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External insect morphology: A negative factor in attitudes toward insects and likelihood of incorporation in future science education settings

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This study investigated if the external morphology of an insect had a negative effect on United States (US) preservice elementary teacher's attitudes toward insects and beliefs concerning the likelihood of incorporating insects into future science education settings. 270 US kindergarten through sixth grade preservice elementary teachers participated and a randomized design with a control group was used for the study. The participants were shown pictures of three insects (i.e., butterfly, lady beetle or dragonfly) and were asked to rate their attitude toward the insects and beliefs concerning the likelihood of incorporating the insects into future science education settings. The treatment group was shown a picture of the larva and adult stage of the insect. The control group was only shown the adult stage of the insect. Unique to this study, is the finding that the external morphology of an insect is a causal factor that can negatively affect preservice elementary teacher's attitudes toward insects and beliefs concerning the likelihood of incorporating insects into future science education settings. Implications are discussed that can assist preservice teacher training programs.

Keywords: Attitude; Belief; Elementary; Insect; Morphology; Preservice

Introduction

Based upon life history, global biodiversity and sheer numbers, insects are arguably the most evolutionarily and biologically successful group of animals on Earth. Insects perform many essential ecological services for humans that range from the pollination of flowing plants by bees, to the consumption of massive global detritus by cockroaches to a myriad of other phenomenon that make human existence possible (Wilson, 1987). At the same time, humans tend to be uneducated about most insects (Kellert, 1993; Prokop, Prokop & Tunnicliffe, 2008) and view most negatively (e.g., Bjerke, & Østdahl, 2004; Kellert, 1993; Prokop, Uşak & Fančovičová, 2010; Wagler, 2010; Wagler & Wagler, 2011).

Kellert (1993), in his seminal article "Values and Perceptions of Invertebrates," hypothesized that one factor, among other potential factors, that may cause humans to avoid invertebrates "is the possible alienation from creatures so morphologically…unlike our own species" (Kellert, 1993, p. 852). Past observational research (e.g., Prokop, Usak, Erdoğan, Fančovičová, & Bahar, 2011) has implied that insect morphology influences human psychologi-

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cal tendencies (e.g., attitude, fear, disgust and perceived danger) but no experimental studies (i.e., groups were randomly assigned to the treatment or control) has been conducted to verify if a causal relationship exists between the external morphology of insects and other human psychological tendencies and beliefs. The current study attempts to bring clarity to this relationship by investigating possible causal interactions between an insect's external morphology, human attitude toward that insect and the likelihood of incorporating that insect into future science education settings. Specifically, this study investigated if the external morphology of an insect (i.e., butterfly, lady beetle or dragonfly), had a negative effect on United States (US) kindergarten through sixth grade (K-6) preservice elementary teacher attitude toward that insect and belief concerning likelihood of incorporating that insect into future science education settings (henceforth referred to as "likelihood of incorporation"). A randomized design with a control group was used for the study.

Theoretical Underpinnings of the Study

Human attitude is defined as a "psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor" (Eagly & Chaiken, 1993, p.1). Human belief is defined as an estimate of the likelihood that the knowledge one has about an entity is correct or, alternatively, that an event or a state of affairs has or will occur (Eagly & Chaiken, 1998). The past beliefs of humans (1) (See Figure 1) that are linked to a particular entity (i.e., a specific insect) affect the individual's present attitude (2) toward that entity.

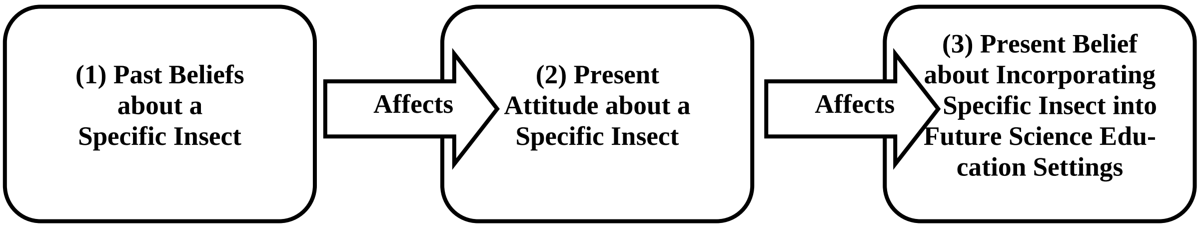

Figure 1. *Association between Human's Past Beliefs, Present Attitude and Present Belief*

That attitude, in turn, affects present beliefs (3) associated with that entity (Kruglanski & Stroebe, 2005; Marsh & Wallace, 2005). The mechanisms by which beliefs influence attitudes and attitudes influence beliefs is based on the way attitudes and beliefs are perceptually organized (Heider, 1958; Albarracín, Johnson & Zanna, 2005), cognitively organized (Osgood & Tannenbaum, 1955; Rosenberg, 1960; Albarracín et al., 2005) and the outcomes of judgmental processes (Sherif, Sherif, & Nebergall, 1965; Albarracín et al., 2005).

