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Plant yourself where language blooms: Direct experience of nature changes how parents and children talk about nature

Thea Cameron-Faulkner

University of Manchester

Ross McDonald

University of Manchester

Ludovica Serratrice

University of Reading

Joanna Melville

University of Manchester

Merideth Gattis

Cardiff University

Abstract

The current study investigated the affordances of direct and indirect experience of nature on parent-child talk. Parents and children produced a wider range of nature words when exploring a park (direct experience) than when exploring a thematically-matched indoor visitor center (indirect experience). Parents and children also produced more plant-related nature word types when exploring the park compared to the visitor center. Direct experience of nature increases the diversity and specificity of parent-child talk about nature, and mitigates the phenomenon of 'plant blindness' (cf. Wandersee & Schussler, 1999). Direct experience of nature provides an optimal context for children to learn the language of nature and consequently to cultivate children's status as custodians of the natural world.

Key words: Nature, parent-child talk, pro-environmental behavior, plant blindness, conservation

Introduction

Engagement with the natural world has a strong effect on health, wellbeing, cognitive capacity and behavior (e.g., Berman, Jonides, & Kaplan, 2008; Bowler, Buyung-Ali, Knight, & Pullin, 2010; Chawla, 2007; Dadvand et al., 2015; Elliot, Eycke, Chan, & Müller, 2014; Faber Taylor & Kuo, 2009; Kaplan, 1995; Lee, Williams, Sargent, Williams, & Johnson, 2015; Ulrich, Losito, Fioritot, Miles, & Zelson, 1991). For example, interactions with nature correlate with emotional bonds and appreciation of the natural world, which in turn have a strong bearing on pro-environmental behavior in both adults and children (e.g., Chawla 2009; Cheng & Monroe 2012; Hinds & Sparks, 2008; Soga, Gaston, Yamaura, Kurisu, & Hanaki, 2016; Zhang, Goodale, & Chen, 2014). However, evidence from a range of sources points to a loss of daily interaction with nature within developed nations (e.g., Kahn, Ruckert, Severson, Reichert, & Fowler, 2010; Miller, 1995; Soga et al., 2016) a trend that appears to be particularly prevalent in modern childhood (e.g., Elliot et al., 2014; Pergams & Zaradic, 2008; Zhang et al., 2014). Pyle (1993) refers to the decline in interaction with the natural world as 'the extinction of experience' and highlights its detrimental effects on health and wellbeing as well as interest and engagement in conservation (see also Miller, 1995).

The decline of interaction with the natural world is mirrored by a corresponding decline in knowledge of nature terms, particularly those relating to the less exotic members of the plant and animal world (e.g., Balmford, Clegg, Coulson, & Taylor, 2002; Moss, 2012; see also Elliot et al., 2014). Knowledge of words is important because language shapes perception: the link between language and perception has been an important theme in the cognitive sciences for decades. For example, many researchers have highlighted the tendency for adults and children alike to be drawn to

conceptual and perceptual distinctions encoded in their language (e.g., Bowerman 1996; Rosch 1973). Not surprisingly, researchers have thus argued that children's knowledge and use of nature terms are inextricably linked to their perception and appreciation of the natural world (e.g., Balmford et al., 2002; Lindemann-Matthies, 2005; Taverna, Waxman, Medin, Moscoloni, & Peralta, 2014). In short, people care more and pay more attention to the things they can label and that are labeled by others than to things that go unlabeled in the language.

Given the importance of language on our perception and sense of responsibility for the natural world it is important to understand the factors affecting its use. To date there has been very little consideration of the interaction between language and nature but two themes from the related fields of environmental psychology and science education present themselves as sensible starting points for research: first the influence of direct versus indirect experience of nature on behaviour and perception, and second the challenges associated with our propensity to focus our attention on exotic species of animals at the expense of our local flora and fauna.

