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Practical Work at School Reduces Disgust and Fear of Unpopular Animals

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Abstract
Disgust and fear are basic emotions that protect humans against pathogens and/or predators. Natural selection favored individuals who successfully escaped or avoided harmful animals; thus animals who pose a disease threat activate aversive responses in humans. However, all these animals who are generally disliked have rights to their own existence and play important roles in ecosystems. Here, we used three unpopular live animals (wood louse, snail, and mouse) in practical biology work with 11-13-year-old children (experimental group). The control group had no opportunity to work with animals. Reported disgust and fear of these animals significantly decreased during the study in the experimental group but not in the control group. This study experimentally supports the idea that attitudes toward animals are positively influenced by physical contact with them.

Keywords
animals, children, disgust, fear, practical work

Introduction

Attitudes toward animals in contemporary humans are influenced by human-animal interactions in our evolutionary past (Herzog & Burghardt, 1988) as well as by direct benefits from the economic value of animals (Serpell, 2004). While the latter category is highly flexible and depends mainly on ontogenetic factors, the former category of human-animal interactions (especially those that influenced human survival) is responsible for fears, prejudices, and phobias of dangerous or disease-relevant animals (Öhman & Mineka, 2001).

Arrindell (2000) identified four types of animals that provoke fear: (a) fear-relevant animals (e.g., rat, bat, snake); (b) dry or nonslimy invertebrates (e.g., wasp, beetle, bee); (c) slimy or wet-looking animals (e.g., snail, worm, eel); and (d) farm animals. The author also argued for a fifth type (a predatory

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animals category), found in other studies where larger predators were included in the survey (e.g., Davey et al., 1998). It is generally believed that the evolutionary origin of animal fears is selected by natural selection favoring individuals who successfully avoided or escaped harmful animals (Öhman et al., 2001; Seligman, 1971). Modern humans, even though not under predation pressures like their ancestors, show behavioral adaptations to dangerous animals, such as immediate reflexive responses to rapidly looming objects, loud noises, and striking animals including snakes (Öhman et al., 2001).

The emotion of fear is associated especially with predatory animals that are potentially dangerous to humans (Edmunds, 1974; Seligman, 1971), and the emotion of disgust is primarily related to avoidance of certain animals, ill humans, feces, vomit, sexual substances, and other harmful things (Rozin, Haidt, & McCauley, 2000). An increasing number of studies have showed that disgust is adaptive, because it reduces the probability of transmission of infectious diseases (Prokop, Fančovičová, & Fedor, 2010; Prokop, Uşak, & Fančovičová, 2010a; Prokop, Uşak, & Fančovičová, 2010b; Oaten, Stevenson, & Case, 2009; Stevenson, Case, & Oaten, 2009; Tybur, Lieberman, & Griskevicius, 2009; Navarrete, Fessler, & Eng, 2007; Curtis, Aunger, & Rabie, 2004; Curtis & Biran, 2001).

Although there is apparent intercultural as well as interpersonal sensitivity to disgust (e.g., Schaller & Duncan, 2007; Davey et al., 1998), this emotion is easily conditioned. Conversely, disgust is rigid and resistant to conventional changes (see Curtis et al., 2001 for discussion).

One of the main aims of biology and science educators and of programs focused on nature protection is to develop students' positive attitudes toward living organisms (Iozzi, 1989). Although *emotions, feeling*, or generally the *affective domain* has been a neglected part of science education within the last decades (see, e.g., Gläser-Zikuda, Fuß, Laukenmann, Metz, & Randler, 2005), there is growing awareness of the importance of understanding the emotional processes of learners (Alsop & Watts, 2003). There are at least two lines of interest in the role of emotions in science and biology education. The first line involves the effects of emotions on learning outcomes. For example, Randler, Ilg, and Kern (2005) examined how emotions influenced children's abilities to identify various amphibian species after a conservation program. They found that children with higher levels of anxiety toward amphibians had significantly lower knowledge scores than those who felt less anxious. Holstermann, Grube, and Bögeholz (2009) looked at students' interest in the dissection of a pig's heart, comparing participants who felt more and less disgusted during dissection. Although both groups of participants showed similar interest in the dissection prior to the experiment, students with high levels of disgust saw

themselves as less effective at mastering the dissection and reported lower interest in the heart compared to their counterparts who were less disgust-sensitive. These reports clearly suggest that emotions play a significant role in student achievement, and especially in practical and hands-on work with animals.