Human Psychological Tendencies and Beliefs toward Invertebrates

Little is known about human psychological tendencies and beliefs toward invertebrates. The US general public and farmers possess a limited knowledge of invertebrates (Kellert, 1993). They also tend to express fear and anxiety toward most invertebrates, particularly insects and spiders. Scientists and conservation organization members tend to have a more positive attitude and possess more knowledge about arthropods. "A large majority of the general public indicated a dislike of ants, bugs, beetles, ticks, cockroaches, and crabs; an aversion to insects in the home; a fear of stinging insects, spiders, and scorpions; a desire to eliminate mosquitoes, cockroaches, fleas, moths, and spiders; and a view of the octopus and cockroach as highly unattractive animals. Farmers generally expressed views similar to those of the general public" (Kellert, 1993, p. 849).

A more positive view of specific invertebrates occurs when that animal is deemed by a human to have utilitarian value (e.g., shrimp). Farmers, in a general sense, tend to display more emotionally detached, antagonistic and pragmatic attitudes toward invertebrates and largely view them as a source of material gain or a threat. Scientists and conservation organization members indicate a "greater interest in direct . . . contact with invertebrates" (Kellert, 1993, p. 849) and express "relatively appreciative and protectionist attitudes toward invertebrates" (Kellert, 1993, p. 851.)

In a study addressing invertebrate and vertebrate animals, Norwegian children and adolescent's degree of preference for animals varied depending on the type of animal (Bjerke, Odegardstuen & Kaltenborn, 1998). The bee, spider, worm and crow were found to be the least favorite species while the "dog, cat, horse, and rabbit were the favorite species" (Bjerke, Odegardstuen & Kaltenborn, 1998, p. 224). Very few of the studies participants were willing to save ecologically-significant insects (i.e., ants, bees and lady beetles) from going extinct (Bjerke, Odegardstuen & Kaltenborn, 1998).

The attention that children, the media and the scientific community give to insects and other arthropods has also been investigated (Snaddon & Turner, 2007). The study assessed the popularity of different arthropod groups drawn by United Kingdom (UK) children, "in modern culture and in the scientific literature (Snaddon & Turner, 2007, p. 33). It was found that UK children's preference for insect groups was strongly correlated with their representation in the scientific literature and in modern culture. It was also found that none of the three measures of popularity of the arthropod groups "correlated with their abundance or conservation status in the UK" (Snaddon & Turner, 2007, p.33). Snaddon and Turner (2007) suggest that the profile of lesser-known arthropod groups "needs to be raised to reduce the chance that threatened taxa are overlooked for conservation action (Snaddon & Turner, 2007, p.33).

Slovak elementary school "children showed misunderstandings of internal organs of invertebrates and ascribed an internal skeleton to them in their drawings. This drawing of bones inside invertebrates was mostly among younger children (up to age of 10)" (Prokop, Prokop & Tunnicliffe, 2008, p. 444). Of the 2,438 animals reported as pets, by the 1,252 participating children, only ten were invertebrates. The findings of the study suggest that "biology/science teachers should encourage children to keep a diverse range of animals, particularly invertebrates that can be obtained and reared easily" (Prokop, Prokop & Tunnicliffe, 2008, p. 446) and "that science activities with animals should be more focused on rearing invertebrates and improving children's attitudes and knowledge about them" (Prokop, Prokop & Tunnicliffe, 2008, p. 431).

Slovakian primary school children possessed better knowledge of unpopular animals (i.e., potato beetle, wolf and mouse) compared to popular animals (i.e., rabbit, lady beetle and squirrel) even though they had less favorable attitudes towards unpopular animals (Prokop & Tunnicliffe, 2010). Participants that had pets in their house had better knowledge and more positive attitudes of both popular and unpopular animals. "Girls were less favorably inclined than boys to animals that may pose a threat, danger, or disease to them" (Prokop & Tunnicliffe, 2010, p. 21).

