

**Question 1-11 are based on the following passage.**

This passage is excerpted from Leyra Castro and Ed Wasserman, "Crows Understand Analogies," © Scientific American 2015.

A recent research collaboration has discovered that crows exhibit strong behavioral signs of analogical reasoning—the ability to solve puzzles like "bird is to air as fish is to what?"

Line Analogical reasoning is considered to be the pinnacle of  
5 cognition and it only develops in humans between the ages of three and four.

Why might crows be promising animals to study? Of course, crows are reputed to be clever. Aesop's famous fable "The Crow and the Pitcher" tells of a crow solving a  
10 challenging problem: the thirsty crow drops pebbles into a pitcher with water near the bottom, thereby raising the fluid level high enough to permit the bird to drink. Such tales are charming and provocative, but science cannot rely on them.

Recent scientific research sought to corroborate this fable.  
15 It found that crows given a similar problem dropped stones into a tube containing water, but not into a tube containing sand. Crows also chose to drop solid rather than hollow objects into the water tube. It thus seems that crows do indeed understand basic cause-effect relations.

But, what happens when crows are given problems that require more abstract thinking? Before setting our sights on analogical reasoning, we might begin with a simpler abstract task. For example, sameness and differentness are key  
20 abstract ideas, because two or more items of any kind—coins, cups, caps, or cars—can be the same as or different from one another. Because sameness and differentness can be detected visually, perhaps that may provide an elegant way to study their apprehension by nonverbal animals.

To do so, we present visual stimuli on a touchscreen  
30 monitor. We reward animals with food for contacting one button when sets contain identical items and we reward animals for contacting a second button when sets contain non-identical items. Several species of birds and mammals learn this task and also transfer their learning to new stimuli,  
35 showing that they have learned an abstract concept, which extends beyond the training items.

Devising a task to study analogical thinking in animals is the next step. Here, the gist of analogy can be captured by arranging a matching task in which the relevant logical  
40 arguments are presented in the form of visual stimuli. Using letters of the alphabet for explanatory purposes, choosing test pair BB would be correct if the sample pair were AA, whereas choosing test pair EF would be correct if the sample pair were CD. Stated logically, A:A as B:B (same = same)  
45 and C:D as E:F (different = different). Critically, no items in the correct test pair physically match any of the items in the sample pair; so, only the analogical relation of sameness can be used to solve the task.

Now, we have found that crows too can exhibit analogical

50 thinking. Ed Wasserman, one of the authors of this article, and his colleagues in Moscow, Anna Smirnova, Zoya Zorina, and Tanya Obozova, first trained hooded crows on several tasks in which they had to match items that were the same as one another. The crows were presented with a tray containing  
55 three cups. The middle cup was covered by a card picturing a color, a shape, or a number of items. The other two side cups were also covered by cards—one the same as and one different from the middle card. The cup under the matching card contained food, but the cup under the nonmatching card  
60 was empty. Crows quickly learned to choose the matching card and to do so more quickly from one task to the next.

Then, the critical test was given. Each card now pictured a pair of items. The middle card would display pairs AA or CD, and the two side cards would display pair BB and pair  
65 EF. The relation between one pair of items must be appreciated and then applied to a new pair of items to generate the correct answer: the BB card in the case of AA or the EF card in the case of CD. For instance, if the middle card displayed a circle and a cross, then the correct choice  
70 would be the side card containing a square and a triangle rather than the side card containing two squares.

Not only could the crows correctly perform this task, but they did so spontaneously, from the very first presentations, without ever being trained to do so.

75 It seems that initial training to match identical items enabled the crows to grasp a broadly applicable concept of sameness that could apply to the novel two-item analogy task. Such robust and uninstructed behavior represents the most convincing evidence yet of analogical reasoning in a  
80 non-primate animal.