The second line involves learners' attitudes toward wild animals. As noted earlier, some animals are less popular and thus are targets of human persecution (e.g., large predators) or intolerance (Røskaft, Händel, Bjerke, & Kaltenborn, 2007; Ericsson & Heberlein, 2003; Treves, Jurewicz, & Naughton-Treves, 2002; Vitterso, Kaltenborn, & Bjerke, 1998), or untrue myths or irrational fear (Prokop, Fančovičová, & Kubiatko, 2009, Prokop, Özel, & Uşak, 2009). Consequently, people are less willing financially to support programs focused on the protection of these unpopular animals in the field (Martín-López, Montes, & Benayas, 2007). This aspect is of special importance for science/environmental educators, because negative attitudes toward animals make any nature protection efforts difficult (if not impossible). Women generally have greater aversion toward unpopular animals (Prokop & Tunnicliffe, 2010; Bjerke, Østdahl, & Kleiven, 2003) probably because they are more disgust-sensitive than men (Prokop, Fančovičová, & Fedor, 2010; Prokop et al., 2010a; Prokop et al., 2010b; Oaten et al., 2009; Tybur, et al., 2009; Curtis et al., 2004).

Animals provide opportunities for detailed observations of their behavior, their external structure, and their life cycles. Some research has showed that school education programs increase participants' knowledge (e.g., Braun, Buyer, & Randler, 2010; Randler & Bogner, 2002, 2006, 2009; Beck, Melson, da Costa, & Liu, 2001; Bogner, 1999) and attitudes toward animals (Ascione & Weber, 1996; Morgan & Gramann, 1989) and that humane education with animals in the classroom resulted in greater social integration, empathy, and lower aggressiveness in comparison to the control group (e.g., Hergovich, Monshi, Semmler, & Zieglmayer, 2002). However, only a few of those focused on animals that elicit fear (Killermann, 1996 [spiders]; Morgan et al., 1989 [snakes]), and none of those studies focused on animals that elicit disgust. This limits any deeper generalizations on whether the use of unpopular animals (albeit equally important in ecosystems) in classrooms influences learners' perception of these animals. Despite the fact that papers have been published emphasizing the need to use specific living animals in classroom science education (e.g., wood lice: Hawkey, 2001), there is a lack of empirical evidence to support these aspects. Here, we experimentally examined whether disgust and fear toward three dissimilar, unpopular animals (mice, snails, and wood lice) could be ameliorated by practical work in traditional school

biology settings. We predicted that physical contact with these animals would make them more agreeable to children; thus the level of disgust and fear would decrease after the study. These two basic human emotions were examined together, because they are compatible and correlate with each other (Prokop & Fančovičová, 2010; Prokop, Fančovičová, & Fedor, 2010; Prokop et al., 2010a, 2010b). Moreover, we predicted that girls would report greater fear and disgust of mice, snails, and wood lice than boys.