A strong statistically significant association has been found between US kindergarten through fourth grade (K-4) preservice elementary teacher's attitudes towards a specific animal and their likelihood to include or exclude that animal from their future science curriculum (Author, 2010). Specifically, if a K-4 preservice elementary teacher had a positive attitude toward an animal they were much more likely to believe they would use that animal in their future science curriculum. Conversely, if a K-4 preservice elementary teacher had a negative attitude toward an animal they were much more likely to believe they would not use that animal in their future science curriculum.

Based on these beliefs the science learning environment that the vast majority of the US preservice elementary teachers in the study would construct for their future students would be dominated by mammals (Wagler, 2010). The learning environment would be void of any invertebrates (e.g., sponges, corals, worms, mollusks, insects [Excluding the adult butterfly], crustaceans, and arachnids), amphibians and reptiles. Wagler's study (2010) provided the first empirical evidence that a preservice elementary teacher's attitude toward an animal affected their belief about using that animal in their future science curriculum.

US K-4 preservice elementary teachers that received frequent direct contact with Madagascar hissing cockroaches *(Gromphadorhina portentosa)* in an education setting during their preservice teacher training program had their attitudes and likelihood of arthropod incorporation in future science curriculum changed in a positive way toward the Madagascar hissing cockroaches but not toward other arthropods that they did not have contact with (Wagler & Wagler, 2011*)*. A pre/post randomized design with a control group was used for the study. The non-contact arthropods included a butterfly, lady beetle, dragonfly, grasshopper, spider, crayfish, millipede, centipede and scorpion. This finding provided evidence that in order to positively change preservice elementary teacher attitudes and incorporate beliefs toward a specific animal, frequent direct contact in an educational setting with that specific animal is needed (Wagler & Wagler, 2011*)*.

Methodology

Research Questions

Research Question 1: Does the external morphology of an insect (i.e., butterfly, lady beetle or dragonfly) have a negative effect on US K-6 preservice elementary teacher attitude toward that insect?

Research Question 2: Does the external morphology of an insect (i.e., butterfly, lady beetle or dragonfly) have a negative effect on US K-6 preservice elementary teacher belief concerning likelihood of incorporating that insect into future science education settings?

Study Participants

Treatment and Control Group

The participants for the study were registered in an elementary science education methods course and enrolled in the last year of their bachelor's degree program at a midsized urban southwestern US border region university with a predominantly Hispanic/Latino population. The treatment group consisted of 138 US K-6 preservice elementary teachers and the control group consisted of 132 US K-6 preservice elementary teachers. All of the participants were non-science majors training to teach K-6 grade students (i.e., approximately 5 to 12 years of age) and had not taken a university course in invertebrate biology. Of the 138 participants in the treatment group, 130 were female and 8 were male. The participants mean age was 28.64 years. 128 were Hispanic/Latino, 6 were White, 3 were Black and 1 was Asian. Of the 132 participants in the control group, 127 were female and 5 were male. The participants mean age was 27.81 years. Of the 132 participants, 126 were Hispanic/Latino, 5 were White and 1 was Black.

Study Procedure

The data collection for the treatment and control group occurred in university classrooms on the first day of the elementary science education methods course before any course information had been presented. The participants of both groups were shown pictures of the insects using a Microsoft PowerPoint presentation. For the treatment group, a picture of the larva stage of the insect was shown first. They were then shown the adult stage of the same insect and were then told "These two pictures are of the same animal." They were then asked to rate their attitude (Likert scale: Extremely Negative [1], Negative [2], Neutral [3], Positive [4], Extremely Positive [5]) toward the animal shown and their likelihood of incorporating (Likert scale: Extremely Unlikely [1], Unlikely [2], Likely [3], Extremely Likely [4]) the animal shown into future science education settings. This procedure occurred for all three insects (i.e., butterfly, lady beetle and dragonfly). The procedure for the control group was identical to the treatment group except they were *only* shown the adult stage of the insect.

It was explained to the students that the "incorporation of the animal shown" could take any form that referenced the animal. Examples were given that included bringing or allowing the actual animal into the classroom, developing or using a science activity that utilized the animal, reading a classroom story that discussed the animal, showing a video with the animal present in the video, having a picture of the animal in the classroom, having the students write a paragraph or draw pictures that incorporated the animal or any other type of media that addressed the animal in any way. It was further clarified to the participants that these were some examples and that they may be thinking of other examples of incorporating the animal into their future science classroom and that any of these "ways of incorporating" would apply to rating the likelihood of incorporating the animal shown into their future science classroom.

