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Perspective

Reviewing how intergenerational learning can help conservation biology face its greatest challenge

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ABSTRACT

Environmental problems can be resolved when the public is no longer willing to accept their risks and demands change (i.e., Reflexive Modernization). Notable examples include responses to the ozone hole and acid rain, but in an emerging post-truth world, politicization of conservation can result in adults ignoring risks and accepting the status quo (i.e., Anti-Reflexivity). This problem is particularly acute for conservation biology challenges linked to climate change. Although strategic framing of conservation messages can help overcome ideological barriers to conservation actions, additional methods are needed to engage citizens in addressing loss of biodiversity. We argue that child to parent intergenerational learning is an understudied but promising pathway to incite biodiversity conservation actions among children and adults. Children have unique perspectives on wildlife and conservation, are easily reached in schools, and are likely the best equipped to help parents navigate ideologically fraught topics in ways that create action. We review key practices of intergenerational learning and outline how its best practices may be integrated in conservation biology programming and research.

1. Introduction

Conservation's greatest challenge is learning to inspire citizens toward conservation action (Kareiva and Marvier, 2012; Vucetich et al., 2017). Climate change and Diamond's (1989) famous evil quartet of extinction drivers (habitat destruction, overkill, invasive species, and extinction chains) (Brook et al., 2008) play primary roles in species loss, are ultimately driven by choices people make, and thus must be addressed by changing those choices. Such a motivated and informed public could change the conservation landscape by providing massive increases in resources so that decisions about which species to abandon are no longer necessary (Parr et al., 2009; Vucetich et al., 2017). Solutions to conservation biology challenges exist, but social barriers to action prevent the large scale response needed to avoid the worst projected outcomes for biodiversity. Solutions for some environmental challenges faced in the past including ozone depletion (Mäder et al., 2010) and sulfur oxide related acid deposition (Brady and Selle, 1985; Stavins, 1998), emerged as people became informed about risks and refused to accept them, a process described as reflexive modernization (Beck, 1992). Modern conservation biology, however, faces a post-truth world (Boon, 2018) where political ideology acts as an anti-reflexive force, causing people to ignore risks and resist remediation behaviors, particularly in relation to climate change (McCright and Dunlap, 2010), but also in broader conservation contexts (Gromet et al., 2013; Cruz, 2017; Boon, 2018). Further, even where societal support for sustainable living is relatively high (e.g., in Sweden), social pressure to adopt a consumer mentality, often from one's own children, has challenged parental will to live sustainably (Isenhour, 2010).

One response to anti-reflexive forces is repackaging conservation behaviors to conform to stakeholder ideologies. Political party, and especially political ideology, shape environmental concern, and have progressively had a stronger impact on that concern during recent years (Cruz, 2017). For instance, politically conservative individuals in the United States were more likely to purchase energy efficient light bulbs if environmental messages were removed from packaging (Gromet et al., 2013). Similarly, political conservatives shifted toward pro-environmental attitudes when doing so was presented as obeying authority, defending purity in nature, and being patriotic, and the trend was most pronounced when information was perceived as coming from an in-group source (Wolsko et al., 2016). Biodiversity conservation, and environmental protection in general, are now ideologically fraught issues, irrespective of whether they should be or not. Strategic framing, and appeals from trusted messengers have helped address ideological resistance to action in related domains including climate change actions

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(Moser and Dilling, 2006; Nisbet, 2009), vaccinations (Gerend and Shepherd, 2007), and evolution (Long, 2012). For conservation biology, messages using anthropogenic frames, particularly those linked to children, have succeeded in promoting large scale shifts in public sentiment toward supporting conservation funding (Marvier and Wong, 2012; Kareiva, 2014). These successful techniques, however, are insufficient to stem the growing polarization and ideological resistance to conservation action, particularly in the United States (Cruz, 2017), indicating a need for novel strategies.

We suggest engaging children in ways specifically aimed at promoting intergenerational learning (IGL) may be one important way to address conservation's greatest challenge: creating an informed and motivated citizenry. Conservation scholars have clearly articulated several important arguments for engaging children directly with conservation messages. Today's children will experience the outcomes of conservation biology, be it success or an impoverished biota (Pyle, 1993; Miller, 2005). Further, engaging children in K-12 contexts can inspire the next generation of conservation leaders, engage far more people than any other venue, engage underserved people, and leverage the value of biodiversity itself in educational efforts (Main, 2004; Wyner and Desalle, 2010; Stevenson et al., 2018b). We build on these arguments by suggesting that reaching parents with conservation messages through their children represents perhaps the most productive but understudied pathway for conservation outreach. Further, engaging parents through their children may promote action among adults on issues where other strategies have failed, particularly ideologically fraught issues linked to climate change and property rights (Peterson and Liu, 2008; Stevenson et al., 2014a).