Methods

Educational Program

We developed an experimental class series for fifth and sixth graders (10 to 12 years old) lasting three lessons (90 minutes per lesson). In every lesson the pupils encountered a different living animal species. The animals were the mouse (*Mus musculus f. domesticus*), the snail (*Helix pomatia*), and the wood louse (*Porcellio scaber et Oniscus asellus*). In all the experiments, pupils worked together in groups of three or four people. The learning process was largely self-directed, and the pupils carried out all experiments with the living animals on their own (Hummel & Randler, 2010). However, at the start of the lessons, teachers gave instructions about the handling of the animals (how to carry the mouse, the snail, and the wood louse), and about ethical aspects (e.g., not to harm the animals, be careful, etc.). For this purpose, there was a preinstruction session for the respective teachers to show them the correct treatment of the animals. This was done by one of the authors (EH). No pupil was forced to touch the animals. The teachers were present during the lessons, and they oversaw the correct handling and ethical treatment of the animals. During the lessons the pupils had close contact with the animals. For example, in the mouse experiment, pupils observed a house mouse (*Mus musculus f. domesticus*) in an open field test. For this reason, pupils had to put the mouse into the experimental box. In the wood louse experiment, there were choice experiments in petri dishes—i.e., to see whether wood lice prefer dark or light areas, or high versus low humidity. For this purpose, the wood lice were put in petri dishes for three to five minutes and then put back in their box (filled with rotten materials, such as leaves, parts of trees, etc., closely resembling their natural environment). In the snail experiments, pupils observed a snail, for example, creeping over a glass top so they could observe the muscle contractions from below and the feeding of the radula (by using apple pieces and salad). We only used noninvasive methods and experiments (mostly observations) that cen-

tered around the natural behavior of these animals. Further, snails and wood lice were collected in nature and put back in their original places after the experiments were completed. We used large transport boxes for wood lice and snails (a transportable vivarium, resembling their natural habit, but different for snails and wood lice).

Research Design

We employed a typical before/after control-impact design—i.e., disgust was measured before and after the experiment to assess changes, and, in addition, we used a control group that did not receive educational materials but also filled in a pre-test and a post-test with a similar delay as the experimental group. This was made to assure that any changes did not occur by chance or as a result of repeated testing (see, e.g., Keeves, 1998).

Pupil sample

A total of 319 pupils (157 boys, 162 girls) participated in the study. Two hundred and twenty-two received the living animal treatment, and 97 served as a control group that did not receive any intervention. The pupils were fifth and sixth graders (age 10-12 years), and the study was based on a convenience sample of teachers and pupils. For ethical reasons we did not want to urge teachers to participate in a program without their support. Assume, for example, that a teacher is afraid of mice, snails, or wood lice; then he/she did not participate. Further, we did not want to implement any teaching sequence (either with or without animals) against the will of a teacher. The study was approved by the ministry of education in Baden-Württemberg, Germany (Regierungspräsidium Stuttgart #7-6499.20/398). Written consent was obtained from the parents of the pupils, and informed consent was obtained from the pupils.

Instrumentation and Procedure

The development of our scales is based on work dealing with snakes and spiders (Kindt, Brosschot, & Muris, 1996; Haidt, McCauley, & Rozin, 1994). We tested disgust using a scale based on five items (see Table 1).

These items were applied three times to reflect each animal (mouse, wood louse, and snail). For every animal subscale, the mean was calculated, and afterward the total mean was calculated. Pre-test and post-test were identical. Cronbach's alpha was 0.68 (pre) and 0.71 (post) for mouse, 0.73 and 0.76 for wood louse, and 0.69 and 0.68 for snail.

Table 1. Items Used as Measure of Disgust/Fear. (In Each Blank Space, Wood Louse, Mouse, and Snail Should Be Inserted.)

When I am outside and I see a _____ I get frightened.
I think working with real _____ in class would be exciting.*
If the teacher brought living _____ into class, I would prefer to leave the classroom.
_____ are pretty animals.*
_____ are disgusting.

Note: * items are reverse coded.

Statistical analysis

Pearson's correlations were used to assess the relationship between pre-test and post-test. We used t-tests for dependent variables to analyze the changes between pre- and post-test, and a general linear model to assess simultaneously the effect of the experiment and of gender (as well as the interaction between them). We used type III sum of squares for unbalanced designs and partial eta-squared was used as a measure of effect size (0.01 was considered small, 0.04 moderate, and 0.1 large; Huberty, 2002).

Results

Disgust in the pre- and post-test were significantly correlated ($r = 0.643$, $p < 0.001$), both in the experimental group ($r = 0.612$, $p < 0.001$) and the control group ($r = 0.688$, $p < 0.001$). Disgust was significantly higher in girls, both in the pre-test and in the post-test (Table 2). However, in the post-test, there were no differences between boys and girls in disgust toward mice (Table 2).