People can experience nature directly through action and experience in the outdoors, or indirectly, for example through books, television, computers, and augmented reality (Kellert 2002; Soga et al., 2016). Both direct and indirect experience have positive effects on pro-environmental behaviors (Eagles & Demare, 1999; Soga et al., 2016). Indirect experience may however lead to a different conceptualization and perception of the natural world. For example, Taverna and colleagues (2014) demonstrated that children's ability to name living things is affected by the degree to which they have direct experience with the natural world. Similarly, Lindemann-Matthies (2006) reported the benefits of an education programme promoting direct experience with nature (e.g., on the way to school and in

daily life) for 8- to 16-year-old children (see also Elliot et al., 2014). Collado, Íñiguez-Rueda and Corraliza (2016) studied the effects of children's daily experiences of nature on their conceptualization of the natural world. They found that children from rural settings, who had more direct experience with nature, were more likely to engage in conversations about nature than children from urban environments (see also Genovart, Tavecchia, Enseñat, & Laiolo, 2013). In summary, studies indicate that being in nature is a more effective way in which to acquire knowledge about nature.

Several studies have documented an asymmetry between the use of nature vocabulary related to flora and fauna. Both adults and children appear to be more knowledgeable about and more interested in animals than plants (e.g., Flannery, 1991; Kellert, 1985, 1993; Lindemann-Matthies, 2005; Patrick & Tunnicliffe, 2011). Such evidence has led researchers to coin the term 'plant blindness' (Wandersee & Schussler, 1999), which is characterized by both "the inability to see or notice the plants in one's environment" and "the inability to recognize the importance of plants in the biosphere and in human affairs" (Wandersee & Schussler, 1999). Kellert (1985) argued that for most people, engagement with the natural world involves 'loveable animals' and a 'static and lifeless environment' (see also Lindemann-Matthies, 2005). As a consequence, people are less interested in the conservation of flora than fauna – despite the interdependence of the two in the natural world. Wandersee and Schussler (1999) stated: "While animals often steal the spotlight where extinction is concerned, one in eight plant species worldwide is threatened by extinction."

Much of the work investigating children's interactions with and knowledge of the natural world focuses on school-aged children and uses some form of survey or questionnaire-based methodology (but see Elliot et al., 2014). There is therefore a need for experimental research that examines how experience of nature shapes

language experience and use in younger children. In the current study we investigated the influence of direct versus indirect experience of nature on parent-child talk. Parent-child pairs explored a pleasant city center park (direct experience) and its thematically related indoor visitor center (indirect experience). The settings were carefully chosen to ensure as much overlap as possible in terms of themes, objects, and accessibility while contrasting directness of experience: nature was experienced directly and in an unstructured manner in the park, versus indirectly in the visitor center through structured visual displays, books, and craft activities.

The research questions were:

1. Do parents and children produce a wider range of nature terms when nature is experienced directly (in the park) or indirectly (in the visitor center)?

2. Is the balance between animal and plant-related nature terms affected by direct versus indirect experience?

Methods

Participants

Participants were drawn from the Cardiff area of Wales, UK, and recruited through the Cardiff University Development@Cardiff database, local museums and social media. Twenty mother-child pairs and one father-child pair took part in the study. Data from three mother-child pairs were excluded: one because of the child's reluctance to wear the recording equipment and two because they dyads spent too much or too little time in one of the settings to allow adequate observations in each. Children in the final sample (6 girls, and 12 boys) ranged from 35 to 56 months (M = 45 months, SD = 5.77). All caregivers had a high school level education or above with 72% of the sample having obtained a University degree of equivalent. 72% of the

sample had visited Bute park before and 83% of the parents stated that they visited a park with their child on a weekly basis.

Setting

The study took place at Bute Park and Arboretum in Cardiff, Wales. Bute Park comprises an extensive area of mature parkland within Cardiff city center. The park contains a range of trails and sculptures in addition to an arboretum and river corridor. The park also contains an indoor visitor center that promotes the park's wildlife, horticulture and history. The visitor center contains child-friendly displays, books, and craft activities, many of which relate to habitats and wildlife. For example, at the time of the study the display boards contained pictures of native birds in their natural habitats and also pictures of various plant species. The craft table was devoted to the theme of butterflies and had butterfly identification charts, materials for making a simple model of a butterfly, and various books containing information on butterflies and their habitats. In addition the visitor center contained a number of large plants. In summary both the visitor center and the park itself promoted the natural world. Figures 1 and 2 provide images taken from the participants' head mounted cameras and are presented with annotations of the concurrent speech produced.