2. Why would intergenerational learning work?

The efficacy of child to parent IGL as an approach to addressing biodiversity conservation depends on several premises. The core premises are: 1) environmental education can effectively foster environmental literacy among children, and 2) promoting environmental literacy among children can effectively foster environmental literacy among their parents. The environmental education field emerged based on a belief in the first premise as articulated in the Tbilisi Declaration in 1977. Environmental education is a diverse field, but largely focuses on using learner-centered and interdisciplinary pedagogies, often within an outdoor or informal learning context, to produce environmental literacy among children (*NAAEE (North American Association for Environmental Education) Guidelines for Excellence,* 2012; Stern et al., 2014). Environmental literacy itself is more than the name might suggest. The most common approach to the concept, among many, breaks it into four related components: knowledge, affect, cognitive skills, and behavior (Hollweg et al., 2011). In short, EE strives to ensure that learners understand the natural sciences associated with environmental challenges, care about addressing them, have the critical thinking skills to analyze them and plan for action, and are motivated to act (Hollweg et al., 2011; Stevenson et al., 2013). Accordingly, EE approaches attempt to do more than build understanding. Outcomes such as connection to nature, critical thinking skills, and pro-environmental attitudes are of value to the EE community as they set learners on a lifelong path to environmental engagement and action (Chawla, 1999; Stevenson et al., 2014b). From its inception, the underlying goal of environmental education and environmental literacy was creating positive changes in human relationships with nature (Chiappo, 1978). This goal, however, has been contested particularly in relation to growing influence of the related education for sustainable development movement which focuses more on sustainable economic growth (Kopnina, 2012).

Since the development of EE, environmental educators have clearly demonstrated interventions can effectively promote environmental literacy among children in diverse contexts and in relation to diverse subjects. Conservation subjects where environmental education has proved particularly effective include forestry and terrestrial ecology (Baig et al., 2019), biodiversity and wildlife management (McDuff, 2000; Kassas, 2002; Pitman, 2004), climate change (Monroe et al., 2017; Stevenson et al., 2018a), water resources (Sutherland and Ham, 1992), and a host of others (Ardoin et al., 2018). Within this literature general trends exist suggesting children gain knowledge, environmental affect, cognitive skills, and pro-environmental behavior changes faster at younger ages (Stevenson et al., 2013), environmental learning can promote differentially high changes in affect among Hispanic and African American students (Larson et al., 2011; Stevenson et al., 2013), girls (Carrier, 2009), and students with emotional, behavioral, or cognitive challenges (Szczytko et al., 2018).

The second premise underlying the efficacy of child to parent IGL has less research momentum than the first largely because fewer researchers study IGL than education in general, and, most IGL research documents how parents impact children's knowledge, attitudes, and behaviors. Parent to child IGL research on the other hand, highlights impacts on diverse domains including a child's academic achievement (Davis-Kean, 2005), future marital relations (Axinn and Thornton, 1993), and health behaviors (Varcoe et al., 2010). However, relying on parents, who struggle with anti-reflexive thinking and clouded judgement on controversial topics (Kollmuss and Agyeman, 2002; Gifford, 2011), to be teachers is not ideal in contexts of ideologically fraught issues.

Fortunately, children can impact parents through IGL, and have been demonstrated to do so in nearly every context where the phenomenon has been tested, and even detected in some research where child to parent IGL was not a initially under consideration (Isenhour, 2010). Children drive parental decisions to adopt consumer culture in general (Isenhour, 2010), and shape purchasing decisions in in specific domains in including food purchase behaviors (e.g., purchase of high sugar cereals) (Flurry and Burns, 2005), outside entertainment choices (e.g., family movie night out), and family vacation patterns (Swinyard and Peng Sim, 1987). Pressure brought to bear on Dunkin' Donuts, Inc. by parents, driven by their elementary-school aged children, led to a commitment for replacing Styrofoam cups with paper cups globally (Wells, 2014). Further, research suggests children effectively encourage parents to adopt new technology (Hampshire, 2000). Similarly, education efforts intended to promote adult environmental knowledge, affect, and behavior via interventions with children have proven effective. This has been documented for general environmental conservation knowledge (Leeming et al., 1997), waste management behaviors (Maddox et al., 2011), flood related knowledge (Williams et al., 2017), and energy conservation behaviors (Boudet et al., 2016).

