II. STATISTICAL SYLLOGISMS

The word syllogism is derived from the Greek and literally means "a putting together of ideas." The use of the term in logic is related to this meaning. *Syllogisms* are arguments with two premisses, and a conclusion that "puts together" information presented in the premisses. The following argument is an example of a deductive form of syllogism.

All men are mortal.
Socrates is a man.

Socrates is mortal.

In an inductive form that closely resembles the deductive form of this syllogism, the general premiss is a statistical generalization, rather than a universal generalization. The form is therefore called a **statistical syllogism.** The following argument is an example of a statistical syllogism.

90 percent of freshmen at State University are residents of the state.
Elena is a freshman at State University.

Elena is a resident of the state.

Merilee Salmon

We use arguments with the form of statistical syllogism when we argue that what is generally, but not universally, true (or false) is also true (or false) for a particular case. The statistical generalization in the premisses is not always stated numerically. *Almost all, most, very often, almost never,* and other terms can be used, as in the following example:

Hardly any freshmen had a philosophy course in high school.
Oscar is a freshman.

Oscar did not have a philosophy course in high school.

Inductive arguments are sometimes contrasted with deductive arguments as follows: In deduction, one goes from general premisses to a particular conclusion, whereas in induction, one goes from the particular to the general. Statistical syllogisms are exceptions to this often-offered (but incorrect) characterization of inductive arguments. As you can see, this form of inductive argument proceeds from a generalization in the premiss to a claim about a particular individual in the conclusion. Because arguments of this form may have false conclusions even though their premisses are all true, they cannot be deductive. However, as with other inductive forms of argument, statistical syllogisms vary in strength.

Reasoning in the form of a statistical syllogism is common in everyday life and guides many of our decisions and beliefs. We do not plan outdoor picnics in Chicago in January because the weather usually won't be favorable. If we are fortunate enough to travel in southern France, we expect to find good food

at country inns because that's usually the case. A summons for an audit of our tax return is dreaded because audits of tax returns are normally costly and unpleasant.

1. Form of Statistical Syllogisms

With the preceding examples in mind, we are ready to look at the abstract form of statistical syllogisms:

X percent of all *F*'s are *G*'s.
a is an *F*.
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a is a *G*.

In this form of argument, *F* and *G* represent classes of individuals or properties that determine those classes. The lower-case letter *a* represents an individual person, place, or thing. The class denoted by *F* is called the **reference class,** that is, the class that the individual mentioned in the second premiss belongs to, or is *referred to.* The class denoted by *G* is called the **attribute class,** that is, the class that has the property *attributed to* the individual in the conclusion. In the preceding argument about the individual Oscar, the reference class is *freshman* and the attribute class is *persons who have had a philosophy class in high school.*

2. Standards for the Strength of Statistical Syllogisms

The most obvious standard for judging the strength of a statistical syllogism is the closeness to 100 percent (or 0 percent in the negative case) of the statistical premiss. If the premiss in the preceding sample argument had stated that 99 percent, instead of 90 percent, of the freshmen at State University were state residents, a stronger case would be made for the conclusion that "Elena is a state resident." Similarly, the argument would have been weaker if only 85 percent, rather than 90 percent, of all the freshmen were state residents. If only 51 percent of all freshmen were state residents, the argument would be so weak that we would call it fallacious. Even when the statistical premiss is not expressed numerically, this criterion applies. For example, "Almost all *F*'s are *G*'s" supports the conclusion that *a*, who is an *F*, is also a *G* more strongly than "A sizable majority of *F*'s are *G*'s."

A second criterion of strength of statistical syllogisms is whether all available relevant evidence has been considered in selecting the *reference class.* This requirement, which is called the **rule of total evidence,** is designed to address problems that arise as a result of individuals belonging to an indefinite number of classes. Elena, for example, belongs not only to the class of freshmen, but also to the class of women students, and many other classes as well. Assume that we have the following information about Elena:

> Besides being a freshman at State, she has brown hair, she is 18 years old, a supporter of equal rights for women, a part-time office worker, and a member of the Foreign Students' Club.

Each of these properties of Elena marks a class to which she belongs. In constructing an argument with the conclusion "Elena is a state resident," we must take into account *every* class that Elena belongs to that might affect the probability that she is a state resident. Suppose, for example, we already know that only 2 percent of the members of the Foreign Students' Club are state residents. If we assign Elena to this reference class, ignoring all the other information, we can construct the following argument with true premisses:

2 percent of all members of the Foreign Students' Club are state residents.
Elena is a member of the Foreign Students' Club.