Design

We used a within-subject design with experience of nature as the independent variable (direct versus indirect experience). The independent variable was operationalised in terms of setting, with the park as the direct experience condition and the visitor center as the indirect experience condition. Two outcome variables assessed the diversity of parent-child language: (1) the probability of using nature word types versus non-nature word types, and (2) the probability of using plant versus

animal-related word types. The first outcome variable measured the number of *different* nature word types as opposed to overall frequencies of all nature words, in order to accurately evaluate the diversity of nature terms used. In cases where a nature word type was produced in the singular and plural (e.g., *bee* and *bees*) the word type contributed just once to the overall count. Consequently we refer to the outcome variable as the frequency of word *types* throughout the report. Details of the nature term coding can be found in the coding section. The second outcome variable evaluated the extent to which parent-child talk focused on either animals or plants, and thus limited diversity, or reflected a balance between the two.

Procedure

Caregivers signed a consent form and assent was obtained verbally from the children. The caregivers and children were asked to wear head-mounted video cameras (Go Pro Silvers) and pedometers and were informed that the recordings would take place in two settings: outside in the park (the direct experience condition) and inside the visitor center (the indirect experience condition). Participants were then given the instruction to "go on a treasure hunt and see what you can find." The instruction was the same for both the direct and indirect conditions. They were told that the experimenter would come and find them after fifteen minutes and take them to the next setting. The order of experience (direct/indirect) was counter-balanced across the sample.

After the recordings, caregivers were asked to fill in a short activity questionnaire and provide general demographic information about their family. Caregivers were provided with travel expenses and the children were provided with a small gift to thank them for their participation.

Coding and transcription

All recordings were transcribed in ELAN (Sloetjes, & Wittenburg, 2008) by trained transcribers and checked by the first author. All nouns used by the caregivers and children were coded manually. To analyze the frequency of nature word types in the sample, each noun was assigned to one of three categories (see Table 1).

An independent rater coded 20% of the nature word types. The inter-rater reliability was high (Cohen's kappa =0.97).

Results

The overarching aim of the study was to compare diversity in parent-child speech during direct and indirect experiences of nature. We used logistic mixed effect models to compare the diversity of parent-child language across the two conditions (direct versus indirect experience) (Baayen, Davidson, & Bates, 2008; Jaeger, 2008). Rather than comparing participant means, these models make use of all of the individual observations (words), while still taking between-participant variance into account. This is particularly useful for naturalistic studies like the present experiment, in which the number of observations inevitably varies between participants (i.e. some dyads use more words than others). All of the models were calculated using the *glmer()* function of the *lme4* package in the R statistical programming environment (lme4: version 3.2; R Core Team, 2012). We conducted two analyses to evaluate (1) the probability of using nature word types versus non-nature word types, and (2) the probability of using animal versus plant-related nature word types. For analysis 1, the dependent measure was the use of nature word types (nature word type = 1, non-nature word type = 0) and for analysis 2 the dependent variable was the type of nature word (plant-related =1, animal-related =0). The models included the fixed factor of experience, which was effect/sum coded (direct experience = .5; indirect experience = -.5) and then centered to account for unbalanced data. All models had a random-slope

structure, with subject as the sole random factor. The *anova()* function of the *car* package (Fox & Weisberg, 2011) was used to determine whether the addition of the fixed effect improved model fit compared to a null model including only the random effect. We tested for order and gender effects using t-tests on the aggregated subject data.

Analysis 1. The diversity of parent-child language: Nature versus non-nature words

No order or gender effects were attested in the data and therefore the analyses were conducted on the sample as a whole. The first analysis focused on the proportional frequency of nature word types used by the parents and children in the direct experience setting of the park and the indirect experience setting of the indoor visitor center.

