Definitions: Properties and Accidents

I. Lesson

"Those things are called like which have the same attributes in every respect, and those which have more attributes the same than different…is like that other thing."

-Aristotle, *Metaphysics* (Barnes transl.)

We often use the word "attribute" to describe the characteristics of something. Aristotle writes quite extensively on attributes and how they are important to understanding the way things are. Here we see that if two things have identical attributes, then they are the same. If they have a majority of similar attributes, then they are similar to one another. We can take the framework that Aristotle uses to help us with being more careful with our definitions. Aristotle distinguishes between types of attributes:

Properties: These are attributes that are shared across *all* possible instances of a given thing. (For instance, *all* triangles have the attribute of having three sides.)

Accidents: These are attributes that are shared by only *some* of the possible instances of a given thing. (For instance, only *some* triangles have the attribute of having a 90-degree angle.)

II. Examples

(1) Let's go over the example of a triangle mentioned above. Some of the properties of a triangle are:
   (a) Having three sides
   (b) Having straight sides
   (c) Being closed (all sides connect with one another)
   (d) Have three angles
   (e) Having angles which add up to 180°

These are properties because they hold for *all* possible triangles – that is, all possible triangles have these attributes. Because of this, we know if something did not have one of these attributes, then that thing would *not* be a triangle. For instance, a geometric figure that has all the properties listed above except being closed and having three angles would certainly not be a triangle. That would be something like:

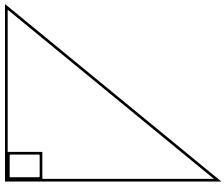
Notice that the thing above has (a) three sides, (b) has straight sides, and (e) has angles which add up to 180°. However, since it is not (c) closed, nor does it have (d) three angles, it is not a triangle.

Activity: With a partner, write down some of the properties of a square. Then draw different things which only have *some* but not *all* of the properties of a square. Remember, if you choose an attribute that some squares do not have, then you have not chosen a property.

Next, let's talk about the *accidents* of a triangle. Remember, accidents are the attributes of something that are not shared across all instances of that thing. Some accidents of a given triangle might be:

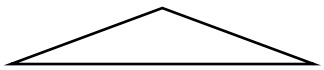
(a) Having an angle larger than 90-degrees
(b) Having three equal side lengths
(c) Having one side that is one meter long
(d) Having two sides that are one meter long

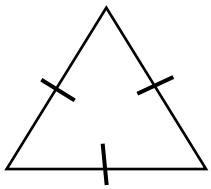
There are many more possible accidents beyond these listed. The point is, while *some* triangles have these things, certainly *not all* triangles have these things. For instance, a triangle which does not have three equal side lengths is still a triangle, as long as it fulfills all of the *properties* listed earlier in this section. This would be an example:

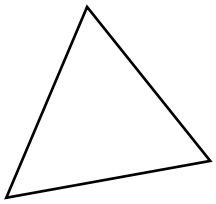


This thing fulfills all of the properties of a triangle: it (a) has three sides, (b) has straight sides, (c) is closed, (d) has three angles, and (e) has angles which add up to 180°. Therefore, this is a triangle. However, it does not have the *accident* of having three equal sides. It does, though, have the *accident* of having a right angle.

Activity: For the following triangles below, list some of the accidents that each has. For example, if a triangle has three angles smaller than 90°, then write this as an accident for that triangle.







This discussion has important applications to an account of proper definitions: we would usually define things in terms of their properties, not their accidents. We would not define a triangle as "a polygon (a closed shape with straight sides) with three sides, three angles, angles which add up to 180°, and one right angle." This is because having "one right angle" is an accident of a triangle, not a property. Instead, we might define a triangle as "a polygon (a closed shape with straight sides) with three sides, three angles, and angles which add up to 180°."

(2) It is very easy to state the properties and accidents of clean, geometric shapes like triangles. As we shall see, it is much harder to do so for other things, like humans, for instance. Interpretations of Aristotle suggest that he defines "human" as a "rational animal." For the sake of the example, let's take Aristotle's definition to be correct. Thus, we see that there are two properties of "human." There is the property of having the capacity to be rational, and there is the property of being an animal. Aristotle furthermore believed that the property of "rationality" was something that made humans different from other animals.