Elena is *NOT* a state resident

Both this argument and the original argument have true premisses, and their statistical premisses are very close to 100 percent and 0 percent. So, if we were to use only the standard that requires a strong statistical generalization, both arguments would appear to be strong. Yet their conclusions cannot both be true because they contradict one another. The conclusion of the first argument says that she is a state resident; the conclusion of the second that she is not. Following the rule of total evidence can help us avoid this unfortunate situation. The rule requires us to assign Elena to a reference class of freshmen at State who are members of the Foreign Student Club and who are also members of *any other classes relevant to state residency* to which she belongs (and for which information is available).

Background knowledge plays an all-important role in helping us to decide which classes are relevant. On the basis of common background information, for example, we know that her hair color and age are irrelevant. (Her age would be relevant, however, if she were much older than the average college freshman.) Working in an office *might* be relevant, because some residence restrictions apply to student eligibility for such jobs. If we do not know or cannot find out about that, however, the information is not available and cannot figure into our construction of the proper reference class. Suppose that the only classes for which information relevant to state residency is available are the class of freshmen and the class of Foreign Students' Club members. A check of school records for past years shows us that generally only 5 percent of freshmen who are state residents join the Foreign Students' Club. We are now in a position to construct the appropriate statistical syllogism that embodies all available relevant evidence:

5 percent of all freshmen at State University who are members of the Foreign Students' Club are state residents.
Elena is a freshman member of the Foreign Students' Club.

Elena is *NOT* a state resident.

In many statistical syllogisms, the statistical premiss is not stated when it is assumed to be part of our common background knowledge. For example, the argument

> The student who sits next to me in logic class doesn't have a home telephone, for he isn't listed in the telephone directory.

could be reconstructed as a statistical syllogism with the implicit premiss, "Almost all phone owners are listed in the telephone directory." When we are concerned with evaluating such arguments, however, we should try to state any implicit premisses. Sometimes when implicit premisses are exposed, we find that they are questionable or fail to represent all available relevant evidence. When the implicit premiss in this argument is exposed, we realize that the student could belong to a class of persons who usually do not have their home phone numbers listed under their own names (for example, the class of persons who have changed residences recently or who live with a group of others). If so, then the argument is weak because the reference class in the implicit premiss violates the requirement of total evidence.

Exercise Set 4.1

Part One. Each of the following arguments is or can be reconstructed as a statistical syllogism. (i) Identify the reference class and the attribute class and (ii) assess the strength of the argument, using the criteria discussed in this section.

1. About 95 percent of all professional hair dyes and a considerable portion of home dyes now contain paraphenylenediamine or related chemicals (also called peroxide dyes). My hair was dyed at the hairdresser's. Therefore, peroxide dye was used on my hair.

2. That cat will probably never learn to use a litter box because she was separated from her mother at only two weeks of age and was not "mothered" by another cat.

3. Of all the students who registered this term, 75 percent favor the university's requiring students to pay an activity fee to support the projects of the student government association. Since Ellen is registered this term, she undoubtedly is in favor of the fee.

4. Very few people dislike chocolate, so Jill will be pleased with the chocolate dessert you made.

5. Since most German shepherds are easy to train, your German shepherd puppy should do well in dog-training school.

6. Stocks typically outperform bonds in the first recovery year after a recession. Since this is such a year, stocks should outperform bonds.

7. Only about 3 percent of cigarette smokers actually die from lung cancer, so my smoking won't result in death from lung cancer.

Part Two. Each of the following passages gives advice that is based on a statistical syllogism. In each case, reconstruct the argument in standard form and explicitly state the statistical premiss, the premiss that refers to a particular individual, and the conclusion.

1. Always remember that the odds in this hobby are heavily against the collector. He is gambling the price of a mess of mushrooms against the doctor and hospital bills. With such odds in mind it is up to the collector to be critical of what he collects.

—A. H. Smith, *The Mushroom Hunter's Field Guide*

2. Dear Dr. Molnar: I am 56 and considering an operation. Would you advise against it? I've had a loss of hearing since about age 12. On a recent checkup my doctor said two bones have grown together in the middle ear. He thinks there is an 85 percent chance of improvement to "very good"; 10 percent chance of no improvement; 5 percent chance of further damage.

Answer: Why should I advise against the operation? Only one chance in 20 of being worse off; 17 chances in 20 of being better off. There are few if any operations in which 100 percent success can be guaranteed. If I were the patient in such a case, I'd take the 17 to 1 odds.

—"Doctor Molnar," syndicated newspaper column

3. At a Democratic committee meeting the incumbent prosecuting attorney loses his party's endorsement. He considers running as an Independent, but his advisers tell him not to because hardly any Independents could receive enough votes to win an election in that city.

4. Take your umbrella when you go out today because there is a 70 percent chance of rain in your area.

5. More than two-thirds of the students who enter this college earn their degrees. So don't bother studying for your finals tonight; come to the party with us.

