about actual pesticide use and pesticide exposure. Our expectation was that judgments about pesticides would change when situated in the context of the orchard environment compared with the more straightforward hypothetical pesticide exposure.

The final question builds from a central and consistent finding by Kahn and his colleagues who found evidence cross-culturally for two overarching forms of children's environmental moral reasoning (Howe, Kahn & Friedman, 1996; Kahn, 1997, 1999; Kahn & Friedman, 1995; Kahn & Lourenço, 2002). One form is based primarily on anthropocentric (or human-centered) considerations of personal interest, aesthetics, and human welfare. For example, when asked if it is all right or not all right to throw garbage in the river, one child said, "[It's not all right] because some people that don't have homes,

they go and drink out of the rivers and stuff and they could die because they get all of that dirt and stuff inside of their bodies" (Kahn & Friedman, 1995, p. 1412). A second form is based on biocentric considerations, wherein nature is accorded moral standing independent of its value to humans. For example, another child said that is not all right to throw garbage into the river because "fishes, they want to live freely, just like we live freely, they have to live in freedom, because they don't like living in an environment where there is so much pollution that they die every day" (Kahn & Friedman, 1995, p. 1412). Kahn and colleagues found that a small percentage (approximately 4% across studies) of children used biocentric reasoning and there was little empirical evidence that it appeared in children younger than 10 to 12 years old (Kahn, Severson & Ruckert, 2009). Based on these results, it would seem that children are almost exclusively concerned with the human impacts that result from harms to the environment, rather than a concern for nature in and of itself. Yet, this latter conclusion is inconsistent with previous research suggesting that, from an early age, children care for a wide range of animals. For example, Myers (2007) observed that children as young as 3 years old form caring relationships with animals. While children certainly benefit from relationships with animals, especially in terms of companionship (Covert, Whirren, Keith & Nelson, 1985; Melson, 2001), it is thought they are also based on children's concern for the animals' well being rather than primarily on self-interest (Myers, 2007; Myers & Saunders, 2002). Thus, Kahn and colleagues' (Howe, Kahn & Friedman, 1996; Kahn & Friedman, 1995; Kahn & Lourenço, 2002) previous findings may have been an artifact of the way the questions were asked—namely, that the scenarios involved humans and potentially, in children's resulting coordination of judgments, pulled for anthropocentric reasoning.

Thus, the fourth question of this study asked whether young children have a biocentric orientation when reasoning about harms to nature that has not yet been recognized in the developmental literature? To investigate this question, a new methodology was developed that explicitly sought to disentangle human considerations from nature considerations. The method entails a story about aliens that come to earth, but there are no humans on earth. The aliens then commit a series of harms to natural constituents, including pets, wild animals, orchards, and forests. In answering questions about the resulting harms, it was expected that even the 7-year-old children would provide evidence for a biocentric orientation to the natural world.

In summary, this study sought to address four questions. First, do farm worker children understand the potential for harm from pesticides and, if so, do they care if such harms occurred? Second, do these children bring moral judgments to bear when reasoning about pesticide exposure? Our third question explores a difficult issue—that pesticides are routinely used in the place where they live—and asks for farm worker children's judgments and reasoning about such pesticide use. Finally, do farm worker children have a biocentric orientation, wherein nature is accorded moral standing, when reasoning about harms to the natural world?

Method

Participants

Forty farm worker children participated in this study, evenly divided across two grade levels: second grade ($M = 7.9$ years, range = 7.4 to 8.6) and fifth grade ($M = 10.6$ years, range = 9.11 to 11.4). There were equal numbers of males and females in each age group. Farm worker children were defined as those children who lived on or next to an orchard (within approximately $\frac{1}{4}$ mile), and whose parent(s) worked in the orchard. A majority of the children (92%) were children of seasonal farm workers, meaning that their parents worked seasonally in the orchard, but lived on or near the orchard year-round, while 8% were children of migrant farm workers. Eighty-five percent of

participants volunteered information about their ethnicity. Of those, 71% self-identified their ethnicity as Hispanic and 29% as White/Non-Hispanic. Participants were recruited from public schools, a community health clinic, and an English-as-a-second language program in Chelan and Douglas Counties, Washington. Parents of participating children provided written informed consent and participants provided verbal assent. Participants were paid \$20 for their participation, an amount commensurate with other research conducted with this population.