Percentage of Crows Correct Responses in 8 Sessions of Identical-Matching Tasks

Bird	Crow 1			Crow 2		
	Object Dimension	Size	Shape	Color	Size	Shape
Session 1	77.8	75.0	66.7	75.0	63.9	77.8
Session 2	75.0	80.6	80.6	72.2	63.9	72.2
Session 3	86.1	61.1	86.1	72.2	63.9	72.2
Session 4	86.1	69.4	75.0	66.7	75.0	80.6
Session 5	72.2	80.6	69.4	86.1	83.3	86.1
Session 6	80.6	69.4	75.0	72.2	66.7	83.3
Session 7	77.8	63.9	63.9	86.1	75.0	77.8
Session 8	80.6	66.7	91.7	80.6	77.8	80.6
Sessions 1-8 (averaged)	79.5	70.8	76.0	76.4	71.2	78.8

Adapted from Anna Smirnova et al., "Crows Spontaneously Exhibit Analogical Reasoning." (C) 2015 by Elsevier Ltd.

1

The main purpose of the passage is to

- A) present research approaches used to determine that crows may be able to think analogically.
- B) show that crows have been proven to be the smartest of all non-primate animals.
- C) argue that crows need proper training in order to perform complex and advanced tasks.
- D) explain that scientists' understanding of crows likely will progress rapidly following a recent study.

2

As used in line 2, "strong" most nearly means

- A) powerful.
- B) compelling.
- C) intense.
- D) extreme.

3

In the fourth paragraph, the phrase "sameness and differentness" primarily serves to

- A) introduce a concept that is central to the experiments described later.
- B) refer to the topic that led researchers to begin studying reasoning in animals.
- C) reveal that expert scientists sometimes use everyday language in their reports.
- D) emphasize that certain terms must be used when describing intelligent animals.

4

The discussion of animals' ability to apply a learned skill in various testing scenarios suggests that some animals

- A) grasp concepts because they are similar to things they experience in the wild.
- B) are capable of understanding the shared concept that underlies different tasks.
- C) cannot differentiate between "sameness" and "difference" after being trained.
- D) learn a new task most quickly when they have just repeated a different task many times.

5

Which choice provides the best evidence for the answer to the previous question?

- A) lines 26–28 ("Because . . . animals")
- B) lines 30–33 ("We reward . . . items")
- C) lines 33–36 ("Several species. . . items")
- D) lines 38–40 ("Here . . . stimuli")

6

Based on the authors' initial explanation of the analogical matching task, a sample pair with a triangle and a square would most correctly be

- A) Two triangles.
- B) A circle and a cross.
- C) Two squares.
- D) A square and a cross.

7

It can be reasonably inferred that a key difference between the two parts of the study done by Ed Wasserman and his colleagues is that the second part

- A) required a more complex task.
- B) involved direct observation, while the first experiment was viewed on a monitor.
- C) involved a new analogical relationship.
- D) tested learned abilities, while the second experiment tested natural abilities.

8

Which choice provides the best evidence for the answer to the previous question?

- A) lines 54–58 ("The crows . . . card")
- B) lines 58–60 ("The cup . . . empty")
- C) lines 62–67 ("Each . . . answer")
- D) lines 72–73 ("Not . . . spontaneously")

9

The averaged results for sessions 1-8 as shown in the chart reveal that

- A) Crow 1 was generally more successful at matching size and Crow 2 was generally more successful at matching color.
- B) Crow 1 was generally more successful at matching shape and Crow 2 was generally more successful at matching size.
- C) Crow 1 was generally more successful at matching shape and Crow 2 was generally more successful at matching color.
- D) Crow 1 was generally more successful at matching color and Crow 2 was generally more successful at matching size.

10

Which statement can be reasonably inferred from the information in the passage and the graph?

- A) Crows' ability to match objects steadily improves as new dimensions are introduced.
- B) Researchers can see evidence of learning even when an animal's performance on a task is inconsistent during observation.
- C) Crows perform differently on matching tasks when they are aware that they are being observed.
- D) Researchers may influence the outcome of scientific trials with animals by varying their teaching methods.

11

The information from the chart best supports the authors' claim that the crows

- A) easily understood the relationship between two unlike objects.
- B) recognized that a learned skill could be applied to a new task.
- C) quickly learned to complete the matching task.
- D) grasped the concept of cause-effect relationships.