Selection of Insect Pictures

Three insects were chosen for the study. The three insects were the lady beetle, dragonfly and butterfly. These three insects were chosen for two reasons. First, because of the population's (i.e., preservice elementary teachers) past tendency to have extremely positive attitudes and extremely likely incorporation rates for the adult stage of the insects (Wagler, 2010; Wagler & Wagler, 2011). This allowed the researchers to observe whether attitudes and likelihood of incorporation were negatively affected by manipulating one variable (i.e., insect external morphology). Without choosing insects with extremely positive attitudes and extremely likely incorporation rates, a floor effect would likely be observed. That is, if the insect already has the lowest possible rating, it is not possible to measure a change in attitude or likelihood of incorporation in the negative direction.

Secondly, these three insects were chosen because the insect species larva (i.e., lady beetle and butterfly) or nymph (i.e., dragonfly) stage looks morphologically different than the adult stage. See Figure 2 and 3 for an example of these differences in the lady beetle. Note the external morphological differences that are visually apparent between the larva (Figure 2) and the adult (Figure 3) stage. An insect of this type is also essential to assessing the studies two research questions versus an insect, such as a Madagascar hissing cockroach, where the nymph's external morphology is almost identical to the adult. These insects were used to see if difference external morphologies of the same insect (e.g., larva versus adult) evoked different attitudes and likelihood of incorporation rates.

Photograph used with permission (Photograph by Derrick Ditchburn)

Figure 2. *Lady Beetle Larva*

Randomization of Study

All university science education methods course sections were randomized into a treatment or control group. The sections, and hence, treatment and control groups were homogenous with respect to gender, age and ethnicity. Homogeneity tests comparing the ethnicity, age and gender of the preservice teacher groups demonstrate that the treatment and control group were very similar with respect to these demographic characteristics ($p_{ethnicity}$=1, p_{age}=0.58, p_{gender}=1). Due to the homogeneity of the treatment and control groups and random assignment of these sections, any observed difference in the attitude or likelihood of incorporation between the treatment and control groups is attributable to the additional information provided to the treatment group (i.e., viewing the external morphology of *both* stages of the insect).

Results

Table 1 presents the overall mean attitude and overall mean likelihood of incorporation for all three insects for the treatment and control group. The treatment group's attitude and likelihood of incorporation rates are based on viewing the external morphology of *both* stages of the insect. The control group's attitude and likelihood of incorporation rates are based on viewing the external morphology of *only* the adult stage of the insect.

Photograph used with permission (Photograph by Derrick Ditchburn)

Figure 3. *Adult Lady Beetle*

The attitude and likelihood of incorporation responses are ordinal level random variables. However, with large sample sizes they may be treated as continuous random variables (Agresti, 2004). To ensure that the statistical method does not affect the results, the analysis is conducted using proportional odds ordinal logistic regression models which treat the responses as ordinal level variables and hypothesis tests which directly compare the means of the responses.

Proportional Odds Ordinal Logistic Regression Model Results

Proportional odds ordinal logistic regression models (Agresti, 2004) are utilized to assess whether the response pattern is homogeneous across the treatment and control groups. Interaction terms involving the animal and treatment groups are modeled to allow different effects due to animal type and by treatment group membership. For the model with animal attitude as a response, all interaction terms are statistically significant (all Wald test p-values < 0.0001), implying there is a change in attitude towards each animal that depends on inclusion in the treatment or control group. Additionally, the p-value associated with the treatment slope parameter demonstrates that the patterns differ across the treatment and control groups (Wald test p-value<0.0001). Similar results are obtained for the likelihood of incorporation scores with all p-values for the interaction slope parameters less than 0.0001. Also, the treatment slope parameter is also statistically significant (Wald p-value < 0.0001). Taken together, this provides strong evidence of an effect on belief about likelihood of incorporation that depends both on the animal being considered and inclusion in the treatment group.

Table 1. *Overall Means (Standard Deviation) for Attitude and Likelihood of Incorporation*

Insect	Treatment Group		Control Group	
	Attitude	Likelihood of Incorporation	Attitude	Likelihood of Incorporation
Lady Beetle	3.46 (1.09)	2.87 (0.75)	4.51 (0.75)	3.69 (0.55)
Dragonfly	3.24 (0.69)	2.75 (0.64)	4.39 (0.64)	3.49 (0.60)
Butterfly	3.58 (1.04)	2.93 (0.81)	4.66 (0.56)	3.81 (0.39)

Note. Attitude Likert Scale (Extremely Negative [1], Negative [2], Neutral [3], Positive [4], Extremely Positive [5]); Likelihood of Incorporation Likert Scale (Extremely Unlikely [1], Unlikely [2], Likely [3], Extremely Likely [4]).