Procedure and measures

Participants were individually administered a 30-minute semi-structured interview (see Helwig, 1995; Kahn, 1999; Killen, 1990; Piaget, 1929/1960). The interview focused on four central areas: understanding and values about potential harms from pesticides, moral judgments about the pesticide exposure, reasoning about pesticide use in the orchard where the children live, and the development of biocentric reasoning (see Appendix A for the complete interview protocol). The interviews were conducted in English, as all participants were proficient in English. All interviews were audio-recorded and later transcribed for analysis.

Experience in the orchard

Participants were first asked about their background experiences in the orchard (e.g., Do you live on or next to an orchard? How long have you lived there? What types of things do you like to do in the orchard?). The interview questions then turned to the four areas under investigation.

Understanding and values about potential harms from pesticides

The first area explored participants' understanding of pesticides, and the potential for harm to humans and nature from pesticides. Participants were asked about their personal experience with pesticides (e.g., Have you ever seen pesticides being sprayed?) and their general understanding of pesticides (e.g., Do you know what pesticides are? Why do you think people use pesticides—what good do they do?). In addition, they were asked about their understanding of harms from pesticides, both generally and to humans and nature (e.g., Do you think using pesticides is at all harmful? Do you think that pesticides harm or do not harm [insects, birds, water, nature, people]?). For each of these questions in which harm was identified, children were further asked whether it mattered to them if such harm occurred (e.g., Does it matter to you that birds are harmed by pesticides?), as it is possible to recognize harm without caring that it has occurred (e.g., killing a mosquito that is trying to bite you).

Moral judgments about pesticide exposure

The second area explored whether farm worker children brought moral judgments to bear in reasoning about pesticide exposure. The assessment of moral obligation drew upon social-domain theory (Helwig, 1995, 1998; Killen, 1990; Turiel, 1983), wherein a moral obligatory judgment is prescriptive, generalizable across relevant contexts, not contingent on rules, authority, or cultural practices, and based on justifications of fairness, rights, and/or others' welfare. Correspondingly, one question focused on whether pesticide exposure was viewed prescriptively (e.g., Is it all right or not all right for one person to go into the orchard while someone else is spraying pesticides?). A second question focused on whether the initial judgment generalized across contexts where the society legitimated the practice (e.g., Let's say that in X [named by the child as a faraway place that s/he had never been to] most people do go into orchards while pesticides are being sprayed. In X is it all right or not all right for a person to go into the orchard while pesticides were being sprayed?). A third question focused on whether participants endorsed legal protection against pesticide exposure (e.g., Should there be a law

against a person going into the orchard while someone else is spraying pesticides?). For each of these three questions, participants were asked to provide justifications for their responses (e.g., Why or why not?).

Reasoning about pesticide use

The third area explored how farm worker children reasoned about pesticide use. We explored whether farm worker children understood the potential risk for pesticide exposure by asking about their practices when pesticides were being used and their understanding for why they engaged in these practices (e.g., What do you and your family do when pesticides are being sprayed in the orchard where you live? Why do you think you do those things?). We also sought their judgment and reasoning about actual pesticide use in the context of their orchard (e.g., Is it all right or not all right for pesticides to be used in the orchard where you live? Why or why not?).

Development of biocentric reasoning

The fourth area focused on biocentric reasoning, wherein nature is extended moral standing independent of its value to humans. To this end, a series of questions were developed—the “Alien Questions”—that made use of a story in which aliens came to earth, but there were no humans on earth. The aliens then committed a series of harms to natural constituents, including harm to pets, wild animals, orchards, and forests (e.g., The aliens see all the wild animals that live on Earth, but they don't like the wild animals, so the aliens kill all of the wild animals. Do you think it is all right or not all right for the aliens to kill all of the wild animals? Why or why not?). These questions sought to explore participants' conceptions of the moral standing of nature and, in particular, potentially earlier existence of biocentric reasoning. As a comparison to the Alien Questions, children were asked to judge pesticide exposure in a scenario that did not separate human interests from environmental concerns (e.g., Do you think it is all right or not all right for one person to pour some left over pesticides into the irrigation ditch? Why or why not?). Children's reasoning about the latter question, if different from their reasoning for the Alien Questions, would provide an indication of whether the Alien Question methodology successfully disentangled human interests from environmental moral reasoning in order to assess biocentric reasoning.