3. The Fallacy of Incomplete Evidence

When the reference class (the class denoted by F in "X percent of F's are G's") in a statistical syllogisms is not based on all available relevant evidence, the argument is fallacious. What we mean by relevant evidence is any evidence that might influence the probability that the individual (a) has the property attributed to it in the conclusion (G). Although we can define *relevant* in this context, we need background knowledge to determine what evidence is relevant.

It is also difficult to say in a general way what *available* means in this context. How much research is required to be sure that we have accounted for all available relevant evidence? We are seldom in a position to spend years of our lives—or even hours—acquiring evidence that is "available" in the sense that it is part of the storehouse of human knowledge. Often, we must make judgments and take actions (such as agreeing to an operation) in the absence of

evidence that may be "available" but that we cannot afford to obtain. The rule of total evidence is not intended to place unrealistic restrictions on reasoning. It only demands a reasonable effort to find appropriate reference classes. The rule of total evidence says that we must not ignore—through carelessness, prejudice, or laziness—evidence that is within our reach, and we must not suppress evidence that is known to be relevant. Consider the following example of a fallacy in the form of a statistical syllogism

90 percent of Harvard's medical-school faculty are men.
Dr. Shirley Jones is a Harvard medical-school faculty member.

Dr. Shirley Jones is a man.

This argument appears to be a strong one only if we ignore the well-known fact that *Shirley* is a name that is rarely given to males in the northern part of the United States. If we accept the argument as it stands, we will be more likely to accept a false conclusion than a true one, for the probability that a faculty member named Shirley is male is very low. Even though we do not have exact figures to assign a probability to the reference class of Harvard medical-school faculty members named Shirley, we can see that this additional evidence is relevant and that it undermines the original argument.

The argument that some celebrity has no phone because she is not listed in the phone directory ignores the information that many celebrities have unlisted numbers. Similarly, it would be a violation of the requirement of total evidence to infer that your bus for work, which is normally on time, will be on time when the city streets are covered with ice.

In statistical syllogisms, the rule of total evidence is designed to ensure that we select an appropriate reference class. The rule of total evidence more broadly understood applies to all other forms of inductive argument as well. To construct good inductive arguments, we must take account of any available relevant information that could affect the truth of the conclusion of the argument. The rules of critical thinking do not permit us to construct arguments in which we selectively choose evidence that supports our conclusions while we ignore available evidence that would undermine them.

Exercise Set 4.2

Each of the following arguments commits the fallacy of incomplete evidence. In each case, discuss the relevant information that is ignored.

1. Most Russians don't speak English, so the newly appointed Russian ambassador to the United Nations probably doesn't speak any English.

2. Most movie actors aren't politicians, so Ronald Reagan, a former movie actor, is not a politician.

3. Most Americans earn less than $100,000 a year, so the president of General Motors earns less than $100,000 a year.

4. Only about 2 percent of college football players ever play professional ball after college, so the Heisman trophy winner probably won't play pro ball after he is out of college.

5. Most American women in their fifties do not exercise. Since Jane Fonda, who has produced a number of exercise videos and books, is now in her fifties, she probably does not exercise.

4. Special Types of Statistical Syllogism

A number of special uses of statistical syllogism are so common that they, and the fallacies that resemble them, have standard names.

i. Arguments from Authority

We all rely on the advice and counsel of those who know more than we do. Sometimes when we present arguments, we appeal to what experts have said on the matter instead of presenting direct evidence to support the claims that we make. Critical thinking allows this, for it would be difficult and wasteful to always reiterate what others have established. Although in some circumstances appeals to authority are fallacious, in others an argument from authority can be construed as a strong statistical syllogism. The principle that guides the difference between correct and incorrect uses of authority is based both on the nature of the authority's expertise and on the nature of subject matter.

It is reasonable to take the word of an authority if:

(i) the authority is an expert on the matter under consideration, and

(ii) there is agreement among experts in the area of knowledge under consideration.

Authorities achieve their status through training, talent, and experience. These qualities enable them to understand and evaluate evidence in areas that are not easily accessible to others. Condition (i) is designed to rule out taking the word of an expert in one field about matters outside the authority's area of expertise. This happens more frequently than one might think. Expertise in physics, chemistry, or another one of the physical sciences does not make a person an authority on social matters or ethics. Expertise in sports or the arts does not make a person an authority on world peace, urban renewal, or the various commercial products athletes and actors are often called upon to endorse.

Condition (ii) recognizes that some areas of knowledge are sufficiently controversial that persons with comparable training, experience, and all other credentials of a genuine authority disagree with one another. Appeals to authority in such a circumstance are feeble because different "authorities" give conflicting opinions on the matter. Although economists, for example, agree in some areas of their discipline, expert economists may hold conflicting views about ways to stimulate the economy, defeat inflation, increase employment, and other such matters. In psychiatry, also, qualified doctors disagree. Thus in

criminal trials, when both prosecutor and defense attorney call expert witnesses to support their opposing positions, the prosecutor's expert psychiatrist might pronounce the defendant sane at the time of the crime, while the defendant's expert psychiatrist will testify to the defendant's insanity.