The parents produced a proportionally larger number of nature word types on average during interaction in the direct experience setting (direct experience: M =.05, SD =.22; indirect experience: M =.03, SD =.18). The results of the logistic mixed effects model showed that the main effect of experience was significant (β = .52, $SE(\beta)$ = .13, $Wald\ z$ = 4.07 p <. 0001). The inclusion of the main effect of experience improved model fit in comparison to a null model containing only the random effect ($\chi 2(1) = 12.85$, $p < .0001$).

Next we repeated the procedure on the children's data. The children, like the parents produced proportionally more nature word types in the direct experience setting (direct experience: M =.06, SD =.24; indirect experience: M =.04, SD =.20). The main effect of experience was significant (β = .64, $SE(\beta)$ = .22, $Wald\ z$ = 2.87, p =.004). The inclusion of the main effect of experience improved model fit in comparison to a null model containing only the random effect ($\chi 2(1) = 7.68$, $p = .006$).

Analysis 2. The diversity of parent-child language: Plant versus animal words

Our second analysis focused on the extent to which parents and children used plant versus animal-related word types during direct and indirect experience of nature. We tested for order and child-gender effects in the parent data using t-tests on the aggregated subject data. No order or child-gender effects were found in the data and therefore the analyses were conducted on the sample as a whole. The parents produced proportionally more plant-related nature word types on average during direct experience (direct experience: M =.52, SD =.50; indirect experience: M =.29, SD =.45). The results of the logistic mixed effects model showed that the main effect of experience was significant (β = .99, $SE(\beta)$ = .22, $Wald\ z$ = 4.49, p <. 0001). The inclusion of the main effect of experience improved model fit in comparison to a null model containing only the random effect ($\chi 2(1) = 13.96$, $p< .0001$).

The same model was applied to the children's data. Gender effects approaching significance were identified in the sample and therefore gender was entered into the model. The main effect of experience was significant (β = 1.50, $SE(\beta)$ = .31, $Wald\ z$ = 4.63, p <. 0001) but gender was not significant (β = .54, $SE(\beta)$ = .35, $Wald\ z$ = 1.54, p =.12) . The inclusion of the main effect of experience improved model fit in comparison to a null model containing only the random effect ($\chi 2(1) = 18.08$, $p< .0001$). The children produced proportionally more plant-related nature word types in the direct experience setting (direct experience: M =.51, SD=.50; indirect experience: M =.20, SD =.41).

Analysis 3. A lexical analysis of high frequency nature terms

Our third analysis focused on the kinds of nature word types produced in the study. Table 2 shows the nature word types produced by four or more parents and

children in each of the conditions. The nature word types used by four or more participants are referred to as *high frequency nature terms*.

A number of interesting patterns emerged. First, almost all of the high frequency nature terms were relatively generic, basic level categories, for example *bird*, *tree*, *flower*, *butterfly*. However exceptions were found in the parents' speech during the direct experience condition where more specific plant-related terms were produced (e.g., *daisy* and *dandelion*), along with more specific animal-related terms (e.g., *swan*). All high frequency nature terms produced by the children were also identified as being high frequency nature terms in the parent sample with the exception of *bee* which was identified as a high frequency nature term for children in the indirect experience condition but was not a high frequency nature term for parents in the indirect condition.

Discussion

Researchers and practitioners from a range of disciplines have highlighted the growing disconnect between humans and the natural world (e.g., Kahn, Ruckert, Severson, Reichert, & Fowler, 2010; Miller, 2005; Soga et al., 2016). The trend is visible in many ways but particularly apparent in children's use and understanding of language to describe the natural world, or in other words, nature terms (e.g. Balmford et al., 2002). Given the positive link between our knowledge of nature terms and appreciation of the natural world (e.g. Lindemann-Matthies, 2005; Taverna, Waxman, Medin, Moscoloni, & Peralta, 2014), the reduction of nature terms in childhood could have far-reaching consequences (e.g. Soga et al., 2016). Consequently it is important to identify features and contexts that promote children's use of nature terms in everyday life.