Coding and reliability

A coding manual was developed from a random selection of half of the interviews, a total of 20 children with 10 from each age group. The coding manual was then applied to the entire data set in order to code the participants' responses. Across the four areas under investigations, three types of responses were coded: (1) content responses (e.g., types of uses for pesticides), (2) evaluative responses (e.g., all right/not all right, yes/no), and (3) justifications for evaluative response (e.g., reasons why it is all right/not all right). Portions of the justification coding system drew upon previous coding manuals on children's social and moral judgments about the natural world (Kahn & Lourenço, 2002) and the computational world (Kahn, Friedman, Freier & Severson, 2003). Multiple justifications were coded. Summary descriptions of the justification coding system are presented in Table 1, along with examples. Inter-coder reliability was assessed using Cohen's kappa. For content responses, $\kappa = .86$, for evaluative responses, $\kappa = .94$, and for justifications at the level reported in Table 1, $\kappa = .78$, all of which are considered excellent agreement (Fleiss, Levin & Paik, 2003). Two commonly referenced benchmarks for interpreting the values of Cohen's kappa are Fleiss, Levin, and Paik (2003), who rate any value of kappa over 0.75 as “excellent” agreement, between 0.40 and 0.75 as “intermediate to good”, and below 0.40 as “poor,” and Landis and Koch (1977), who rate a kappa of 0.81 to 1.00 as “almost perfect” and between 0.61 and 0.80 as “substantial” agreement.

Table 1
Summary of justification coding categories.

Category	Definition
Effects on nature	An appeal to effects on nature, including animals, vegetation, non-living parts of nature, species, and natural processes, <i>without</i> specifying whether those effects led to anthropocentric or biocentric considerations.
No harm to nature	An appeal to the absence of harm to nature. Reasoning is based on a concept of welfare, but specifies that harm has not occurred (e.g., “because our landlord is careful about the hummingbirds and if he comes to spray and he sees all the hummingbirds flying over there then he’ll just leave and won’t spray”).
Harm to nature	An appeal based on harm to nature. Reasoning is based on a concept of welfare, and describes the occurrence of a harm (e.g., “it can hurt birds that eat pesticides”).
Benefit to nature	An appeal based on the benefits to nature (e.g., “because [pesticides are for] the trees, so the trees grow and they would have cherries”).
Anthropocentric	An appeal based on considerations of effects on humans.
Punishment avoidance	An appeal based on punishment or its avoidance, including in the form of legal action (e.g., “[they] might go in jail”).
Personal interests	An appeal based on personal predilections, interests, and projects of self and others (e.g., “because people like fish... they’re cool to watch them spawn and stuff”).
Welfare	An appeal based on individuals’ and others’ physical welfare (e.g., “it might kill us”), material welfare (e.g., “they will go right to the cities where they sell ‘em [in] stores”), psychological welfare (e.g., “that makes me really sad”), and societal welfare (e.g., “what if all the people in the world do that? The sickness starts, and then all the people in the world would be sick”).
No harm to humans	An appeal based on the absence of harm to humans, including harm to individuals and others (e.g., “everybody gets in their houses really quick so nobody could get hurt”).
Justice	An appeal based on a concept that humans have rights, deserve respect, fair treatment, ownership of property, and/or merit freedom (e.g., “Shouldn’t be [a law because] I have to drive in a orchard to get to my house”).
Aesthetics	An appeal based on the preservation of the environment for the viewing or, more broadly, sensorial pleasure of humans (e.g., “people just wouldn’t come there anymore cause most of the attraction is when the fish came to Icicle waters”).
Biocentric	An appeal to the moral standing of nature independent of its value to humans.
Intrinsic value	An appeal that nature has value, the validity of which is not derived solely from human interests, and it is in the form of value for the welfare of biological life (e.g., “they’re living things, so they shouldn’t be killed”), value of natural processes (e.g., “they all die then the life cycle won’t be working that much”), and teleology of nature (e.g., “they’re meant to grow and just stay alive as long as they can”).
Harmony	An appeal based on a conception of harmony between humans and nature that is relational, in terms of psychological rapport or preservation, or compositional, in terms of balance with nature.
Justice	An appeal that nature deserves respect or fair treatment (e.g., “they were here first, they deserve to be treated the way [they] were treated before the aliens came”), has rights (e.g., “the animal they have derechos [rights] ...they have to live”), and/or merits freedom (e.g., “the animals are meant to live and be free and run around”).
Analogical	An appeal based on the recognition of a correspondence between humans and other natural biological and non-biological entities (e.g., “because the animals they have life like the human”).