Comparing Measures of Center

Analogous results are obtained when treating the responses as continuous. Two-sample t tests assess whether the mean scores differ for the two groups and Wilcoxon rank sum tests compare the locations of the treatment and control groups for each animal and response. Standard deviations between the treatment and control groups for attitude and likelihood and across all three insects were relatively homogeneous with the exception of the butterfly group. The ratio of the standard deviations for butterfly attitude and likelihood of incorporation were greater than 2. Thus, these t tests will assume unequal variances while the remaining assume equal variability between groups. Table 2 displays the results of the analysis for both the t tests and the Wilcoxon rank sum tests. These results confirm that there is a difference in the mean score, and similarly location, for the treatment and control groups across all insects and for both sets of scores (i.e., attitude and likelihood of incorporation).

Table 2. *Results Comparing Means and Locations for Treatment Group versus Control Group*

Attitude	T test p-value	Wilcoxon p-value
Dragonfly Treatment versus Control	p<0.001	p<0.001
Butterfly Treatment versus Control	p<0.001	p<0.001
Lady Beetle Treatment versus Control	p<0.001	p<0.001
Likelihood of Incorporation	**T test p-value**	**Wilcoxon p-value**
Dragonfly Treatment versus Control	p<0.001	p<0.001
Butterfly Treatment versus Control	p<0.001	p<0.001
Lady Beetle Treatment versus Control	p<0.001	p<0.001

Discussion

Findings

This is the first study to assess if a causal relationship exists between the external morphology of insects and other human psychological tendencies and beliefs. This study utilized a randomized design with a control group. The only manipulated variable in the study was the external morphology of the insect. This occurred when the researcher told the treatment participants 'These two pictures are of the same animal' thereby informing the treatment participants that the animal possessed two external morphologies. Based on the analysis of the data we can conclude that the external morphology of the three insects is a factor that influences the attitude and likelihood of incorporation of the treatment group when compared to the control group. Specifically, based on the observed differences in the Likert-scale scores and associated p-values of the groups (i.e., treatment and control); we can conclude that the external morphology of the butterfly larva, lady beetle larva and dragonfly nymph negatively affected the attitude and likelihood of incorporation of the preservice elementary teachers (see Table 1 and 2). These findings are unique to this study.

Implications

This study presents evidence, in a randomized controlled setting that confirms that the external morphology of an insect is a factor that can negatively affect preservice elementary teacher attitude toward insects and the likelihood of incorporating them into future science education settings. This is apparent after the attitude and likelihood of incorporation of the preservice elementary teacher significantly declined after the external morphology of all three insects changed.

The functional external morphology of insects is one of the major factors that have allowed insects to be so successful in virtually every niche on Earth. Biological evolution has equipped insects with innumerable types of external morphological characteristics which have, in part, allowed them to dominate Earth for over 400 million years. The external morphological differences between insects and humans vary greatly at all stages in their development. This is most apparent when comparing body architecture (e.g., head, thorax and abdomen), appendages (e.g., antennae, setae, legs and ovipositor) and life cycles (e. g., egg, larva, pupae and adult). When humans interact with an insect quite often the first sensory stimulus they receive is the insect's external morphology. These external morphological characteristics serve a functional purpose for the insect but, as this study shows, can also serve as a negative stimulus impacting human attitude and likelihood of incorporation.

Past research has shown children prefer mammals over insects and are not willing to save ecologically-significant insects (Bjerke, Odegardstuen & Kaltenborn, 1998). Further research has shown children possess less favorable attitudes towards specific insects (Prokop & Tunnicliffe, 2010), have misconceptions about their morphology (Prokop, Prokop & Tunnicliffe, 2008) but those that have direct experiences with animals have a more positive attitude and are more willing to study animals (Prokop, Özel, Uşak, 2009; Tomažič, 2008; Tomažič, 2011). Because of the vast number of essential ecological roles insects play in the biosphere, *not* incorporating these insects into science education settings has detrimental effects on the preservice elementary teacher's future students understanding of insect's life cycles, food chains, food webs and a myriad of other ecosystem interactions. Awareness that the external morphology of an insect can negatively affect attitude and likelihood of incorporation can assist preservice teacher training programs.