In the current study we focused on the parent-child speech during direct and indirect experiences of nature. Our findings demonstrated that both children and parents used more diverse nature terms when experiencing nature directly (i.e. during exploration of a city park) than during the indirect experience condition. This clear demonstration of the *direct experience advantage* complements and extends on previous studies demonstrating the benefits of learning about the natural world in outdoor settings (e.g. Lindemann-Matthies, 2005). The direct experience advantage is especially striking given that the setting for indirect experience (i.e. the visitor center) contained maximally informative displays, as well as carefully chosen artifacts and well-planned resources. Indeed, the visitor center arguably covered a greater range of nature-based topics than the park. Despite the information-rich context of the visitor center, the number of different nature terms produced by the parents and children was significantly higher in the unstructured natural setting of the park, thus demonstrating the direct experience advantage.

One reason for our results may be the difference between experiencing nature predominantly through the two-dimensional (2D) representations that are typical of indirect experience versus real life natural objects and scenes, which are three-dimensional (3D) and have richer perceptual characteristics. There are a number of differences between 2D and 3D objects which have an effect on behavior and cognition both for children (see Deloche, Pierroutsakos, & Uttal , 2003) and adults. For example, Snow, Skiba, Coleman, and Berryhill (2014) found that memory recall was better for real objects than photographs or line drawings, and attributed it to the richness of cues for real objects, including cues to shape, texture and function. In the current study, direct experience of natural objects and scenes would have increased cue richness in a similar manner, and cue richness may have in turn influenced parent-

child language. Future research might examine this explanation in more detail by comparing recall of natural objects from the two conditions.

An important issue addressed in the current study relates to the tendency to focus on animals (particularly charismatic, 'cute' species) as opposed to plant life, a bias referred to as 'plant blindness' (Genovart et al., 2013; Patrick & Tunnicliffe, 2011; Wandersee & Schussler, 1999). Not surprisingly this bias is linked to a lower regard for the conservation of natural habitats than for the animals that inhabit them (Lindemann-Matthies, 2005; Wandersee & Schussler, 1999). In the current study, plant blindness appeared to be mitigated during direct experience of nature. Both parents and children used a wider range of plant-related terms and also more specific types of words (e.g. *dandelion* as well as just *flower*) while exploring the park than they did in the visitor center. One might hypothesize that the effect was simply down to differences in the types of nature-based objects and representations available in the park and the visitor center. However a number of factors point to a deeper explanation. First, almost all the depictions of animals in the visitor center showed them in their natural habitats. These habitats included trees, flowers, hedgerows and expanses of vegetation. In addition, the visitor center contained living plants and also books and pictures specifically of plant life. Therefore participants were exposed to a considerable number of references to plant life in the indirect experience condition but nevertheless focused on animals. Second, when exploring the city park the parents and children did use a range of animal terms ranging from the physically present bees, spiders, and dogs to fictitious animals such as *the Gruffalo* (a popular character from a series of children's books) and dragons. Nevertheless when experiencing nature directly, both parents and children appeared to view nature more broadly and

produced a wider range of plant-related nature terms than they did when experiencing nature indirectly.

Therefore we suggest that the language use patterns relating to plants versus animals were not simply a function of the informational affordances of the settings but rather a consequence of perceptual distinctiveness. We suggest that the multisensory experience associated with direct experience of nature triggers a greater awareness of plant life. We not only see plants when we are in natural settings, but can also touch them, smell them, and hear them move in the breeze. When we directly experience nature, we see plants not as a static backdrop but as living entities (cf. Wandersee & Schussler, 1999).

The current study builds on and extends a growing body of literature on the importance of directly experiencing nature by demonstrating that sensitivity to direct versus indirect experience of nature occurs before the school years. Our findings suggest that the developmental origins of engagement with the natural world may stem from patterns of language use in parent-child talk. Parents produced a wider range of nature terms during direct experience of nature and thereby highlighted the types of things 'worth talking about' (cf. Ochs & Schieffelin, 1983). Directly experiencing nature influences parent-child interactions and thereby introduces children to the diversity and value of nature: in our study, being immersed in a classic park setting increased the diversity of nature talk compared to a carefully selected and attractively presented set of nature artifacts. Given the strong association between our knowledge of nature words and our sense of custodianship for the natural world (e.g., Chawla, 2009; Soga et al., 2016) we suggest that urban planners as well as educationalists consider the unique affordances of direct experience with natural environments for children and families.