In addition, in the experimental group, disgust was significantly lower in the post-test (pre: 2.21 ± 0.65 versus post: 1.89 ± 0.58; t-test: $t = 8.494$, $df = 221$, $p < 0.001$; Fig 1), but not in the control group (pre: 2.42 ± 0.61 versus post: 2.33 ± 0.63; group: $t = 1.88$, $df = 96$, $p = 0.063$). This indicates that educational programs are suited to reduce disgust toward animals. However, to assess the influence of pre-test, gender, and experiment simultaneously, we used a general linear model with pre-test as covariate; gender, the experiment, and the interaction between both as fixed factors; and post-test as dependent variable (Table 3).

Table 2. Gender Differences in Disgust/Fear Prior to the Educational Experiment (Both Groups) and Afterward (Experimental Group Only)

Experiment	Gender	N	Mean	SD	T	df	p
Mouse	Boys	157	1.77	.67	–2.176	317	.030
	Girls	162	1.96	.91			
Wood louse	Boys	155	2.43	.82	–5.353	312	.000
	Girls	159	2.98	1.00			
Snail	Boys	156	2.08	.78	–3.497	314	.001
	Girls	160	2.41	.896			
Mouse	Boys	99	1.44	.61	–.464	214	.643
	Girls	117	1.48	.73			
Wood louse	Boys	98	1.78	.65	–5.096	211	.000
	Girls	115	2.31	.82			
Snail	Boys	101	2.01	.72	–2.495	216	.013
	Girls	117	2.28	.83			

Table 3. General Linear Model (GLM) Based on Post-experimental Disgust/Fear as Dependent Variable. Pre-experimental Disgust (Covariate) and Gender and Experiment (Fixed Factors) Were Used as Independent Variables

Source	df	Mean of Squares	F	p	Partial Eta^2
Corrected Model	4	14.965	70.585	.000	.473
Pre-disgust/fear scores	1	37.070	174.842	.000	.358
Experiment	1	6.990	32.969	.000	.095
Gender	1	1.353	6.380	.012	.020
Experiment * Gender	1	.236	1.112	.292	.004

R^2 = .473 (corrected R^2 = .467)

We found a significant and high effect of pre-test on post-test—i.e., pupils scoring high on disgust prior to the study also showed higher scores after the study. Further, a significant influence of gender and experiment were obtained while the interaction experiment*gender was not significant. In detail, girls scored higher on disgust than boys, and pupils in the experimental group showed lower disgust scores.