Prior research has shown the benefits of incorporating activities with living insects into elementary science education methods courses (Wagler & Wagler, 2011). Based on the findings of this study it is suggested that during these insect activities instructors of elementary science education methods courses increase preservice elementary teacher's awareness of the functional external morphology of insects with the central question being "From a functional perspective, why do these insects look the way they do?" Ideally, these insect activities should allow preservice elementary teachers to interact with diverse types of living insects (Wagler & Wagler, 2011) at different stage of their development (Shepardson, 2002) but if living insects are not available pictures and videos of insects can be used to emphasis the functional external morphology of insects during their science education methods course.

For example, all of the external morphological characteristics of the lady beetle larva (See Figure 2) that were found to negatively impact the preservice elementary teacher's attitude and likelihood of incorporation are the same characteristics that have made it so biologically successful (Koch, 2003) and can be emphasized during their science education methods course. The lady beetle larva's elongated somewhat flattened and alligator shaped body, which is integrated with six grasping legs, allow the larva to move very quickly and efficiently on plants to catch and eat prey (Osawa, 2000). The larva are also equipped with chewing mouthparts which allow them to consume large numbers of aphids, mites, scale insects, flies and other arthropods (Koch & Hutchison, 2003; Lucas, Coderre & Vincent, 1997; McClure, 1986; Tedders & Schaefer, 1994). The yellowish orange colors on the predominantly black larva serve as a warming to potential predators. If attacked by a predator a noxious fluid is released by the larva's body and protruding flexible spines (Dettner, 1987).

The insect activities should also incorporate discussions and information about the mechanisms of biological evolution (e.g., natural selection) and how these mechanisms have changed the gene frequency within a population over time. The preservice elementary teachers should be made aware that one of the ways humans observe this change is in the phenotypic expressions we see in the great diversity of insect species external morphological characteristics. Insect activities should also allow preservice elementary teachers to compare the differences of insect's external morphology with the external morphology of other arthropod groups such as arachnids, myriapods and crustaceans (Shepardson, 2002). Furthermore, activities in natural environments that allow observations of insects and other arthropods further solidify the relationships between the species functional external morphological characteristics, the species habitat and the species biological evolution.

Limitations of the Study

Because the pictures of the three insects were projected on a screen, the insects appeared bigger than they actually are. The pictures were also two dimensional compared to the actual insects that are three dimensional.

Conclusion

The incorporation of biodiverse insects into education setting is important to students understanding of ecosystems. One of the factors preventing preservice elementary teachers from including biodiverse insects in science education settings is the external morphology of an insect. Insect activities that help preservice elementary teachers become aware of why insects look the way they do have the potential to positively change attitudes, increase the likelihood of insect incorporation into science education settings and increase students knowledge of ecosystem interactions.

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Dış böcek morfolojisi: Böceklere karşı tutumda olumsuz bir etken ve gelecekte fen eğitimine entegrasyonu ihtimali

Bu çalışma, bir böceğin dış morfolojisinin Amerika Birleşik Devletlerindeki ilköğretim öğretmenlerinin böceklere karşı negatif bir tutum oluşturup oluşturmadığını ve böceklerin gelecekte fen eğitiminde entegrasyonu ihtimaline ilişkin onların inançlarını araştırmayı amaçlamıştır. Çalışmaya iki yüz yetmiş anaokulundan altıncı sınıfa kadar değişen öğretmen katılmıştır ve kontrol-deney grubu içeren bir araştırma tasarlanmıştır. Katılımcılara üç böceğin (kelebek, uğur böceği ve helikopter böceği) resimleri gösterilmiştir ve bu böceklere karşı tutumlarını derecelendirmeleri, gelecekteki fen eğitimine entegrasyonlarının yapılmasına ilişkin inançlarını belirtmeleri istenmiştir. Deney grubuna larva ve ergin durumdaki bir böceğin resmi gösterilmiştir. Kontrol grubuna sadece ergin bireyin resmi gösterilmiştir. Bu çalışmaya özgü olarak, bir böceğin dış morfolojisinin ilköğretim öğretmenlerinin böceklere karşı tutumunu ve bunları gelecekteki fen eğitimi dairesinde kullanılmasını olumsuz etkilediğini bulunmuştur. Çalışmanın olası etkileri servis öncesi öğretmen eğitimi programlarına yardım amaçlı olarak çalışılmıştır.

Anahtar kelimeler: Tutum; İnanç; İlköğretim; Böcek; Morfoloji; Servis öncesi