Before closing we raise some limitations of the current study. As expected, parents and children talked about the same kinds of topics during their explorations but the extent to which the parents or children initiated these discussions is not answered by the current analyses. That is, we do not know if, for example, children were more likely to trigger nature-based talk more than their parents during direct or indirect experience of nature. Future research should include analyses of interaction patterns to address this issue. Second, we focused on just one direct experience setting and one indirect experience setting. However, we chose settings which captured prototypical and accessible exemplars, a classic city park and free-entry, child-friendly visitors center. We believe both settings to be representative of family experiences in the European context. Finally our sample consisted of a relatively homogenized group of participants. Cross-cultural differences in perception and interaction with the natural world are well documented (see for example Taverna et al., 2014) and therefore future research should incorporate participants from a range of backgrounds.

To conclude, our study highlights the unique and valuable affordances of direct experience of nature for conversations about nature between parent and child. In addition our findings suggest that direct experience of natural settings not only stimulates talk about nature but also brings the plant world to life. We suggest that natural settings provide optimal contexts within which to socialize children into the language of nature and consequently promote their status as custodians of the natural world.

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Plant yourself where language blooms

Figures and tables

Dyad 2.

Child: "Wriggly leaves."

Mother: "Wriggly leaf. They are wriggly leaves."

Dyad 4.

Mother: "Look at the butterfly'"

Child: " Huh?"

Mother: "By there, look."

Mother: "Gone now."

Fig. 1 Head mounted camera views and associated annotations from the direct experience condition.

Dyad 4.

Child: "There's plants there."

Child: "Plants, plants, plants."

Mother: "There are plants everywhere!"

Dyad 2.

Child: "Mummy, there's a butterfly."

Child: "Butterfly here."

Mother: "Ah."

Fig. 2. Head mounted camera views and associated annotations from the indirect experience condition.

Cameron-Faulkner, T., McDonald, R., Serratrice, L., Melville, J., & Gattis, M. (2017). Plant yourself where language blooms: Direct experience of nature changes how parents and children talk about nature. Children Youth & Environments, 27, 110-124.

Table 1. Nature word type categories used in the current study

Nature word type categories	**Definition**	**Examples**
Animal-related	Nouns relating to real and fictitious animals and their byproducts	Squirrel, dog, dragon, spiderweb, honey.
Plant-related	Nouns related to vegetation	Tree, flower, leaf, grass, twig.
Non-nature	All other nouns	Bike, table, sign.

Table 2. High Frequency Nature Words Uttered by Parents and Children

	Animal-Related Words		**Plant-Related Words**	
	Direct exposure	**Indirect exposure**	**Direct exposure**	**Indirect exposure**
Parents	bee (8)	butterfly (18)	tree (17)	tree (9)
	dog (8)	bird (6)	flower (14)	flower (5)
	bird (6)	wing (6)	leaf (11)	plant (5)
	butterfly (6)	bug (4)	branch (8)	holly (4)
	spider (6)	caterpillar (4)	grass (8)	
	squirrel (6)	duck (4)	daisy (7)	
	duck (5)	kingfisher (4)	stick (7)	
	swan (5)	moth (4)	dandelion (4)	
	dragon (4)	rabbit (4)	stump (4)	

	feather (4)	spider (4)	trunk (4)	
	horse (4)	squirrel (4)	wood (4)	
Children	dog (7)	butterfly (14)	tree (14)	flower (4)
	bee (5)	bee (4)	flower (13)	plant (4)
	bird (5)		leaf (10)	
	swan (5)		stick (9)	
	squirrel (4)		grass (4)	
	ducks (4)			
	spider (4)			

Numbers following each word indicate the number of speakers who produced the word type.