Results

Nonparametric tests were used to test statistical significance of the categorical data, as reported. The Bonferonni approach was used to adjust for multiple comparisons. No sex differences were found, thus the data were collapsed across sex. Age differences were found where reported.

Experience in the orchard

All of the participants (100%) lived on or next to an orchard (within ¼ mile). When asked about their favorite experiences in the

orchard, 58% of participants reported engaging in adventure and play (e.g., playing hide-and-seek or riding bikes), 18% sought out physical comfort (e.g., relaxing in the tree’s shade), 10% explored the natural environment and wildlife (e.g., looking for deer), 8% cared for the natural environment and wildlife (e.g., providing food for hummingbirds), 5% helped their family work (e.g., turning on sprinklers), 5% spent time alone, and 3% appreciated the aesthetics of the orchard and surrounding natural environment.

Understanding and values about potential harms from pesticides

As expected, all of the participants (100%, $N = 40$, $Z = 6.32$, $p < .001$) could describe what pesticides were and all but one participant (98%, $N = 40$, $Z = 5.85$, $p < .001$) could recall having previously seen pesticides sprayed in the orchard. When asked to explain why pesticides are used, participants reported pesticides helped the trees and fruit grow (55%), deterred insects or other pests (30%), and killed insects or other pests (18%). In line with our expectations, a significant majority of participants (77%, $N = 39$, $Z = 3.36$, $p < .001$) judged that, in general, pesticides could cause harm. Table 2 reports participants’ judgments about whether pesticides could harm specific constituents and, for those participants who identified a potential for harm, whether it mattered to them if that harm occurred.

Moral judgments about pesticide exposure

Consistent with our expectations, all participants (100%, $N = 40$, $Z = 6.32$, $p < .001$) judged that it was not all right for pesticide exposure to occur in the orchards where they lived (prescriptive act evaluation). Negative judgments of pesticide exposure were maintained even in far away countries where cultural conventions permitted exposure (100%, $N = 39$, $Z = 6.24$, $p < .001$) (generalized judgment, not contingent on cultural practice). Participants’ justifications are presented in Table 3. Across the two scenario questions, a vast majority of participants reasoned that pesticide exposure was not all right based on moral considerations (moral justification). Specifically, for the prescriptive act evaluation, a McNemar (exact) test revealed that negative (not all right) judgments about pesticide exposure were based on moral considerations of human physical welfare significantly more than concerns for punishment ($N = 39$, $\chi^2 = 34.00$, $p < .001$). Similarly for the generalizability question, Cochran’s Q test indicated that participants reasoned that pesticide exposure in a faraway place was not all right based on moral considerations of human physical welfare than either concerns for punishment or personal interests ($N = 39$, $Q = 50.581$, $p < .001$). Uncodable responses, missing data, and categories with low overall frequency (<4%) were not included in these or subsequent justification analyses.

We then assessed participants’ conceptions of moral obligation based on social-domain theory’s moral criteria of prescriptivity, generalizability, non-contingency on cultural practice, and moral justifications (Smetana, 1985; Turiel, 1983; Turiel & Davidson, 1986). The results showed that the majority of participants established that pesticide exposure was not all right based on moral obligatory criteria (84.6%, $N = 39$, $Z = 4.17$, $p < .001$). In addition, participants were

Table 2
Participants’ understanding and values about potential for harm from pesticides.

	Affirmed potential for harm from pesticides to			If harm affirmed, mattered if harm occurred to		
	% (N)	Z	p	% (N)	Z	p
People	88 (40)	4.74	<.001	100 (35)	5.92	<.001
Insects	88 (40)	4.74	<.001	38 (32)	1.41	ns
Birds	51 (39)	0.16	ns	82 (17)	2.67	ns
Water	56 (39)	0.80	ns	100 (22)	4.69	<.001
Nature	70 (40)	2.53	ns	86 (28)	3.78	<.001

Table 3
Percentages of justifications by category.