When the two conditions for being an authority on a given subject are fulfilled, however, we can say that most of what the authority has to say about the subject matter in which she or he is an authority is correct. In such a case, the argument from authority is a statistical syllogism of the following form:

Most of what authority *a* has to say on subject matter *S* is correct.
a says *p* about *S*.

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p is correct.

The first premiss is a statistical generalization; the second premiss is a statement about a particular assertion (a member of the reference class of assertions in the authority's field of expertise); and the conclusion attributes the property of being correct to that assertion.

Arguments from authority are rarely presented in this strict form. Usually the authority is merely cited or quoted in support of some conclusion. For example, a point in the theory of relativity might be argued by quoting Einstein's view on the matter; a claim concerning the best way to bake a soufflé might cite Julia Child. Sometimes, a group of authorities is cited: "All leading physical scientists agree that the earth is more than a million years old." Regardless of the way arguments from authority are stated, they are acceptable only when the conditions (i) and (ii) are fulfilled.

Because arguments from authority are inductive, the conclusion of an argument from authority can be false even when the premisses are true and the conditions for authority are satisfied. In a correct argument from authority with true premisses, however, probably the conclusion will be true. Nevertheless, in using arguments from authority, it is wise to remember that history, including the history of science, offers many examples of expert authorities who were mistaken in their beliefs and were proved wrong in the light of new evidence. New evidence must be assimilated (often a slow process) before experts in the field recognize its significance and change their opinions. Despite these cautions, arguments from authority have an important place in both scientific and everyday reasoning.

Arguments that resemble correct arguments from authority but that cite an alleged authority who lacks expertise in the area of concern or that ignore disagreements among experts are fallacious. Such arguments can deceive us in several ways.

First, when someone is a genuine expert in a particular field of knowledge or has achieved success in a difficult and highly competitive enterprise, that person is properly entitled to prestige and recognition for those accomplishments. Such people are often asked to express their views on a wide variety of issues, many of which are completely outside their field of expertise. Famous physicists are asked their opinions on moral questions; a football hero testifies

to the virtues of one brand of panty hose. Their statements cannot carry the weight of a legitimate appeal to authority, for they are speaking about subjects beyond their area of expertise. We must be careful not to accept arguments that rely on the glamour or prestige of an authority in one field to support the truth of claims in another, unrelated area of knowledge.

Second, some persons set themselves up as authorities—or their followers set them up—even though they lack the expertise of a genuine authority. Authoritative knowledge of modern science, for example, requires years of training and study under the supervision of experts. Yet, some people claim to have achieved such knowledge through self-study of obscure texts, visions, inspirations, revelations, or other questionable means. They claim to have found cures for diseases that have eluded standard medical research or they claim to be able to explain major cosmic events in ways that defy the truth of well-accepted scientific theories. These people, called "cranks" by all but their followers, are not reliable authorities in the subject areas in which they profess expertise. We should not accept arguments that appeal to such "authorities," and must be especially careful to scrutinize them carefully when their conclusions—such as a new cure for a hitherto incurable disease—are ones we wish were true.

Finally, in many branches of knowledge, widespread disagreement obtains among those who have all the right academic and professional credentials. Economics and psychiatry, already mentioned, are merely two examples. It is probably no exaggeration to say that in every discipline in which scholars are actively engaged, there are some areas in which the experts disagree. The U.S. Civil War, for example, has been extensively studied and analyzed by historians, most of whom hold similar beliefs about many aspects of this conflict. To settle a noncontroversial point, an appeal to a distinguished historian of that period would suffice. Nevertheless, different schools of U.S. history dispute the precise role of slavery as a causal factor in the War between the States, and so appeals to authority on that topic are weak. Scientists avidly debate whether birds are descendants of dinosaurs, as many paleontologists believe, or whether, as some ornithologists hold, the two developed in parallel evolutionary paths. The *evidence* presented by the experts can be considered and evaluated on its own merits, by those qualified to judge. When such evidence is considered and evaluated, however, the form of argument is not that of an argument from authority but some other type.

In determining whether an argument from authority is fallacious, background knowledge must be called upon to judge both whether an alleged authority is genuine and whether the area of knowledge is one in which experts disagree.

Exercise Set 4.3

Creation scientists, who claim that scientific evidence supports the biblical account of creation more strongly than it supports evolutionary biology argue for their view by listing the many supporters of creationism who hold Ph. D. degrees in various branches of science, from earth science, to chemistry, to