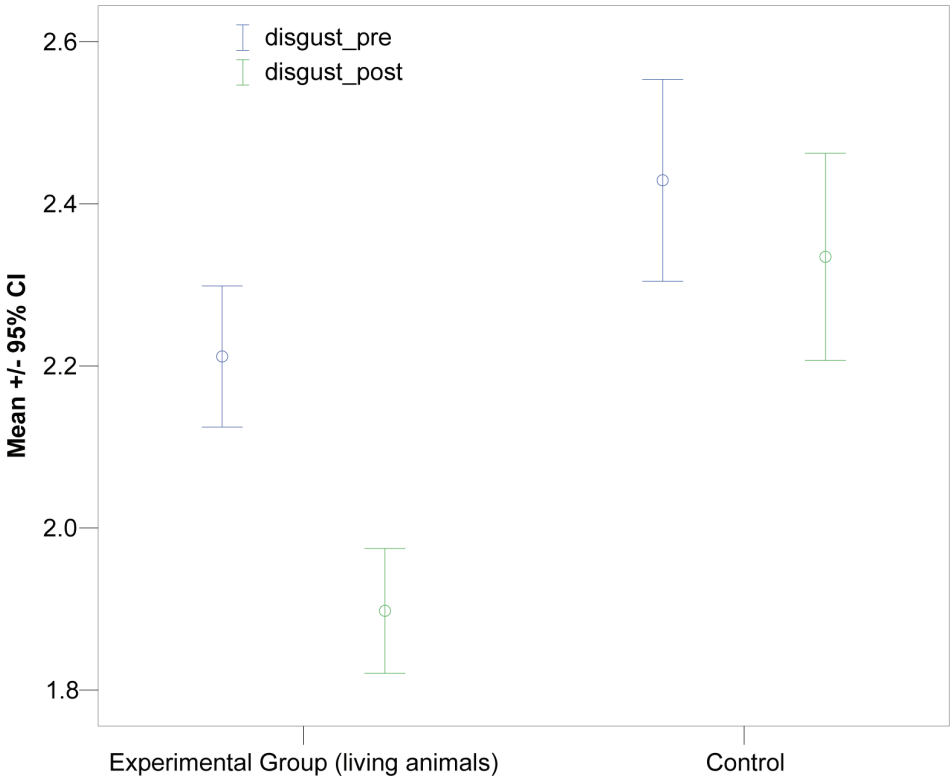

Figure 1. Differences in disgust/fear before and after the experiment in the experimental and control groups.

Discussion

This study investigated whether practical work with three different species of unpopular animals can successfully reduce disgust of students toward them. Further, the results presented here are based on a large sample size, which allows generalization. We examined two predictions:

1. Physical contact with these animals will make them more agreeable to children; thus the level of disgust or fear will decrease after the experiment. In accord with this prediction, disgust/fear of all unpopular animals decreased after the study, but no such pattern was observed in the control group. These results partly corroborate previous research showing that completion of the "snake biology program," focusing both on information about biology of snakes and direct physical contact of children with snakes, resulted in better

knowledge and more positive attitudes toward snakes (Morgan et al., 1989). In contrast, some researchers only reported improved knowledge, but not more positive attitudes toward nonnative birds after the experiment (Braun et al., 2010). These differences could arise because children in the present study (as well as in Morgan and Gramann's study) were allowed to handle individual experimental animals (e.g., by putting the snails from their boxes into a glass pot [NB: please note that the treatment excluded harming, violating, or dissecting]), while the contact with animals in the Braun et al. (2010) study was only observational. Alternatively, these differences could arise because of the different taxa studied in the cited research. This explanation is unlikely, however, because snakes as well as invertebrates are much less preferred by humans than birds (e.g., Bjerke et al., 2003). We propose that physical contact with animals could be responsible for changes in participants' emotions, because physical contact with animals reduces anxiety in humans (Shiloh, Sorek, & Terkel, 2003). In summary, our work supports the idea that contacts with wild animals positively influences the affective area of learners (Hergovich et al., 2002; Ascione et al., 1996; Killermann, 1996; Morgan et al., 1989), namely disgust and fear.

2. Girls will consider mice, snails, and wood lice more disgusting than boys. This prediction was fully supported, because girls rated all three animals higher in disgust/fear than boys. This supports previous works showing that women are more disgust/fear sensitive than men (Prokop, Fančovičová, & Fedor, 2010; Prokop et al., 2010a, 2010b; Oaten et al., 2009; Tybur et al., 2009; Curtis et al., 2004). Evolutionary psychologists agree that greater fear/disgust sensitivity in women has an origin in different investment in offspring (e.g., Navarrete et al., 2007; Curtis et al., 2004), because human females invest more in producing (number and size of gametes, gravidity) and carrying (lactation) offspring than men. Our data do not allow testing this hypothesis, because we did not compare disgust/fear sensitivity of women who actually have or do not have young children. However, our results extend current knowledge about gender differences in the emotions of disgust/fear in young participants of prereproductive age, because most researchers have examined gender differences only in adults (e.g., Tybur et al., 2009; Curtis et al., 2004). This provides evidence for the fact that this evolutionary stable trait is already present before the reproductive period, and hence does not occur during maturation.

Do participants' emotions reflect the risk of contamination?