Justification category	Moral judgments about pesticide exposure			Reasoning about pesticide use	Development of biocentric reasoning						
	Not all right for someone to be exposed to pesticides		Endorsed legal protection against exposure (N = 27)	All right for pesticides to be used (N = 31)	Not all right for aliens to harm					Not all right to pour pesticides into irrigation canal (N = 37)	
	Act eval. (N = 40)	Generaliz. (N = 39)			Pets (N = 30)	Wild Animals (N = 32)	Orchards (N = 31)	Forests (N = 33)	Combined (N = 37)		
Effects on nature											
No harm to nature	0	0	0	9.7	0	0	0	0	0	0	0
Harm to nature	0	5.1	3.7	0	0	0	0	0	0	0	18.9
Benefit to nature	0	0	0	29.0	0	0	0	0	0	0	0
Anthropocentric											
Punishment avoidance	12.5	5.1	3.7	0	0	0	0	0	0	0	0
Personal interest	0	0	0	3.2	0	0	0	0	0	0	8.2
Welfare											
Physical	97.5	84.6	74.1	3.2	0	0	0	0	0	0	86.5
Material	0	0	0	19.4	0	0	0	0	0	0	0
Psychological	0	0	3.7	0	0	0	0	0	0	0	0
No physical harm	0	0	3.7	32.3	0	0	0	0	0	0	0
Justice	0	0	3.7	0	0	0	0	0	0	0	2.7
Aesthetics	0	0	0	0	0	0	0	0	0	0	2.7
Biocentric											
Intrinsic value	0	0	0	0	40.0	68.8	77.4	84.8	94.6	5.4	0
Harmony	0	0	0	0	3.3	0	3.2	0	8.1	0	0
Justice	0	0	0	0	36.7	34.4	0	3.0	40.5	2.7	0
Analogical	0	0	0	0	6.7	6.3	0	0	8.1	0	0
Uncodable	0	7.7	3.7	3.2	3.3	3.1	9.7	3.0	16.2	0	0
I don't know	2.5	2.6	7.4	9.7	13.3	3.1	6.5	6.1	18.9	0	0

Note. Act Eval. = Act evaluation in child's orchard; Generaliz. = Generalizability in a far away orchard. Uncodable responses did not fit within an existing category. Percentages do not always equal 100% as multiple justifications were possible.

asked if they thought that a legal solution was necessary to protect against pesticide exposure. Two-thirds of participants believed that there should be a law (68%, $N = 39$, $Z = 2.08$, $p < .05$) in large part to protect people's physical wellbeing (see Table 3). A logistic regression was used to test if ethnicity predicted participants' judgments in support of a law against pesticide exposure. The result showed that ethnicity was a significant predictor of affirmative judgments about the need for a law, where Hispanic participants were significantly more likely than non-Hispanic participants to judge that a law was necessary to protect against pesticide exposure (Odds ratio = 9.3, $\chi^2 = 6.313$, $p < .05$).

Reasoning about pesticide use

We first explored farm worker children's understanding of the potential risk for pesticide exposure by assessing their practices, and particularly their reasoning for these practices, when pesticides were used. All participants (100%, $N = 40$, $Z = 6.32$, $p < .001$) reported that they and their family routinely engaged in certain practices, such as staying inside their house (93%) and/or leaving the orchard altogether (20%), when pesticides were sprayed. The rationales for these practices were primarily related to mitigating exposure to pesticides (85%, $N = 40$, $Z = 4.27$, $p < .001$). Fifty-eight percent of participants made a general statement that these practices were done for one's physical wellbeing, but did not specify whether they believed the practices were successful in ensuring their wellbeing. Whereas an additional 28% of participants made a specific statement that these practices eliminated harm from pesticides (e.g., "because the spray doesn't get inside of the house so it, so because there's clean air in the house"). Contrary to our expectations, these results suggest that farm worker children were aware of the potential for harm to themselves from pesticides and actively sought to reduce their exposure.

When participants were asked for an overall judgment about pesticide use in the orchards where they lived, 84% of participants positively accepted pesticide use ($N = 37$, $Z = 4.11$, $p < .001$).

McNemar's (exact) test was used to test for differences between participants' judgments about pesticide use and their earlier judgments about pesticide exposure. The results indicated that significantly more participants made negative judgments about hypothetical pesticide exposure (100%) than about actual pesticide use (16%) ($N = 37$, $\chi^2 = 31.00$, $p < .001$). Thus, farm worker children more harshly judged exposure to pesticides, yet more readily accepted pesticide use in the orchards where they live.

