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Spiders are special: fear and disgust evoked by pictures of arthropods☆

Antje B.M. Gerdes[a,1], Gabriele Uhl[a,b,1], Georg W. Alpers[a,c,*]

[a]University of Würzburg, Würzburg, Germany
[b]University of Bonn, Bonn, Germany
[c]University of Bielefeld, Bielefeld, Germany

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Abstract

Because all spiders are predators and most subdue their prey with poison, it has been suggested that fear of spiders is an evolutionary adaptation. However, it has not been sufficiently examined whether other arthropods similarly elicit fear or disgust. Our aim was to examine if all arthropods are rated similarly, if only potentially dangerous arthropods (spiders, bees/wasps) elicit comparable responses, or if spiders are rated in a unique way. We presented pictures of arthropods (15 spiders, 15 beetles, 15 bees/wasps, and 15 butterflies/moths) to 76 students who rated each picture for fear, disgust, and how dangerous they thought the animal is. They also categorized each animal into one of the four animal groups. In addition, we assessed the participants' fear of spiders and estimates for trait anxiety. The ratings showed that spiders elicit significantly greater fear and disgust than any other arthropod group, and spiders were rated as more dangerous. Fear and disgust ratings of spider pictures significantly predicted the questionnaire scores for fear of spiders, whereas dangerousness ratings of spiders and ratings of other arthropods do not provide any predictive power. Thus, spider fear is in fact spider specific. Our results demonstrate that potential harmfulness alone cannot explain why spiders are feared so frequently.

Keywords: Spider phobia; Biological preparedness; Evolution; Fear; Disgust; Estimated risk

1. Introduction

For humans, spiders are among the top five most feared animals; in the UK, about 30% of women and 20% of men are anxious, nervous, or frightened when confronted with a spider (Davey, 1994a). A specific phobia (see Hofmann, Alpers, & Pauli, 2009) of spiders has been documented to be the most prevalent phobia related to animals, with a prevalence rate of 3.5% (Jacobi et al., 2004). Moreover, spiders are preferentially processed in the visual system by those who fear them (e.g., Alpers et al., in press; Gerdes, Alpers, & Pauli, 2008).

The observation that some stimuli, such as spiders and snakes, are feared with higher probability than other animal groups or objects is often explained in terms of biological preparedness (Seligman, 1971). This hypothesis is based on the fact that most spiders and many snakes are predatory animals and possess venom to immobilize their prey. They are thus thought to have been potentially hazardous for our pretechnological ancestors. Seligman defined *prepared fear learning* by the following criteria: learning is specific to selective cues, is noncognitive, is highly resistant to extinction, and can be acquired in one trial. For example, laboratory-raised rhesus monkeys are less afraid of snakes compared with those raised in the wild (Mineka, Keir, & Price, 1980), but they acquire this fear easily (Mineka, Davidson, Cook, & Keir, 1984) and retain it (Mineka & Keir, 1983; Mineka et al., 1980).

Further support for the preparedness hypothesis comes from conditioning experiments (Öhman, Erixon, & Lofberg, 1975). When pictures of spiders and snakes served as conditioned stimuli that predicted mildly aversive shock, participants showed stronger and lasting skin

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* Corresponding author. Department of Psychology, University of Würzburg, Marcusstrasse 9-11, 97070 Würzburg, Germany. Tel.: +49 931 312840; fax: +49 931 312733.

E-mail address: alpers@psychologie.uni-wuerzburg.de (G.W. Alpers).

[1] A.B.M. Gerdes and G. Uhl contributed equally to this work.

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conductance responses (an index of emotional activation) than when flower or mushroom pictures were paired with the shock. In addition, the conditioned fear to these stimuli was significantly more resistant to extinction (Öhman et al., 1975). Based on the resistance to extinction documented for experimentally acquired responses (McNally, 1987), the preparedness hypothesis has been widely accepted and entered almost every textbook on biological psychology and abnormal psychology, although evidence for other characteristics of preparedness (ease of acquisition, irrationality, and belongingness) is much more limited (McNally, 1987).