By implication, we see that many other attributes of humans under Aristotle's definition are accidents. For instance, having a nose, having two eyes, being 6 feet tall, walking on two legs, organizing political systems, and many other things are accidents of being a "human" under this definition. Some human could not have these things, and they would still be a human. For instance, a person could not have a nose, and they would still be human. They could not have a nose, only have one eye, are 10 feet tall, and walk on one leg, and they would still be a human as long as they have the capacity for reason and are an animal.

One could object to this definition and say, "it certainly seems that all humans have brains, but having a brain is not explicitly a property of being a human under Aristotle's definition." However, it is important to note that just because it is proper to define a category by properties of its members does not entail that *all* properties of its members need be listed in a proper definition. Rather, a proper definition need only list a sufficient number of properties to distinguish such a category from any other. Thus, since a human brain is a necessary condition for human rationality, only the latter needs to be listed in a definition to avoid redundancy.

Activity: Talk with a partner about Aristotle's definition of "human." Do you agree with this definition? If so, defend why this is the case. If not, show why the definition is unsatisfactory. (Hint: Find a property of humans that is not contained within the definitions of "animal" and "rational," or find a property contained within "animal" or "rational" that is not essential for being a human.)

III. Exercises

Exercise 1

Directions: List 5 properties for each of the geometric shapes below.

1.) Rectangle
2.) Trapezoid
3.) Parallelogram
4.) Pentagon
5.) Hexagon

Exercise 2

Directions: List 3 possible accidents for each of the shapes above. Justify your answer by showing that the attributes listed hold for some, but not all, instances of the given shape.

1.) Rectangle
2.) Trapezoid
3.) Parallelogram
4.) Pentagon
5.) Hexagon

Exercise 3

Directions: Write whether the following attributes are a property or an accident of the thing listed. Explain why this is the case.

1.) Water
    a.) The attribute of being a liquid
    b.) The attribute of being two parts hydrogen and one part oxygen (H_2O)
    c.) The attribute of being in the ocean
2.) Triangular Prism
    a.) The attribute of being 3D
    b.) The attribute of having 5 faces
    c.) The attribute of being 10 feet tall
    d.) The attribute of having straight sides
    e.) The attribute of being opaque
3.) The number 15
    a.) The attribute of being a number
    b.) The attribute of not being able to knock over a domino
4.) Line
    a.) The attribute of being longer that 10 inches
    b.) The attribute of being the color yellow
    c.) The attribute of being 1D
    d.) The attribute of being straight

Exercise 4

Directions: Examine the following definitions. List the properties that the definition assumes each thing has.

1.) A book is a typed or hand-written publication which has covers on each end and is bound on one side.
2.) A glass is a cup which is made out of glass.
3.) A table is a piece of furniture which is round or square and things can be placed on top of.
4.) A triangle is a polygon which has three sides and three angles.
5.) A tree is a type of plant which typically has a wooden stump.

Exercise 5

Directions: Reevaluate the definitions which were given in exercise 4. Are these good definitions? Why or why not? (Hint: Do they treat any accidents of the thing being defined as properties of the thing being defined?)

1.) Book
2.) Glass
3.) Table
4.) Triangle
5.) Tree

Exercise 6 (Challenge)

Directions: Try to create a definition for each of the following words using the techniques we have talked about in this lesson (create a comprehensive list of properties for the thing the word refers to, then put the properties into sentence form).

1.) School
2.) Cube
3.) Physics (as a class)
4.) Pencil
5.) Logic

IV. Conclusion:

We have learned in this lesson that defining things is very difficult. This is because it is very difficult to list the properties of a thing. Listing the properties of shapes such as triangles and squares are easier, but to find a comprehensive list of attributes which hold for *all* instances of a word like "human" is quite difficult. However, understanding properties and accidents is crucial for defining

things in a satisfactory manner. This is because if we treat an attribute like a property in a definition, we inevitably make the definition too narrow. (Things that fit the definition we give will only be a subset of the actual things in the world we wish to bring under one definition.)

V. Lesson Goals

- Understand the difference between properties and accidents
- Understand why it is important to not mix up properties and accidents when we are defining things
- Improve skills of defining things in a logically satisfactory way
- Be able to distinguish between types of attributes when they are given for a specific thing

Answer Key:

Exercise 1

(Answers may vary, but answers must hold for all instances of a given thing.)