As reported in Table 3, their acceptance of pesticide use was primarily based on at least one of three forms of reasoning. Some participants reasoned that there was no harm to people when pesticides were used as certain practices, such as staying inside the house, eliminated the potential for harm. For example, one participant indicated that, "I get inside the house and just stay inside until they stop spraying...So I don't get sick cause you might get sick, really sick and die and you might not by getting in...cause it's it's like walls protecting you." Another form of reasoning used by participants was based on claims to material welfare; that is, that using pesticides provided for jobs or better crops that yielded income. Along these lines, one participant accepted pesticide use "so that we won't, me and my family, won't get hungry [because] they usually pay my dad." Still other participants indicated that pesticides were beneficial to the orchard trees and fruit, but did not specify whether those effects led to anthropocentric or biocentric considerations. While only a minority of participants (16%, $N = 37$, $Z = 4.11$, $p < .001$) judged that it was not all right to use pesticides in their orchards, their reasoning was consistently based on concern for harm from pesticides due, in part, to their families' proximity to the orchard. As one participant said, "we live next to it, cause we live right there...it might go in through our house and someone might breathe it in."

Development of biocentric reasoning

The Alien Questions examined participants' judgments of the moral standing of nature and, in particular, assessed the development

of biocentric reasoning, wherein nature is accorded moral standing independent of its value to humans. A significant majority of participants negatively evaluated aliens harming pets (75%, $N = 40$, $Z = 3.16$, $p < .01$), wild animals (82%, $N = 39$, $Z = 4.00$, $p < .001$), orchards (78%, $N = 40$, $Z = 3.47$, $p < .001$), and forests (87%, $N = 38$, $Z = 4.54$, $p < .001$). Averaged across the four natural constituents, 79% of participants negatively judged harms to nature ($SD = .31$). In addition, nearly all of the participants (95%, $N = 40$) provided a 'not all right' evaluation to at least one of the Alien Questions. As reported in Table 3, participants justified their negative evaluations of the aliens' harms to nature based on biocentric considerations.

A developmental shift in biocentrism was assessed for the two primary justification categories used in accord with the Alien Questions: intrinsic value of nature and justice. To assess statistical differences between these two categories, each participants' justifications were collapsed to the highest categorical level such that multiple sub-category justifications were only counted once after collapsing. The main developmental finding for the Alien Questions centered on biocentric reasoning based on conceptions of justice, with fifth-grade participants significantly more likely than second-grade participants to use reasoning based on justice (Fig. 1). The strength of the relationship between grade and use of justice reasoning was assessed using Phi ($\varphi = .36$), indicating a medium effect of grade on the use of justice considerations in reasoning about the moral standing of nature. As indicated in Fig. 1, there were no developmental differences in reasoning based on intrinsic value; that is, second-grade participants were just as likely as fifth-grade participants to use reasoning based on intrinsic value of nature.

As a comparison to the Alien Questions, which sought to disentangle human considerations from environmental moral reasoning, judgments were sought about a scenario in which human considerations were possible. Specifically, the scenario involved judgments about pouring leftover pesticides into an irrigation canal. The results indicated that a significant majority of participants (95%) negatively judged the act of pouring pesticides into an irrigation canal ($N = 37$, $Z = 5.60$, $p < .001$). In this scenario a minority of participants reasoned that it was not all right to pour pesticides into the irrigation canal based on biocentric con-

siderations (see Table 3). Instead, participants more often justified their negative evaluation based on anthropocentric considerations of human welfare. We then used a McNemar test to assess differences in the proportion of participants' evaluations and justifications between the two forms of questions: Alien questions, where constituents of nature were the recipients of harm, and the irrigation canal question, where the recipients of harm were unspecified. As reported in Table 4, no differences were found in the proportion of negative evaluations of scenarios where the recipient of harm was either ambiguous (in the irrigation canal question) or specified as constituents of nature (in the Alien Questions). However, significant differences were found in the forms of biocentric reasoning used following a negative evaluation for these two types of questions. Specifically, results showed that participants significantly more often appealed to biocentric considerations, in the form of the intrinsic value of nature and justice, when reasoning about scenarios where constituents of nature were the recipients of harm compared to the scenario where the recipient of the potential harm was ambiguous.

Discussion

The farm worker children in this study understood that they lived around pesticides, and that pesticides could harm insects, birds, water, nature, and people. These children also said that it would matter to them if such harms occurred. They judged that it was not all right to be exposed to pesticides in an orchard, and this judgment was (a) upheld in spite of societal conventions that accepted pesticide exposure, (b) generalized to a different cultural context, and (c) justified based on an appeal to people's physical welfare. Thus, based on social-domain criteria (Turiel, 1983, 1998, 2002), this study supports the proposition that farm worker children bring moral reasoning to bear to their judgments about pesticide exposure.