Visual inspection of fear and disgust toward the three animals studied here showed that wood lice had the highest disgust/fear score, followed by snails and mice. At first glance these results disagree with evolutionary explanations

of the origin of fear and disgust suggesting that these emotions evolved as pathogen avoidance mechanisms (Prokop, Fančovičová, & Fedor, 2010; Prokop et al., 2010a, 2010b; Oaten et al., 2009; Stevenson et al., 2009; Tybur et al., 2009; Navarrete et al., 2007; Schaller et al., 2007; Curtis et al., 2004), because wood lice do not pose a risk of contamination to humans. In contrast, mice—who have been rated lowest in fear/disgust sensitivity—are responsible for spreading diseases like the plague (reviewed by Meerburg, Singleton, & Kijlstra, 2009). In addition, mice are serious crop pests; thus, there are several reasons for negative attitudes toward them (Kaltenborn, Bjerke, & Nyahongo, 2006). How to explain this "mice paradox"? First of all, it should be pointed out that we did not examine children's emotions toward more diverse groups of animals (e.g., disease-irrelevant mammals); thus, these results do not mean that mice are popular animals, but only *relatively* more popular than wood lice and snails. Previous research fully supports this idea (Prokop & Tunnicliffe, 2010; Kaltenborn et al., 2006). Second, mice are more easily handled than snails or wood lice, who are slimy and tiny, respectively. We suggest that the reduced physical contact with snail and wood louse could be at least partly responsible for differences in emotions toward mice relative to invertebrates. Research supports the idea that physical contact with animals is beneficial for reducing anxiety in humans (Shiloh et al., 2003). Third, mice are phylogenetically closer to humans than invertebrates and close similarity positively influences human attitudes toward animals (Herzog et al., 1988). The behavior of mice is more complex than that of invertebrates; thus children could consider them more agreeable. Fourth, emotions that protect humans against pathogens do not react to specific cues triggered by parasites because these may greatly vary; instead they respond in a hypersensitive and overgeneral way to the perceived presence of pathogens in the sensory environment (Schaller et al., 2007). That is, some cues of wood lice (e.g., looking slimy) could be perceived as disgusting, even though this animal is not known to be harmful to humans.

Conclusion

Every child spends a significant proportion of his/her time at school. Science teachers should positively influence children's attitudes toward the environment in general, and toward animals in particular. We showed that practical work with living animals who are easily kept under school laboratory conditions significantly reduces disgust and fear of animals that are generally labeled as unpopular. We therefore recommend the use of living animals in biology lessons, but some aspects have to be considered: First, we do not suggest

invasive experiments (or killing/violating) on the middle-school level, since we agree with abolishing the use of animals as dissection objects in middle-school classrooms. Second, we do not recommend forcing pupils to handle and touch the animals against their will, so pupils with a higher fear might only observe, but not handle, the animals. Third, we strongly recommend a discussion between teachers and pupils about the ethics of using animals in the classroom (keeping them short-term for teaching purposes and returning them to their natural habitats). Fourth, we emphasize the need for thorough instruction about handling the animals prior to the lessons. The benefits should not override the need for the ethical treatment of individual creatures.

Viewed from the pupils' perspective, we cannot simply overlook some animals in biology education just because they elicit some levels of disgust or fear. As all animals have important roles in ecosystems (regardless of whether or not they are disgusting to humans), they need to be included in teaching in schools. It does not seem probable that pupils will build positive attitudes toward all animals if we omit "disgusting" ones. Further, the majority of teachers surveyed believed that the use of live pets in the classroom contributed positively to increased empathy, as well as socioemotional development, in students, much of which is supported by current research (Daly & Suggs, 2010). In addition, personal interactions with living animals provide the best opportunity for the bonding and empathetic response between student and nonhuman animal (Weatherill, 1993; Ascione, 1992; Davis & Balfour, 1992; Shapiro, 1990).

Special attention should be dedicated to the relationship between animals and women/girls, who show greater aversion toward them compared with men/boys. Furthermore, it seems that closer physical contact with these animals has a stronger effect on the reduction of fear and disgust; this question, however warrants deeper attention. More positive attitudes toward animals would contribute to greater willingness on the part of children to understand the role of animals in ecosystems and ecosystem functioning, and their role in protecting and saving our planet.

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