Child to parent IGL is especially promising for an ideologically fraught topic like biodiversity conservation for three reasons. First, political ideologies and worldviews are primary drivers of how adults interpret facts for controversial issues (McCright and Dunlap, 2011; Kahan et al., 2012), but do not appear to filter perception of facts among children (Flora et al., 2014; Stevenson et al., 2014a, b). For example, children's acceptance of anthropogenic climate change depends on awareness of facts, but not views of teachers (Stevenson et al., 2016). Second, parents are willing to talk about uncomfortable subjects with their children, whom they trust, even when they are not willing to discuss the topic with other people. For example, Morawska et al. (2015) found parents were uncomfortable talking about sexuality with other adults, and were most willing to talk to their children about the subject. Third, children effectively change the minds of their parents on ideologically fraught topics. For example, children have changed their parents views on sexual orientation, whereas interactions with other adults often fails to do so (LaSala, 2000). Similarly, children successfully change parental views about the urgency of climate change (Lawson et al., 2019), whereas general climate change education appears to make adults dig even deeper into their initial positions (Kahan et al., 2012). Children represent a good pathway to communicate the biodiversity conservation message to their parents, as they are less

resistant to action than parents, more trusted by parents than other sources, and effective at helping parents translate scientific facts to reasonable positions on sensitive issues.

Although not all core drivers of biodiversity loss are ideologically fraught, thus rendering child to parent IGL uniquely valuable, many clearly are. Habitat destruction is fundamentally intertwined with property rights views that define personal identity in much of the United States (Brook et al., 2003; Peterson and Liu, 2008), invasive species management (e.g., control of feral cats) often revolves around group identities of stakeholder groups (Peterson et al., 2012; Lohr and Lepczyk, 2014), and mitigating global climate change requires most citizens in the United States to accept climate science despite ideological barriers to doing so (IPCC, 2018). In all thse cases, children may operate as powerful agents of conservation. Because child to parent IGL has yet to gain a foothold in conservation biology social science (Bennett et al., 2017), species specific examples published in scientific literature are rare. Establishment of the Orianne Society, however, provides one notable example. In this case, a major conservation effort for saving herpetofauna, was started when a child asked her father to save the eastern indigo snake (*Drymarchon couperi*) from extinction (Jenkins, 2014).

3. How to leverage intergenerational learning for biodiversity conservation

Fortunately, conservation biologists have a wealth of educational materials designed for K-12 audiences. These resources include: AFWAs Project WILD and Aquatic WILD (https://www.fishwildlife.org/afwa-inspires/project-wild/aquatic-wild), a growing list of programs supported by The National Wildlife Federation (e.g., Schoolyard Habitats; https://www.nwf.org/en/Educational-Resources/Education-Programs), a host of citizen science programs (see scistarter.com/educators for a number of projects with links to educational materials), and many location-specific programs linked to museums, zoos, aquaria, parks, research stations and the like. In our experience the developers and caretakers of these curricula are eager and willing to assist with innovative additions and modifications such as those done to integrate climate change (go.ncsu.edu/wwcc). Further, many practitioners and scholars are already working toward curricula with impacts that expand beyond students to broader communities (Mueller and Tippins, 2012). Given this context, conservation biologists have an opportunity to create, evaluate, and benefit from minor curricula changes designed to promoted child to parent IGL.

Several principles have been established for designing effective child to parent IGL curricula. Education efforts should be focused on local issues (Sutherland and Ham, 1992; Ballantyne et al., 2001), engagement with students should be longer term and involve in-depth lessons (i.e., repeated contact, lasting multiple weeks), projects should be hands-on, and should engage parents (Percy-Smith and Burns, 2013). Further, qualitative research suggests interactions with wildlife often stand out to children even when programming focuses on other topics (e.g., water quality) (Ballantyne et al., 2001). Sutherland and Ham (1992) discovered hands-on work in a watershed combined with follow up parental participation in a workbook completed at home, resulted in child to parent IGL. Specific homework elements requiring parental engagement (Leeming et al., 1997; Vaughan et al., 2003) such as parental interviews, family trips to natural areas to identify species, family activities to create backyard habitat (e.g., building a bird feeder or water feature) are key for successful child to parent IGL.

Most of the emerging research in the domain of child to parent IGL is observational and/or qualitative, and focuses on conservation topics other than biodiversity conservation. Therefore, experimental studies focused on programs related to biodiversity conservation are needed to evaluate causality. Conducting research with children in their family units can be challenging, and may stymie research in child to parent IGL. Research with people under 18 years of age generally faces more scrutiny by Institutional Review Boards, developing protocols for working with various levels of school administrations, and parents, and securing informed consent from all parties add additional logistical barriers (Klingner et al., 2003; Swauger, 2009). Similarly, hierarchical data collection from teachers, to students, to parents can reduce response rates drastically (Wellington, 2015). Survey design for IGL research can be difficult because instruments equally valid for adults and younger children are difficult to develop (Greig et al., 2012). Finally, IGL work is inherently interdisciplinary, and truly interdisciplinary work is difficult in practice, despite being popular in concept (Youngblood, 2007).