Yet a troubling finding emerged insofar as these same children accepted the use of pesticides in their own orchards. Why? We highlight two main reasons, both of which show coherence in children's thinking. First, some children assumed—albeit incorrectly based on what we know from the toxicological literature (Fenske et al., 2000; Loewenherz et al., 1997)—that they were safe from the harms of pesticides (cf. Rao et al., 2007). Indeed, all the children reported engaging in practices that they understood to mitigate their exposure to pesticides. This form of reasoning can be characterized as an informational assumption about how the physical world works, which partly sets into place the normativity of children's social and moral judgments (Turiel, Hildebrandt & Wainryb, 1991; Wainryb, 1991, 2004; Wainryb & Brehl, 2006; Wainryb, Brehl & Matwin, 2005). Because in this instance children's informational assumptions are factually incorrect, they could well be amenable to educational interventions.

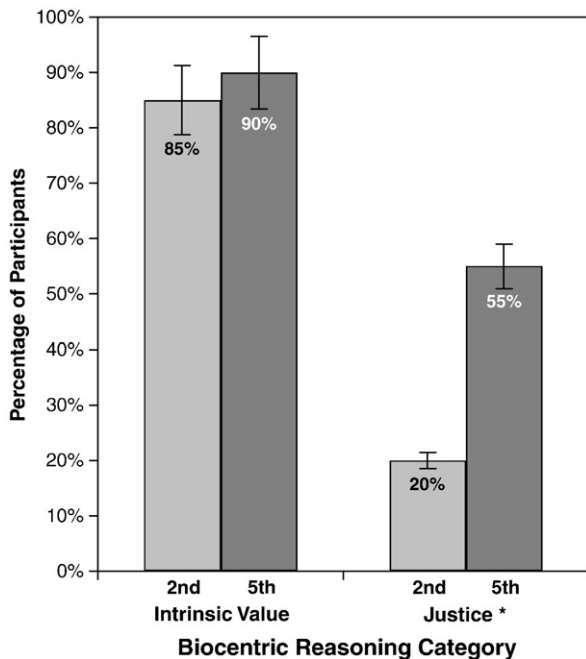


Fig. 1. Developmental difference in use of biocentric reasoning categories. $N = 40$. Error bars = standard error of mean. $\chi^2(1, N = 40) = 5.23$, $p < .05$, $\varphi = .36$, $p < .05$.

Table 4

Comparison of evaluations and biocentric justifications to question types where the recipient of harms were (a) specified as constituents of nature (Alien Questions) or (b) left ambiguous (irrigation canal question).

	Recipient of harm		McNemar test p -value
	Constituents of nature (Alien Questions) % (N)	Ambiguous (irrigation canal question) % (N)	
Not all right evaluation	100% (38)	90% (36)	.50
Biocentric justification			
Intrinsic value	91.7% (36)	5.6% (36)	<.001
Justice	38.9% (36)	2.8% (36)	<.001

Note. Only participants who negatively evaluated both types of questions were included in the statistical tests for differences in biocentric justification categories ($N = 36$). Percentages reported above for Alien Questions represent a collapsing of the four Alien Questions.

Second, some children believed that the benefits associated with pesticides, such as jobs for their family, justified its use. This form of reasoning highlights a real conundrum in this situation—that concerns for financial security exist alongside concerns about physical harm—and points to the sophistication of children's understanding of the complexity of their family's situation. While these children understand that pesticides can be harmful and make moral judgments about pesticide exposure, these concerns have been subordinated to an altogether different, and valid, concern for financial security. Such conflicted situations point to a need for an account of how children at different ages coordinate various considerations. Social-domain theorists have provided an account—Coordination Theory—for understanding the psychological coordination of competing interests (Helwig, 1995, 1998; Smetana, 2006; Smetana et al., 1993; Turiel, 1983, 1998, 2002; Turiel & Davidson, 1986). In this account, “many events or situations are multifaceted and entail overlapping concerns...sometimes in conflict with one another and sometimes in synchrony” (Smetana, 2006, p. 123). Coordination theory offers a promising structure for systematic developmental research on how children coordinate multiple concerns in conflicted situations.