From an evolutionary perspective (for overviews, see Nesse, 1990), readily associating spiders with fight-or-flight responses should have a selective advantage for humans because spiders are potentially hazardous. Indeed, most arthropods, such as arachnids (e.g., spiders and scorpions) and hymenoptera (bees, wasps, ants), are venomous. However, although arthropods make up 75% of the world's animal species, only few come in direct contact with humans and even fewer cause significant medical problems. As to spiders, of all known species (about 38,000), very few (approximately 0.1%–0.3%) are considered to cause significant morbidity or mortality (Foelix, 1996; Maretić, 1987; Steen, Carbonaro, & Schwartz, 2004). Since spiders generally prey upon insects or other spiders, their venom has not evolved to harm large vertebrates such as humans. Spiders rarely use venom in response to vertebrates for defense and generally do so as a last resort (Foelix, 1996). Moreover, most studies of spider bites have been retrospective and bites have not been confirmed by eyewitnesses (Diaz, 2004). For example, 80% of suspected cases of spider bites in Southern California were caused by other arthropods, mostly ticks and reduviid bugs (Russel & Gertsch, 1982).

The other potentially hazardous arthropod group is the order Hymenoptera (bees, wasps, ants). Many have evolved highly specialized poison glands that are generally used for defense and, by some, to overcome prey. Overall, even potent honeybee or wasp venom did not evolve to kill but to repel large vertebrates trying to intrude onto nests (Schmidt, 1990). Hence, the response to the venom is very fast and partly caused by activated pain receptors that cause pain out of proportion to the wound inflicted (Schmidt, 1990). Although the dose that causes mortality in 50% of nonallergic human individuals (lethal dose=50) was estimated to be 500–1500 bee stings (Camazine, 1988; Michener, 1975), Mejia, Arbelaez, Henao, Sus, and Arango (1986) reported that receiving more than 1000 stings can indeed be lethal. Stings of bees and wasps are a significant hazard because of their high incidence and ability to produce fatal anaphylactic reactions or respiratory dysfunctions at least in hypersensitive humans (Habermann, 1974; Habermehl, 1987). Compared with spider stings, bee and wasp stings are aggravated by the facts that humans encounter bees and wasps more often, encounters usually occur in swarms (Maretić, 1987; Schmidt, 1990), and encounters often occur near food sources.

Despite the low mortality risk from stings, spiders and bees/wasps (Hymenoptera) still differ from other groups of small animals in terms of potential harmfulness, which may have resulted in a selective advantage for avoidance responses and increase in fear. Surprisingly, there hardly exists any information on fear of arthropods other than the highly prevalent fear of spiders. A small number of single case reports show that these fears (e.g., fear of wasps or other insects) exist but that their prevalence may be very low (Brown, Abrahams, & Helbert, 2003; Elsesser, Heuschen, Pundt, & Sartory, 2006; Jones & Friman, 1999). Contrary to this observation, the underlying rationale of the preparedness hypothesis would lead us to expect a stronger overlap of fear of spiders and other venomous arthropods. Alternatively, disgust instead of fear may play a special role in the common aversive behavior toward spiders (Davey, 1992). The disgust hypothesis postulates that emotional responses to spiders are culturally transmitted (Davey, 1994b) because these animals were historically associated with disease and infection from medieval times onward. However, it is unclear why mainly spiders, and not other "creepy crawlies," have been considered to be responsible for infections and disease.

Contrary to spiders, some beetles infest food items, and preparedness for aversive responses to them, specifically the experience of disgust, is plausible. Taken together, it has not been convincingly documented that specific spider cues should be prepared for conditioning of fear or disgust in humans. Other arthropods that are comparable in terms of venomousness, appearance, or behavior to spiders may elicit similar reactions, but cultural transmission may exert strong biases on verbal labeling. Individuals who report being afraid of spiders may stick with a cultural stereotype ("fear of spiders is common"), although their fears may be much less specific than commonly thought. A variety of arthropods may elicit fear or disgust (e.g., beetles), but "fear of spiders" may merely be a culturally accepted verbal label for a wide spectrum of animal fears (see Wenegrat, 2001).

A necessary first step is therefore to investigate if *different* kinds of arthropods are perceived similarly, if only a subset (i.e., poisonous ones such as spiders and bees/wasps) elicits comparable responses, or if spiders are special. To this end, we compared ratings of fear and disgust elicited by grayscale pictures of spiders (Araneae), bees and wasps (Hymenoptera), beetles (Coleoptera), as well as butterflies and moths (Lepidoptera). Because it is not known as to what extent individuals are aware of the degree of harmfulness of the depicted animals, we collected estimates of harmfulness for each animal. Possible discrepancies between high fear ratings and low estimates for harmfulness could be interpreted as evidence for the irrationality of a fear (Seligman, 1971). Because individuals with high levels of fear of spiders (i.e., phobic fear) may be particularly prone to