1.) Having four sides, having straight sides, having four right angles, being two dimensional, being closed, having four angles, having angles which add up to 360°, etc.
2.) Having four sides, having straight sides, having exactly one pair of parallel sides, being two dimensional, being closed, not having four right angles, having four angles, having angles which add up to 360°, etc.
3.) Having four sides, having straight sides, having exactly two pairs of parallel sides, being two dimensional, being closed, having four angles, having angles which add up to 360°, etc.
4.) Having five sides, having straight sides, being two dimensional, being closed, having five angles, having angles which add up to 540°, etc.
5.) Having six sides, having straight sides, being two dimensional, being closed, having six angles, having angles which add up to 720°, etc.

Exercise 2

(Answers may vary, but answers must not hold for all instances of a given thing.)

1.) Having a side which is 10 feet long (or any non-zero length, for that matter), having equal side lengths, having two side lengths that are double the length of the other two side lengths, etc.
2.) Having a side which is 5 feet long (or any non-zero length for that matter), having one parallel side be 3 inches longer than the other parallel side, having the two parallel sides centered with one another, having a 90° angle, etc.
3.) Having a side which is 10 inches long (or any non-zero length, for that matter), having equal angles, having two side lengths that are double the length of the other two side lengths, having four 90° angles, etc.
4.) Having a side which is 100 yards long (or any non-zero length, for that matter), having equal side lengths, having a pair of parallel sides, having two pairs of parallel sides, having equal angles, etc.
5.) Having a side which is 20 kilometers long (or any non-zero length, for that matter), having equal side lengths, having a pair of parallel sides, having two pairs of parallel sides, having three pairs of parallel sides, having equal angles, etc.

Exercise 3

1.) (a) Accident – Ice and water vapor are instances of water and are not liquid; (b) Property – If some substance was not H_2O, it would not be water; (c) Accident – There is water that is not in the ocean but is still water.
2.) (a) Property – All triangular prisms are 3D; (b) Property – All triangular prisms have two triangular faces and three rectangular ones; (c) Accident – There are triangular prisms which are a different height than 4 feet but are still triangular prisms; (d) Property – All triangular prisms have either triangles or rectangles as faces (all of which have straight sides); (e) Accident – There could be a glass triangular prism and thus would not be opaque but yet would still be a triangular prism.
3.) (a) Property – all "15's" are numbers; (b) Property – Numbers are causally inert (they can't cause anything).
4.) (a) Accident – Lines can be shorter or longer than 10 inches and are still lines; (b) Accident – Lines can be drawn in any color, not just red, and yet those would still be lines; (c) Property – All lines are one-dimensional (d) property – all lines are straight

Exercise 4

1.) The property of being typed or hand-written, the property of being a publication, the property of having covers on each end, the property of being bound on one side.
2.) The property of being a cup, the property of being made out of glass.
3.) The property of being a piece of furniture, the property of being round or square, the property of being able to have things be placed on top of it.
4.) The property of being a polygon, the property of having three sides, the property of having three angles.
5.) The property of being a type of plant, the property of typically having a wooden stump.

Exercise 5

(Answers may vary. Answers may be different than the one given here, as long as a satisfactory case is given for the answer written.)

1.) This is a good definition. All of the attributes listed are properties, and there aren't any obvious properties to be added to the definition.
2.) This is a good definition. Both of the attributes listed are properties, and there aren't any obvious properties to be added to the definition.
3.) This is a bad definition. The attribute of being round or square is an accident, not a property. There are triangular tables, pentagonal tables, etc.

4.) This is a good definition. All of the attributes listed are properties, and there aren't any obvious properties to be added to the definition. All other properties are logically entailed by the properties given.
5.) This one is a bit tricky. It certainly seems as if there are trees which have stems and not stumps, or stems of a material that is not wood (consider a *very* young tree). However, the definition given does not imply that "having a wooden stump" is a property. Rather, it is that "typically having a wooden stump" is a property. Under this, a case could be made that this is a good definition.

Exercise 6

(Answers may vary drastically. As long as the definitions are composed of properties and not accidents (the student makes a well-attempted case for why the attributes listed are properties and not accidents), the definitions will be a satisfactory answer.)