These barriers, however, are not insurmountable, and have been overcome in studies on family exercise (Solomon-Moore et al., 2017), substance abuse therapy (Boustani et al., 2016), and educational achievement (Davis-Kean, 2005). In our experience, IRB board administrators can develop a culture that recognizes differences between medical research and educational research, which facilitates rapid approval for some research with children, including the option for expedited (versus full) review in some cases. This process can be coordinated by working directly with IRB staff at a research institution, but national guidelines similar to those wildlife experts have advocated for distinguishing free ranging animals from laboratory contexts in animal use committee deliberations (Sikes and Animal Care and Use Committee of the American Society of Mammalogists, 2016), may be useful for promoting large scale change. Research protocols that integrate parental participation into actual assignments or associate data collection with 'normal' activities such as signing forms to acknowledge assignments may produce acceptable response rates for IGL research (e.g., $\geq$50%) in some cases (Evans et al., 2001). Minor changes to instruments validated among adults using standard survey design principles and evaluation techniques (e.g., cognitive interviews, pretesting) may suffice to ensure comprehension among K-5 audiences and adults alike (Clark et al., 2017). Similarly, as rules of thumb for survey design suggest using 4–7th grade reading levels (Vaske, 2008), instruments validated for children may work with adult audiences. Ultimately, child to parent IGL research addressing biodiversity conservation will require support from conservation biologists (as peer reviewers and practitioners), journal editors, and funding agencies. These key players must reward the extra effort required to engage with and study multiple generations as once.

Emerging research on child to parent IGL in biodiversity conservation can address several important questions. First, which behavior theories best explain child to parent IGL for biodiversity conservation? Second, which biodiversity conservation behaviors are most amenable to child to parent IGL? In energy conservation contexts, child to parent IGL promoted relatively large changes in many residential energy use behaviors (e.g., turning off power strips, adjusting refrigerators), but almost no effect on food and transportation behaviors (Boudet et al., 2016). Whether such disparities in behaviors directly impacting biodiversity exist is unknown, but disparities are certainly possible for behaviors ranging from changing purchasing to creating backyard wildlife habitat. Further, the social and structural mechanisms underlying such differences are unknown. Third, what contextual factors make child to parent IGL more effective? The aforementioned principles of effective IGL education matter, but a host of other factors including self-efficacy of children (i.e., the belief in one's ability to accomplish a task) (Bandura, 1977), intra-family communication levels and types, and connection to nature (i.e., feeling emotionally connected to the natural world) (Mayer and Frantz, 2004) seem relevant but understudied in this context.

Research on intergenerational relations may provide particularly valuable in unraveling the mechanisms driving efficacy of child to parent IGL efforts. Specifically, child to parent IGL may be more effective in contexts where intergenerational relationships are characterized by high solidarity and low conflict and ambivalence (Silverstein and Bengtson, 1997; Szydlik, 2008). Intergenerational

solidarity studies suggest cross generational relationships are stronger when financial (e.g., help paying bills), health (e.g., help coping with an illness), and emotional needs (e.g., companionship and attention) exist within families (Szydlik, 2008). Similarly, structural attributes of a society can weaken solidarity (e.g., strong welfare states, and high inheritance taxes promoting independence) or strengthen it (e.g., strong housing markets promoting multi-generation households). Child to parent influence tends to be stronger and operate in more rational ways when both generations are able to observe the behaviors of concern (Bursztyn and Coffman, 2012). Immigrant families, particularly those from collectivist cultures and those experiencing economic hardships, often maintain strong positive intergenerational family relations (Kwak, 2003). Within families, intergenerational relations with fathers and divorced parents tend toward lower cohesion (Silverstein and Bengtson, 1997).

4. Conclusion

Although some suggest IGL-based approaches may burden children (Thompson, 2014), children appear to be embracing that burden in domains critical to biodiversity conservation including environmental justice and waste management (Wells, 2014; Stapleton, 2018). Children are working to solve political issues though engagement with the March for Our Lives protests (The New York Times, 2018) and the Fridays for Future marches (Böck, 2019), rather than waiting to vote. Ethical concerns about placing pressure on children through child to parent IGL, must be balanced with the ethical concerns of failing to empower them in ways necessary to create a world they want to inherit. Child to parent IGL, need not present children as agents of conflict challenging parental views about conservation. In contexts where parents want to "stop shopping" (Isenhour, 2010) children can shift roles from being the last barrier to sustainable behavior to becoming the primary impetus for positive change some parents want to make. Governance principles linked to intergenerational equity may provide a powerful justification for child to parent IGL globally because such principles are constitutionally enshrined by 74% of nations (Treves et al., 2018). By helping children gain more influence over the trajectory of conservation, child to parent IGL may be a small step from a myopic conservation vision focused on the interests of adults toward a form of ecojustice embracing contributions from more diverse agents, including species and ecosystems (Peterson et al., 2010; Washington et al., 2018).

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