A key finding from this study is that biocentric reasoning may emerge earlier than previously established in the developmental literature (Kahn, 1999). The majority of children (ranging from 75 to 87%) said it was not all right for Aliens to cause harm to pets, wild animals, orchards, and forests. Moreover, in justifying their evaluations, the large majority of children (90%) provided biocentric reasons. Thus, this study provides evidence that biocentric reasoning develops in children as young as 7 years old. Across the two age groups, a majority of children appealed to the biocentric justification of intrinsic value of nature to justify their judgments against harming nature. Developmentally, however, fifth graders were significantly more likely than second graders to appeal to biocentric justice (that nature deserves respect and fair treatment, has rights, or merits freedom). These results are consistent with previous research indicating that conceptions of other's welfare appear earlier than conceptions of fairness and justice (Smetana, 1981).

However, it could be argued that the farm worker children in this study were a special population, predisposed to a biocentric worldview by virtue of their already close connection to their orchard environment. But there are two reasons to set this argument aside. First, Howe et al. (1996) found low levels of biocentric reasoning among indigenous children living along the Rio Negro in the Brazilian Amazon—a population that lived closer to the land than did the farm worker children in the present study. Second, and more directly, in the current study children were asked the question about harm to nature in the same form employed by Kahn and colleagues (i.e., “Do you think it is all right or not all right for one person to pour some left over pesticides into the irrigation ditch? Why or why not?”). In line with the results by Kahn and colleagues, when asked the environmental moral question in this form, where consideration may be given to humans, nature, or both, the farm worker children provided very little evidence of biocentric reasoning (intrinsic value 5.6%; justice, 2.8%).

In other words, taking the current results together with the previous research on the development of environmental moral reasoning the following propositions emerge: If children are asked questions about environmental harms when humans are involved, then biocentric reasoning appears seldom, and it appears late in development. But if children are asked questions about environmental harms without the pull of human considerations (as achieved, e.g., by means of the new methodology that employed the Alien Questions), then biocentric reasoning appears often and early. It is not that one way of asking the questions is the “right” way; but that the different ways get at different underlying structural processes, and both warrant additional research. Along these lines, future studies could investigate whether differences exist in the development of biocentric reasoning (by way of the Alien Question Method) between

children with comparatively more or less exposure to nature. Too, subsequent studies could employ the Alien Question methodology with younger children to assess whether biocentric reasoning is present in children younger than 7 years. There are, however, potential limitations with the Alien Question methodology. It may be that children anthropomorphize the aliens and thereby replace humans with aliens in their conceptualization. If this is the case, the Alien Question methodology may result in an under-reporting of biocentric considerations since anthropocentric considerations would still be present. A second limitation relates to the imaginary context implicit to the Alien Question methodology. That is, children's logical reasoning abilities are improved with the use of imagination, such as using a pretend context of another planet (Dias & Harris, 1988, 1990). Thus, the Alien Question methodology may “advance” children's reasoning beyond what would be apparent in non-imaginary scenarios.

According to Pyle (1993) open natural spaces “are the places of initiation, where the borders between ourselves and other creatures break down, where the earth gets under our nails and a sense of place gets under our skin” (p. xvii). Children seek out such places for exploration, solitude, and a sense of connection with the wider natural world. The farm worker children in this study had that connection to their orchards. However, the initial problem described in this study remains: that while the orchard provides farm worker children with this connection, it also exposes them to increased risks due to a high level of exposure to pesticides. What can be done?

One established practice is for adults and children alike to leave the orchard while pesticides are applied, and only return after a safe re-entry time. It is a good practice, but it is not always feasible since the period for safe re-entry can last as long as two weeks. Another solution would be to remove children entirely from the orchards; but this solution seems particularly poor, for even if there was a means to keep families intact, this practice would not help to keep children connected to nature. Why not, then, reconsider the use of toxic pesticides themselves? Some of the children interviewed did just that. For example, one 5th grade child said:

Well I think there might be some kind of like natural kind of spray that could just kill bugs and probably wouldn't be harmful, but I think those would be really expensive.... I think that would be better...if it didn't really matter how much it cost then people would probably prefer to do that cause it'd be safer for people, but still have the same effect on the bugs.

It is not a new idea: lessen the toxicity of the pesticides. Another idea is not to use pesticides at all.

Perhaps there are multiple solutions that can work in complementary ways. But whatever they are, the solutions need to build from the literature that has established that experiences with nature foster children's physical and psychological wellbeing. Too, the solutions need to take seriously one of the central findings from this study: that in spite of the potential for harm to themselves, farm worker children want to be connected to the orchard, and they value the orchard in biocentric terms.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi: [10.1016/j.appdev.2010.02.003](https://doi.org/10.1016/j.appdev.2010.02.003).

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